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## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Concrete Forming & Accessories: Refer to structural drawings
2. Commercial Steel Doors and Frames Section 08100

### **1.2 Source Quality Control**

1. Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. **Wood Materials:** Material, straight, sawn square, true, dressed four (4) sides properly sized, shaped to correct dimensions from nominal sizes indicated or specified.
2. **Lumber: Use only grade marked lumber. Where left exposed, use best brand of lumber available.** Lumber and moisture content to conform to official grading rules of NLGA, for particular lumber and grade, and structurally conform to latest requirements of Ontario Building Code. Conform to Grading Standards, CSA Standard Softwood Lumber 2005. Moist content not greater than 19% at time of installation.
3. **Blocking, Cants, Bucks, Grounds and Nailing Strips:** Douglas fir Graded 122-C, construction or No. 2 Pine, pressure treated in accordance with CSA 080 Series 08.
4. **Plywood:** Douglas fir plywood to CSA 0121-08, good one side with waterproof adhesive.
5. **Rough Hardware:** Nails, screws, bolts, lag screws, anchors, special fastening devices and supports required for erection of all carpentry components. Use galvanized components where exposed to exterior atmosphere.

## **PART 3 - EXECUTION**

### **3.1 General**

1. Do all wood framing in accordance with the Ontario Building Code, Engineering Design in Wood and CSA 086 - 01.
2. Machine dressed work shall be slow fed using sharp cutters and finished members shall be free from drag, feathers, splinters or roughness of any kind.
3. Frame materials with tight joints rigidly held in place.
4. Design construction methods for expansion and contraction of the materials.
5. Erect work plumb, level, square and to required lines.

6. Be responsible for methods of construction for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other trades.

### **3.2 Furring and Blocking**

1. Supply and install furring and blocking, required.
2. Align and plumb faces of furring and blocking to tolerance of 1:600.

### **3.3 Rough Bucks, Nailers**

1. Install wood bucks and nailers, as indicated, including wood bucks and linings around frames for doors and windows.
2. Except where indicated, otherwise, use material at least 38 mm thick secured with 9 mm bolts located within 300 mm from ends of members and uniformly spaced at 1200 mm between.
3. Countersink bolts where necessary to provide clearance for other work.

### **3.4 Roof Fascias, Cants, Nailers, Curbs**

1. Install wood cants, fascia backing, nailers, curbs and other wood supports for roofing, sheet metal fork, roof mounted equipment.  
Refer to Section 07550 Modified Bituminous Roofing.
2. In reference to section 07550 Modified Bituminous Roofing, subsection 3.4 Carpentry and Section 07610 Sheet Metal Roofing: all wood blocking work related to roofing including but not limited to parapets, walls and curbs is by Section 06100 Rough Carpentry. The general contractor is responsible to turn over this work in a dry condition to roofing contractor for making watertight as part of roofing work. After acceptance, the roofing contractor is responsible to maintain water tightness.

### **3.5 Supports for Mechanical Units**

1. Install wood blocking for prefabricated curbs for mechanical units to allow for a level installation on sloping roof.

### **3.6 Pressure Treated Wood**

1. Use wood pressure treated in accordance with CSA 080 for all wood members in contact with exterior walls and roofs.
2. Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
3. Fasten each slat to steel frames with 2 screws at top, bottom and at diagonal bracing.

### **3.7 Installation of Hollow Metal Frames**

1. Set frames plumb and square in their exact location and at correct elevation. Firmly block and brace to prevent shifting. Shim up where required to ensure proper alignment dimensions from finished floor to head of frame. Install temporary wood spreaders at mid-height.
2. Where pressed steel frames are installed in concrete walls, secure frames to concrete using lead expansion shields and anchor bolts through pipe sleeves. Perform drilling of concrete as required. Fill recessed bolt heads flush to frame face with approved metal filler and sand smooth.
3. Install fire rated door frames in accordance with requirements of National Fire Code Volume 4, produced by The National Fire Protection Association (NFPA 80).

### **3.8 General**

1. Supply and install all other carpentry shown on drawings or as required for completion of work. Co-operate with other trades in installing items supplied by other sections, cut openings in woodwork when so required and make good disturbed surfaces.

End of Section

## **PART 1 - GENERAL**

### **1.1 Section Includes**

1. Section includes for provision of all labour, materials, equipment and services for new rough carpentry in accordance with Contract Documents.

### **1.2 Related Sections**

1. Section 07520 SBS Modified Bituminous Membrane Roofing
2. Section 07620 Sheet Metal Flashing and Trim for Roofing
3. Section 07901 Joint Sealers for Roofing

### **1.3 References**

1. CSA B111 / ASTM F1667 - Wire Nails, Spikes and Staples
2. ANSI/ASME B18.6.1 - Slotted and Recessed Wood Screws
3. ASTM A307-Carbon Steel Bolts & Studs
4. CSA O121 - Douglas Fir Plywood
5. CAN/CSA O141 – Softwood Lumber
6. CSA O151 – Canadian Softwood Plywood
7. CAN/CSA-080 Series - Wood Preservation
8. CAN/CSA-O325.0 – Construction Sheathing
9. Graded lumber must be in accordance with rules and regulations of the National Lumber Grades Authority (NLGA).

### **1.4 Operations**

1. Do not interrupt or delay *Owner's* operations.
2. Perform operations, at times designated by the *Owner*, that will not adversely affect occupants of building and operations in and around site access and egress.

### **1.5 Protection**

1. Provide perimeter barricades and tarpaulins, guardrails, overhead scaffolding and other necessary protection to ensure safety of occupants, public and site workers.
2. Temporarily protect interior spaces, where overhead work is proceeding, and provide dustproof and weatherproof partitions.

### **1.6 Shop Drawings**

1. Submit shop drawings, stamped by a Professional Engineer, licensed in Province of Ontario, if members and securement are part of structural components.

### **1.7 Permits**

1. If required, arrange and pay for all permits, notices and inspections necessary for the proper execution of work in this section.

### **1.8 Quality Assurance**

1. Lumber shall be identified by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
2. Plywood shall be identified by grade mark in accordance with applicable CSA standards.

### **1.9 Lumber Requirements**

1. Dimensions of lumber must conform to dressed sizes specified in CAN/CSA-0141. Dimensions specified and shown are nominal sizes.
2. Moisture content of lumber at time of installation must be S-DRY - maximum 19% moisture content.
3. Lumber must be sound and free of splits and deficiencies, which impair strength and durability.

### **1.10 Securement**

1. Members shall be framed, anchored, fastened, tied and braced to provide necessary strength and rigidity.
2. All nails shall be long enough so that not less than half their required length penetrates into the second member.
3. Individual pieces must be secured with minimum of 2 fasteners at all corners.
4. Splitting of wood members shall be minimized by staggering nails in the direction of the grain and by keeping nails a minimum of 52 mm (2 in.) in from edges.

### **1.11 Waste Management and Disposal**

1. Remove from site and dispose packaging materials at approved facilities.

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## **PART 2 - PRODUCTS**

### **2.1 Material**

1. Wood Blocking: No.1 Exterior Grade, 52 x 52 mm (2 in. x 2 in.) 52 x 104 mm (2 x 4 in.), 52 x 152 mm (2 x 6 in.), 52 x 203 mm (2 x 8 in.), 52 x 254 mm (2 x 10 in.) and 52 x 305 mm (2 x 12 in.) and as noted on drawings/details.
2. Plywood Sheathing: 13 mm (1/2 in.) and 19 mm (3/4 in.), exterior grade, solid one side (G1S) unsanded, Veneer Grade B+. Moisture content of plywood shall not exceed 19% on a 'dry weight basis'.
3. Wood Cant: 75 x 75 mm (3 x 3 in.), No.1 Grade, Pressure Treated, exterior grade
4. Shims: Constructed from plywood sheathing or tapered wood blocking to provide minimum 10% slope to interior of roof surface, as indicated on drawings.
5. Wood Sleepers: Fabricated from wood blocking and plywood, configuration, sizes and length as detailed.
6. Fasteners: Are to be of sufficient length to penetrate concrete decks 52 mm (2 in.), metal decks 19 mm (3/4 in.) and wood decks 38 mm (1½ in.).  
Acceptable Material:
  1. Nails: No. 10 spiral shank, hot dipped galvanized.
  2. Wood and Metal Deck Screws (Low profile head):
    1. Roofgrip #14 Buildex by ITW Construction Products
    2. #14 Heavy Duty Drill Point Fastener by Tru-Fast.
    3. Rawl #14 Deck Screw by Rawlplug Canada Ltd.
  3. Masonry anchors (Robertson head):
    1. Tapcon Plus, 6 mm (1/4 in.) diameter, Climaseal coated by ITW Construction Products.
    2. Tap-Grip heavy-duty self-tapping concrete anchors by Perma-Grip Fasteners.
    3. Rawl PERMA-SEAL TAPPER, 6 mm (1/4 in.) diameter by Rawlplug Canada Ltd.
  4. Steel: Flat head, self-tapping steel screw with coated finish, FM Approved. Fasteners to be of sufficient length to penetrate crest of metal deck 20 mm +/- 5 mm (3/4" +/- 1/4").
  5. Bolts, Washers and Nuts: Size as indicated on Drawings. Hot dipped galvanized, corrosion resistant finish, 12.5 mm (1/2") diameter unless otherwise noted.

## **PART 3 - EXECUTION**

### **3.1 Preparation**

1. Substrates shall be structurally sound to receive rough carpentry.
2. All wood framing shall be in accordance with Ontario Building Code or more stringent requirements noted within Contract Documents.

### **3.2 Installation**

1. Cut and fit members accurately. Mitre all corners, leaving no space or unevenness greater than 3 mm (1/8 in.) between components. Lay out work to provide a uniform transition for insulation and membrane.
2. Install continuous plywood sheathing, wood blockings, cants, studs, nailers and continuous shims where required and detailed.
3. Shims to be of sufficient height to ensure a minimum ten percent (10%) positive slope is provided on all parapet walls and under cap flashings.
4. Erect members in position, align, level, square, plumb and secure permanently in place as specified. Brace work temporarily as required to maintain safely in place.

### **3.3 Fastening**

1. Secure new wood with minimum of 2 fasteners at 457 mm (18 in.) on centre staggered, and as follows:
  1. Into masonry: masonry anchors.
  2. Into wood: wood screws.
  3. Into metal: metal screws.
2. Secure lumber as follows:
  1. All fasteners to be placed a minimum of 12 mm (1/2") from any edge. Install fasteners in two rows in direction of grain, with each fastener offset from one another not less than 457 mm (18") on centre.
  2. Offset and countersink all screw fasteners flush with surface of wood blocking being secured.
  3. Co-ordinate work to keep cutting and remedial work to a minimum.

### **3.4 Parapets/Perimeters/Walls/Curbs/Sleepers**

1. Construct parapets, perimeters, walls, curbs and sleepers as detailed.
2. Provide new HVAC equipment wood sleeper supports. Width to be a minimum of 140 mm (5.5"). Length of sleeper to span between two framing members.

3. Where possible, maintain minimum height of 305 mm (12 in.) above finished roof surface for sleepers and curbs.
4. Install wood blocking for prefabricated curbs for mechanical units to allow for a level installation where deck is sloped.

### **3.5 Dividers and Movement joints**

1. At dividers and movement joints, neatly cut plywood to required dimensions. Cutting shall be done by 'scoring' with carbide tipped utility tool/knife or circular saw with carbide blade. Smooth cut-edges with a wood rasp.
2. Secure plywood to substrate using appropriate fasteners, screws at 205 mm (8 in.) on centre each way and along perimeters. Maintain screws 13 mm (1/2 in.) from edges and maintain 3 mm (1/8 in.) gap between each piece of board.

### **3.6 Clean-up**

1. Remove all excess materials, debris, tools and equipment as work proceeds and on completion.

End of Section



## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Rough carpentry: Section 06100
2. Painting: Section 09900

### **1.2 Reference Standards**

1. Do millwork to Millwork Standards of the Architectural Woodwork Manufacturers' Association of Canada (AWMAC) Premium Grade.

### **1.3 Samples**

1. Submit duplicate 300 x 300 mm samples of each type of paneling laminate, melamine and each type of solid wood or plywood to receive stain or natural finish.
2. Submit sample of each type of hardware specified in accordance with Section 01340.
3. Submit a typical prototype unit representative of the work of this section.

### **1.4 Shop Drawings**

1. Submit shop drawings in accordance with Section 01340.
2. Clearly indicate details of construction, profiles, jointing, fastening and other related details.

### **1.5 Qualification**

1. Millwork manufacturer to have not less than 5 years proven first class experience in institutional millwork and shall be a member of AWMAC.

### **1.6 Warranty**

1. Submit a two (2) year warranty for the work of this section against defects in material and workmanship.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. Softwood lumber: to CSA 0121-M1978 and National Lumber Grades Authority (NLGA) requirements, with maximum moisture content of 10% for interior work. Yard lumber select for natural finish of species, indicated to AWMAC premium grade.

2. Hardwood lumber: to National Hardwood Lumber Association (NHLA) requirements, moisture content of maximum 10% for interior work, of species indicated to AWMAC premium grade.
3. Hardwood plywood: to CSA 0115-1967 of thickness indicated, rotary cut face veneer, birch plywood, veneer core. Select veneers to provide book match veneer strips to be 240 mm wide minimum. Grade: Select White.
4. Nails and staples: to CSA B111-1974 galvanized for exterior work, interior high-humidity areas and for treated lumber; plain finish elsewhere. Use spiral thread nails except where specified elsewhere.
5. Particle Board core: to CAN3-0188.1-M, Grade R, 720 kg/m<sup>3</sup> density in thicknesses indicated.
6. Book Match Veneer: strips to be 240 mm wide minimum.

## **2.2 Plastic Laminate**

1. Conforming to CAN3-A172, General Purpose - standard grade (GP-S), 1.25 mm thick for tops, Post Forming - standard grade (PF-S) 1.25 mm thick for post forming. Balance all panels with 0.5 mm backing sheet (BK) by same manufacturer as face panel. Use waterproof adhesive capable of holding materials together without failure. Provide acid resistant grade where shown. Finish shall be "Velvatex" or "Suede" by Arborite, or equivalent manufactured by Formica, Durolam Ltd., "Wilson Art" as distributed by Meteor Plywoods Ltd., "Micarta" distributed by Montego Forest Products Ltd., "Nevamar" distributed by Ceratec Inc., or approved equivalent by Octopus Products Limited. Selections to be confirmed by Consultant.

- .1 For base price of plastic laminate colour and pattern use the following colour – Formica Smoke Quarstone. Note, the colours are not finalized.

## **2.3 Edge Banding**

1. Solid polyvinyl chloride (PVC), 3 mm thickness x full width of panel edge, colour/pattern to match finished face of melamine panel or as selected by Consultant. All exposed edges of banding to be radiused to 2 mm radius after installation on panels. Submit sample of edge-banded panel with radiused edges to Consultant for approval prior to fabrication of architectural woodwork.

- .1 Acceptable Material: Solid PVC edging as manufactured by "Woodtape" Edge-Banding.
- .2 Acceptable Material: Solid PVC edging as manufactured by "Complast Inc."

## **2.4 Cabinet Hardware**

1. Furnish and install all hardware to custom casework as follows:
  - .1 **Cupboard Doors - 19 mm thick:**

Hinges	200 Series 110° Salice
Roller Catches	807N 2G (SgDr) Onward
Elbow Catches	T03222 C15 (DhDr)
Door Pulls	CBH235-3 1/2" C32D

Cupboard Locks	8703/8704 14a National
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**.2 Drawers - 19 mm thick.:**

Drawer Slides	KV1300X length to suit
Drawer Pulls	CBH235-3 1/2" C32D
Drawer Locks	8703 - 14a National

**.3 Shelving:**

Plaster strips	KV255 Zinc Knappe & Vogt
Shelf Clips	KV256 Zinc Knappe & Vogt

**.4 Cupboard Doors - 35 mm thick:**

Hinges	F179 76x76 Stanley C15
Roller Catches	504N Onward C26
Surface bolt	043-4 X Angle Strike C15
Door Pulls	CBH245-4 1/2" C32D
Cupboard Locks	44F73-44FS3-626 Best Lock

**.5 Closet Rods and Flanges**

Rods: chrome finish, Ø 33 mm.

Flanges: chrome finish, closed flanges at both ends of rods.

2. This section shall also include accessories such as rubber door silencers (2 per drawer or door), and other items necessary for the completion of the millwork.
3. Cabinet Keying: Key all cabinet and drawer locks alike in each room, and different from other rooms.

**2.5 Melamine Clad Cabinetwork**

1. All cabinet frames whether for base, wall or tall floor standing cases, shall be fabricated so each is a self-contained module. Front side top and bottom, exterior and interior surfaces shall be finished allowing future relocation of any module, into any bench arrangement, without need of any additional finishing.
2. Gables and panels shall be fabricated from 19 mm thick melamine surfaced panels with a P.V.C. edging applied to exposed edges.
3. Bottoms shall be fabricated utilizing the same materials and edge finish as gables. Front edge will be edged with P.V.C. edging. All other edges will be thoroughly sealed and moisture proofed prior to attachment to gables.
4. Rails shall be fabricated and machined to join the gables and form a rigid cabinet frame.

5. Tops (applies to wall and tall units only) shall be fabricated utilizing the same material and edge finish as gables. Front edge will be edged with P.V.C. edging.
6. Toe kick rail shall have a 100 mm x 19 mm section, machined to receive four screw nails for attachment to bottom front edge of gables. Cabinet base shall be plywood attached to melamine cabinet separately, insuring the melamine OSB centre core gables do not come in contact with the floor.
7. Backs in base cupboards shall be fabricated from a 6 mm thick melamine surfaced panel.
8. Backs in wall and tall cabinets shall be fabricated from 6 mm thick melamine surfaced panels securely glued and screw nailed into the check out provided in the backs of gables, tops, and bottoms.
9. All shelves shall be adjustable at 13 mm increments and each will be supported by a shelf support resting in four pilaster strips attached to the gables.
10. Doors shall be fabricated from 19 mm thick melamine surfaced panels. All four edges shall be P.V.C. edging.
11. Drawer fronts shall be fabricated utilizing the same material and edge finish as doors. All four edges shall P.V.C. edging. Fronts will be secured to drawer bodies with five screw nails through the front of the drawer body into the core of the drawer front.
12. Drawer bodies shall consist of box construction fabricated from 13 mm birch plywood with solid birch edge, front, sides and back with a 6 mm hardboard bottom dadoed and glued into box members. Joint front, sides and back with carefully fitted glued and tenoned joints. Alternately, Blum Metabox drawer body and side can be used.
13. 35 mm thick doors shall be solid core with plastic laminate both sides and on all four edges, color and grain to match melamine.
14. Solid hardwood glazed door fronts and frames shall receive lacquer finish. Glazing shall be 3mm tempered clear glass. Benches are millwork only, no glazing.
15. **Finish:**
  - .1 Melamine surfaced panels shall be finished both sides in the same colours, patterns, and grain as selected by the Consultant.
  - .2 Solid hardwood glazed doors and drawer bodies shall be sanded, then sealer coated, and sanded with two finish coats of catalytic type acid resistant varnish.
  - .3 Colour of all Melamine Cabinets to be **Hardrock Maple**.

## **2.6 Shop Fabrication**

1. Shop install cabinet hardware.
2. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.

3. Shop assemble work for delivery to site in size easily handled and to insure passage through building openings.

### **2.7 Benches**

1. 32 x 92 solid maple boards with 32 x 108 solid maple edges. Lengths, as indicated on Plans, secured to metal supports. Polyurethane finish, semigloss.

### **2.8 Plastic Laminated Tops**

1. 19 mm thick particle board core with post-forming grade plastic laminate finish bonded with resorginal formaldehyde resin glue to a particleboard core. All countertop front face to return vertically 35 mm  $\pm$  . All front and backsplash edges to be rounded.
2. Underside to receive a backing sheet, sanded one side and bonded same as surfacing material.
3. Exposed edges to be finished with same material as used for the top.
4. Drip grooves to be cut into underside of the top where exposed edges occur.
5. Splash backs, curbs and curb shelves are to be of similar construction as the tops.
6. Use acid resistant post-forming grade laminate, where indicated on drawings. Colour: black.
7. At all wall termination, provide backsplash return.

### **2.9 Moulding and Trims**

1. Fabricate mouldings in maximum practical lengths to profile shown. Solid birch to receive varnish finish unless noted otherwise. Install with concealed fasteners.

## **PART 3 - EXECUTION**

### **3.1 Installation**

1. Set and secure all material and components in place, rigid, plumb and square.
2. Provide heavy duty fixture attachments for wall mounted cabinets.
3. Use draw bolts in countertop joints.
4. At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant.
5. Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.

6. After installation, fit and adjust operating hardware for wood and laminated plastic cabinet doors, drawers and shelves.

End of Section

## **PART 1 - GENERAL**

### **1.1 Section Includes**

1. Note: in order to maintain continuity and quality control, the supply and installation of the full project scope of vapour barrier membrane is to be carried by a single trade.
2. Materials and installation methods of the primary air/vapour barrier membrane system.
3. Materials and installation methods of dampproof coursing and through-wall flashing membranes.
4. Materials and installation methods for the adhesion of rigid and semi-rigid insulating materials.

### **1.2 Related Sections**

- |  |               |
|--|---------------|
| 1. Masonry:                              | Section 04200 |
| 2. Building Insulation:                  | Section 07212 |
| 3. Firestopping and Smoke Seal:          | Section 07270 |
| 4. Modified Bituminous Membrane Roofing: | Section 07520 |
| 5. Sealants:                             | Section 07900 |
| 6. Aluminium Windows:                    | Section 08520 |

### **1.3 Submittals**

1. Prior to commencing the Work, submit documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air/ vapour barrier membranes, including primary membrane and transition sheets, exceed the requirements of the National Building Code.
2. Prior to commencing the Work submit copies of manufacturers' current ISO certification.  
Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.
3. Prior to commencing the Work submit references clearly indicating that the membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen years. Submit references for a minimum of ten projects.
4. Prior to commencing the Work submit manufacturers' complete set of standard details for the air/vapour barrier membrane systems showing a continuous plane of air tightness throughout the building envelope.

#### **1.4 Quality Assurance**

1. Submit in writing, a document stating that the applicator of the primary air/vapour barrier membranes specified in this section is recognized by the manufacturer as suitable for the execution of the Work.
2. Perform Work in accordance with the manufacturer's written instructions of the air/vapour barrier membrane and this specification.
3. Maintain one copy of manufacturer's written instructions on site.
4. At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the air/vapour barrier membrane manufacturers' representative.
5. Components used in this section shall be sourced from one manufacturer, including sheet membrane, air/vapour barrier sealants, primers, mastics and adhesives.

#### **1.5 Mock-Up**

1. Construct mock-up in accordance with Section 01340 - Shop Drawings, Product Data & Samples.
2. Provide mock-up of air/vapour barrier materials under provisions of Division 1.
3. Where directed by consultant, construct typical exterior wall panel, 2 m long by 2 m wide, incorporating substrate, window frame, attachment of insulation, and; showing air/vapour barrier membrane application details.
4. Allow 24 h for inspection of mock-up by consultant before proceeding with air/vapour barrier work. Mock-up may remain as part of the Work.

#### **1.6 Pre-Installation Conference**

1. Convene one week prior to commencing work of this section, under provisions of Division

#### **1.7 Delivery, Storage and Handling**

1. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
2. Store role materials on end in original packaging.
3. Store liquid air/vapour barrier material, adhesives and primers at temperatures of 5°C and above to facilitate handling.
4. Keep solvent away from open flame or excessive heat.
5. Protect rolls from direct sunlight until ready for use.



### **1.8 Co-ordination**

1. Ensure continuity of the air/vapour barrier membrane system throughout the scope of this section.

### **1.9 Alternates**

1. Submit requests for alternates in accordance with Division 1.
2. Alternate submission format to include:
  - .1 Submit evidence that alternate materials meet or exceed performance characteristics of Product requirements and documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air/ vapour barrier membranes, including primary membrane and transition sheets, exceed the requirements of the National Building Code.
  - .2 Submit copies of manufacturers' current ISO certification.
  - .3 Submit references clearly indicating that the membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen years.
  - .4 Submit manufacturers' complete set of standard details for air/vapour barrier membrane systems showing a continuous plane of air tightness throughout the building envelope.
3. Submit requests for alternates to this specification a minimum of ten (10) working days prior to tender closing for evaluation. Include a list of ten projects executed over the past ten years.
4. Acceptable alternates will be confirmed by addendum. Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project.

## **PART 2 - PRODUCTS**

### **2.1 Membranes**

1. Transition and continuous wall envelope barrier membrane (Self-Adhering): Basis of design is Blueskin® SA as manufactured by Bakor, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, or approved equal,. For application temperatures down to - 12°C use Blueskin® SA LT. Membrane shall have the following physical properties:
  - .1 Thickness: 1.0 mm (40 mils);
  - .2 Air leakage: <0.005 L/s•m<sup>2</sup> @ 75 Pa to ASTM E283-91;
  - .3 Water vapour permeance: 2.8 ng/Pa.m<sup>2</sup>.s (0.05 perms) to ASTM E96;
  - .4 Low temperature flexibility: -30°C to CGSB 37-GP-56M;
  - .5 Elongation: 200% to ASTM D412-modified.

2. Through-wall flashing membrane and dampproof course (Self-Adhering): Blueskin® TWF as manufactured by Bakor, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, having the following physical properties:
  - .1 Film Thickness: 0.225mm (9.0 mils);
  - .2 Puncture Resistance (film); 180N minimum;
  - .3 Tear Resistance (film); 58N MD;
  - .4 Air leakage: <math><0.005 \text{ L/s}\cdot\text{m}^2 \text{ @ } 75 \text{ Pa}</math> to ASTM E283-91;
  - .5 Water vapour permeance: 2.8 ng/Pa.m<sup>2</sup>.s (0.05 perms) to ASTM E96;
  - .6 Low temperature flexibility: -30°C to CGSB 37-GP-56M.

Approved Equal: Air-Shield Thru-Wall Flashing by W.R. Meadows of Canada and AquaBarrier TWF by IKO Industries.

## **2.2 Primers**

1. Primer for self-adhering membranes: For all temperatures, Blueskin® Primer as manufactured by Bakor, a synthetic rubber based adhesive type, quick setting, having the following physical properties:
  - .1 Colour: Blue;
  - .2 Weight: 0.8 kg/l;
  - .3 Solids by weight: 35%;
  - .4 Drying time (initial set): 30 minutes.

Approved Equal: S.A.M. Adhesive / S.A.M. Adhesive LVC by IKO Industries

2. Primer for self-adhering membranes: For temperatures above -4°C, Aquatac™ Primer as manufactured by Bakor, or approved equal, a polymer emulsion based adhesive type, quick setting, having the following physical properties:
  - .1 Colour: Aqua;
  - .2 Weight: 1.0 kg/l;
  - .3 Solids by weight: 53%;
  - .4 Water based, no solvent odours
  - .5 Drying time (initial set): 30 minutes at 50%RH and 20°C.

## **2.3 Adhesive**

1. Liquid air seal mastic and insulation adhesive: Air-Bloc 21 or 230-21 Insulation Adhesive as manufactured by Bakor, a synthetic, trowel applied, rubber based adhesive type, having the following characteristics:
  - .1 Compatibility: With air/vapour barrier membrane, substrate and insulation.
  - .2 Air leakage: 0.013 L/s°m<sup>2</sup> @ 100 Pa.;
  - .3 Water vapour permeance: 1.7 ng/Pa.m<sup>2</sup>.s. (0.03 perms);
  - .4 Long term flexibility: CGSB 71-GP-24M;
  - .5 Chemical resistance: Alkalis and salt.

## **PART 3 - EXECUTION**

### **3.1 Examination**

1. Verify that surfaces and conditions are ready to accept the Work of this section. Notify in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

### **3.2 Preparation**

1. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spawled areas in substrate to provide an even plane. Strike masonry joints flush.
2. New concrete should be cured for a minimum of 14 days and must be dry before air/vapour barrier membranes are applied.
3. Where curing compounds are used they must be clear resin based without oil, wax or pigments.

### **3.3 Primer for Transition and Through-wall Flashing Membrane (Self-Adhering Type only)**

1. Apply primer to poured concrete, metal and glass-faced wallboard substrates at rate recommended by manufacturer. Primer not required on concrete block.
2. Allow primer to dry prior to application of the membrane.

### **3.4 Transition Membrane (Self-Adhering Type)**

1. Align and position Blueskin, or approved equal, self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.
2. Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
3. Promptly roll all laps and membrane with a counter top roller to effect seal.

### **3.5 Through-wall Flashing & Dampproof Coursing (Torch Applied)**

1. Where torch applied through-wall flashing & dampproof coursing are indicated on drawings, install Blueskin® TG membrane on primed and prepared surfaces in accordance with manufacturer's written instructions. Approved equal AquaBarrier TG by IKO Industries
2. For through-wall flashing ensure membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
3. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing

and shall extend a minimum of 200 mm up the back-up wall.

### **3.6 Through-wall Flashing Membrane (Self-Adhering Type)**

1. Align and position the leading edge of Blueskin® TWF self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls or self angles, partially remove protective film and roll membrane over surface and up vertically.
2. Press firmly into place. Ensure minimum 50mm overlap at all end and side laps.
3. Promptly roll all laps and membrane to effect the seal.
4. Ensure all preparatory work is complete prior to applying Blueskin® TWF.
5. Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
6. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 200 mm up the back-up wall.

### **3.7 Heat Sensitive Transition Membrane (Self-Adhering Type)**

1. Align and position Blueskin® SA self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.
2. Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
3. Promptly roll all laps and membrane with a counter top roller to affect seal.

### **3.8 Inspection**

1. Notify consultant when sections of work are complete so as to allow for review prior to installing insulation.

### **3.9 Protection of Finished Work**

1. Blueskin is not designed for exposure. Good practice requires covering as soon as possible.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work Specified Elsewhere**

1. Masonry: Section 04200
2. Air Vapour Barrier Membrane: Section 07112  
Note: in order to maintain continuity and quality control, the supply and installation of the full project scope of vapour barrier membrane is to be carried by a single trade.

## **PART 2 - PRODUCTS**

### **2.1 Insulation**

1. **Perimeter Foundation Insulation:** Extruded expanded polystyrene to CAN/CGSB-51.20-M87, Type 4, butt or shiplapped edges. For use at perimeter of building and at perimeter of basement areas above and below grade as well as at miscellaneous detail locations calling for rigid insulation.
  - .1 Thickness 75 mm (3.0 in.) (RSI 1.76/R 10.0) - where so indicated.
  - .2 Acceptable Material: "Styrofoam SM" as manufactured by Dow Chemical Canada Inc.
  - .3 Acceptable Material: "Celfort 300" as manufactured by Celfortec Inc.
2. **Cavity Wall Insulation - Masonry:** Expanded polystyrene insulation to CAN/CGSB-51.20-M87, Type 4 butt or ship lapped edges. For use in cavity wall construction above and below grade.
  - .1 Thickness 100 mm or as indicated.
  - .2 Acceptable Material: "Cavitymate" Type 3 as manufactured by Dow Chemical Canada Inc.
  - .3 Acceptable Material: "Celfort 300" as manufactured by Celfortec Inc. or approved equal.
3. **Cavity Wall Insulation – Metal Panel:** water-repellent and semi-rigid thermal insulation to CAN/ULC-S702-97, formed of bonded basalt fibres. For use in cavity wall construction or portions thereof with metal panel or siding cladding.
  - .1 Acceptable Material: 100mm "CavityRock MD" as manufactured by Rockwool Inc.
  - .2 Acceptable Material: 100mm "MB PLUS" as manufactured by Fibrex Insulations Inc.

### **2.2 Adhesive**

1. Type A: to CGSB 71-GP-24M plus Amdt-Nov.-83, compatible with respective rigid insulation, air, vapour and waterproofing membranes and recommended by manufacturer's. Use Bakor 230-21 rigid insulation adhesive with Blueskin air-vapour barrier.

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## **PART 3 - EXECUTION**

### **3.1 Workmanship**

1. Install insulation after building substrata materials are dry, thoroughly clean and capable of providing a firm, uniform bonding surface.
2. Install insulation to maintain continuity of thermal protection to building elements and spaces.
3. Fit insulation closely around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
4. Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use longest possible lengths to reduce number of joints.
5. In multiple layer applications offset both vertical and horizontal joints.
6. Do not enclose insulation until it has been inspected.
7. Install semi rigid board to manufacturer's requirements.

### **3.2 Rigid Insulation**

1. **Cavity Walls Above Grade**  
Press insulation in full contact with air/ vapour barrier membrane by installing plastic wedges "Wedge-Lok" between the masonry reinforcing and the insulation. Wedges at 400 mm o.c. vertically and horizontally. Apply adhesive on board edges and press boards tightly to prevent air infiltration between boards.
2. **Cavity Walls Below Grade**  
Apply adhesive to insulation board by bead method with 4 mm diameter beads at 350 mm o.c.
3. **Perimeter Insulation**  
Apply adhesive to insulation board by spot method with daubs 40 mm diameter x 25 mm high at 200 mm o.c. each way.

End of Section

## **PART 1 - GENERAL**

### **1.1 Related Work**

- |  |                              |
|--|------------------------------|
| 1. Cast-in-Place Concrete:                           | refer to structural drawings |
| 2. Masonry:  | Section 04200                |
| 3. Rough Carpentry (Architectural) Plywood:          | Section 06100                |
| 4. Gypsum Board:                                     | Section 09250                |
| 5. Firestopping and Smoke Seals for Mechanical Work: | Division 15                  |
| 6. Firestopping and Smoke Seals for Electrical Work: | Division 16                  |
| 7. Sound Seal at Gypsum Board Partition              | Section 09250                |

**Note:** Firestopping and Smoke Seals within mechanical and electrical assemblies are specified in Divisions 15 and 16. All other firestopping and smoke seals are the responsibility of this Section.

### **1.2 Reference**

1. ASTM E814 - Test Method of fire tests of through-penetration firestops, Factory Mutual.
2. CAN4-S101M - Standard Methods of Fire Endurance Tests of Building Construction and Materials.
3. CAN4-S115M - Standard Method of Fire Tests of Firestop Systems.
4. ULC - List of Equipment and Materials.

### **1.3 System Description**

1. Firestopping Materials: CAN4-S115M ASTM E814 to achieve a fire protection rating as noted on Drawings.
2. It is the intent of this Section that in conjunction with Divisions 15 and 16 a competent, single source be responsible for the firestopping and smoke seals of the entire project.

### **1.4 Submittals**

1. Submit a product data to requirements of Section 01340.
2. Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation, ULC design references.

3. Submit proposed type of fireproofing system for each location for approval by Architect. Fireproofing System must be appropriate to achieve expected appearance and finish.

### **1.5 Quality Assurance**

1. Manufacturer: Company specializing in manufacturing products of this Section with minimum five years documented experience.
2. Applicator: Approved, licensed and supervised by the manufacturer of firestopping materials. Company with minimum five years documented experience.
3. Product: Manufactured under ULC Follow-up Program. Each container or package shall bear ULC label.

### **1.6 Regulatory Requirements**

1. Conform to applicable code for fire protection ratings.
2. Provide certificate of compliance for authority having jurisdiction indicating approval.

### **1.7 Delivery, Storage & Handling**

1. Deliver and store materials in a dry, protected area, off ground in original, undamaged, sealed containers with manufacturer's labels and seals intact.

### **1.8 Project & Site Conditions**

1. Application temperature and ventilation as per Manufacturer's instructions.

### **1.9 Sequencing & Scheduling**

1. Sequence work to permit installation of firestopping and smoke seal materials to be installed after adjacent work is complete and before closure of spaces.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. A/D Firebarrier Firestop Systems, by A/D Fire Protection Systems Inc., capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4-S115 and not to exceed opening sizes for which they are intended.
2. Mineral Wool Backing Insulation: ULC labelled, preformed non-combustible material (A/D Firebarrier Mineral Wool) by A/D Fire Protection Systems Inc.
3. Retainers: Clips to support mineral wool.
4. Firestopping Sealant: ULC labelled, single component silicone bases, A/D Silicone Firebarrier Sealant by A/D Fire Protection Systems Inc.



5. Firestopping Seal: ULC labelled, single component water-base seal, A/D Firebarrier Seal by A/D Fire Protection Systems Inc.
6. Firestopping Foam: ULC labelled, two components silicone foam, A/D Firebarrier RTV Foam by A/D Fire Protection Systems Inc.
7. Firestopping Mortar: ULC labelled, non-combustible fibre reinforced, foamed cement mortar, A/D Firebarrier Mortar by A/D Fire Protection Systems Inc.
8. Damming Material: In accordance with tested assembly being installed as applicable and as acceptable to authorities having jurisdiction.

### **PART 3 - EXECUTION**

#### **3.1 Examination**

1. Examine surfaces to receive work of this Section and report any defects which may affect the Work of this Section.
2. Verify that openings are ready to receive the Work of this Section.
3. Confirm compatibility of surfaces to receive firestopping and smoke seal materials.
4. Beginning of installation means acceptance of existing surfaces and substrate.

#### **3.2 Preparation**

1. Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
2. Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instruction.

#### **3.3 Application**

1. Install firestopping and smoke seal material and components in accordance with ULC listing and manufacturer's instructions.
2. Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
3. Apply in sufficient thickness to achieve rating to uniform density and texture.
4. Provide temporary forming if required.
5. Tool or trowel exposed surfaces to a neat finish where required.
6. Remove excess material promptly as work progresses and upon completion.

7. Protect installed material until cured or set.

### **3.4 Cleaning**

1. Clean adjacent surfaces of firestopping and smoke seal materials.

### **3.5 Field Quality Control**

1. Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

### **3.6 Scheduling**

1. Firestop and smoke seal at:
  - .1 Penetrations through fire separations (rated and non-rated); masonry, concrete, and gypsum board partitions and walls.
  - .2 Top of fire separations (rated and non-rated); masonry and gypsum board partitions.
  - .3 Intersection of fire separation masonry and gypsum board partitions.
  - .4 Control and sway joints in fire separation masonry and gypsum board partitions and walls.
  - .5 Penetrations through fire separation floor slabs, ceilings and roofs, if applicable.
  - .6 Openings and sleeves installed for future use through fire separations.
  - .7 Refer to AD drawings for locations of fire separations.
  - .8 Refer to AD725 for detail of top of wall fire separation assembly.

### **3.7 Sound Seal**

1. At top of all non fire separations masonry partitions compress mineral wool and fill space between masonry and structure. Apply sealant on at least one side of the sound separation.

End of Section

## **PART 1 - GENERAL**

### **1.1 Scope of Work**

1. Work in this section shall include design, fabrication, supply and installation of a custom made, preformed, prefinished, aluminum composite, dry joint modular wall and soffit system, sub girt system, fastening hardware and flashings.

### **1.2 Related Work**

1. Structural Steel Framing refer to drawings
2. Air Vapour Barrier Membrane Section 07112
3. Building Insulation Section 07212

### **1.3 Quality Assurance**

1. Supplier/ installer shall have minimum 10 years proven experience and must have completed at least 5 major projects in the specified aluminum composite material panel system.

### **1.4 References**

1. ASTM A653 "Standard Specification for Sheet Steel, Zinc Coated (Galvanized) by the Hot Dip Process".
2. ASTM B209 Aluminum Sheet and Plate
3. ASTM B221 Extruded Aluminum Shapes.
4. ASTM E283-99 Air Infiltration and Exfiltration.
5. ASTM E331-00 Water Infiltration.
6. ASTM E330-02 Wind Load Resistance

### **1.5 Design and Performance Requirements**

1. Design, fabricate and erect a pressure equalized wall panel system to meet the following requirements.
  - .1 Rain Penetration: prevent rain penetration through wall system. Design system based on "Rain Screen Principle" per the National Research Council. Incorporate means of draining to the exterior.
  - .2 Wind load: Design wall system to resist wind loads, positive and negative, expected in this geographical region (OBC climatic data, 100 years probability) without causing rattling, vibration or excessive deflection of panels, overstressing of fasteners, clips and other detrimental effects on system.

- 
- .3 Structural and thermal movement: Accommodate movement of supporting structural framing and movement caused by thermal expansion and contraction of system component parts without causing bowing, buckling, delamination, oil canning, and failure of joint seals, excessive stress on fasteners or any other detrimental effects.
  2. Panel flatness tolerance: Fabricate panels not exceeding the following tolerances:
    - .1 Rises and falls across the panel, (local bumps and depressions) will not be accepted.
    - .2 1.5 mm in a concave/ convex direction, measured perpendicular to the normal plane.
  3. Panel removal: System/ procedure to allow removal of individual panels within wall system.
  4. Maximum deviation from vertical and horizontal alignment of erected panels: 6 mm in 6 m.
  5. Testing: Provide wall assembly that has been tested and certified to conform to the following criteria:
    - .1 Structural: Provide systems that have been tested in accordance with ASTM E330 at a design pressure of 60 psf and have been certified to be without permanent deformation or failures of structural members.

### **1.6 Samples**

1. Submit samples in accordance with Section 01340.
2. Submit duplicate, minimum 130 x 180 mm samples of each colour selected.

### **1.7 Shop Drawings**

1. Submit shop drawings in accordance with Section 01340.
2. Indicate elevations, profiles, dimensions and thickness of panels and joint details.
3. Indicate attachment clips, system extrusions, fastening, anchor and installation details.

### **1.8 Maintenance Data**

1. Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual.

### **1.9 Mock up**

1. Submit mock-up in accordance with Section 01340.
2. Erect mock-up panel approximately 3m long x 2m high in location as directed by architect.

3. Mock-up panel shall include all components of the wall system and will be incorporated into work once approved.

### **1.10 Maintenance Data**

1. Protect panel face with a plastic film adhered to panel in accordance with panel manufacturer's recommendation.
2. Store components and materials in accordance with panel manufacturer's recommendations.

### **1.11 Duranar XL Panel Finish Warranty**

1. Provide a manufacturer's written warranty: Furnish panel manufacturer's written warranty covering failure of factory-applied exterior finish on composite metal panels within the warranty period; warrant finish per ASTM D 4214 for chalk not in excess of 8 NBS units and fade not in excess of 5 NBS units. Warranty period for finish: 10 years after the date of Substantial Completion.

### **1.12 Material and Workmanship Warranty**

1. Warranty against defects or deficiencies shall be for a period of one year from date of substantial completion.

## **PART 2 - PRODUCTS**

### **2.1 Panels**

1. Aluminum Composite Material (ACM)
  - .1 Composition: Two sheets of aluminum sandwiching a core of extruded thermoplastic formed in a continuous process without the use of glues or adhesives between dissimilar materials. Bond integrity testing to adhere to ASTM D1781-76
  - .2 Aluminum face sheets: Aluminum alloy 3003, thickness: 0.51 mm
  - .3 Panel thickness: 4 mm
  - .4 Panel weight: 5.28 kg/sq.m.
  - .5 Tolerances:
    - .1 Panel bow: Maximum 0.8% of panel dimension (width or length).
    - .2 Panel Dimensions: Take site measurements before proceeding with production unless dimensions can be guaranteed by General Contractor.
    - .3 Panel lines, breaks and angles to be sharp and true; panel surfaces to be free from warp or buckle.
  - .6 Panel System: rout and return dry vented joints, pressure-equalized rainscreen design, with 12.5 mm wide panel joints with splines, using proprietary aluminum extrusions.
  - .7 Acceptable material and manufacturer:
    - .1 Accumet 2000 supplied by Flynn Canada
    - .2 Reynobond ACM supplied by Kanalco Ltd.
    - .3 Alucobond SL-2000 supplied by Sobotec Ltd.

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- .4 Alpolic ACM, supplied by ACM Panelworx.
  - .5 Alcotex ACM by Ontario Panelization.
2. Panel finish: Duranar XL, three coat, coil-coated finish containing Kynar 500 polyvinylidene fluoride resin. Colours: to consultant's selection. Allow for two different colour selections including one wood grain look.
  3. Panel and Wall Accessories
    - .1 Provide proprietary aluminum extrusions to manufacturer's standard profiles for a complete installation.
  4. Fasteners: as recommended by panel manufacturer, concealed and non-corrosive. No Exposed fasteners permitted.
  5. Extrusions and extrusion clips for attaching panels to the sub-structure: Purpose made aluminum.
  6. Extrusions shall be full length around panel perimeter for panel reinforcement and alignment. Intermittent clips are unacceptable.
  7. Joint filler strip: Same material and color as panels. Use of caulking at joints is not acceptable.
  8. Plastic shims, shall be used as thermal separator between extrusions and sub-girts.
  9. Sub-girts: To be manufactured from G-90 galvanized steel and shall be designed to accommodate expansion and contraction, dynamic movements and design load requirements.
  10. Flashing: Pre-finished aluminum to match panels.

## **PART 3 – INSTALLATION EXECUTION**

### **3.1 Panel System**

1. Before proceeding, examine work of other sections upon which this section depends.
2. Erect panels and joint filler strip in accordance with manufacturer's details to meet specified design criteria and performance.
3. Finished work shall be securely anchored, free of distortion, free of surface imperfections and uniform in colour.
4. Use concealed fastenings only.
5. Install panels plumb, true, level and in alignment to established lines and elevations.

**3.2 Clean up**

1. Remove protective plastic film from panels.
2. Repair and touch-up with colour matching high grade enamel minor surface damage.
3. Replace damaged panels and components which cannot be satisfactorily repaired.

End of Section

## **Part 1 - GENERAL**

### **1.1 Section Includes**

1. Section includes for provision of labour, materials, equipment and services for the supply and installation of the SBS Modified Bituminous Membrane Roofing in accordance with Contract Documents.

### **1.2 Related Sections**

1. Section 06110                      Rough Carpentry for Roofing
2. Section 07620                      Sheet Metal Flashing and Trim
3. Section 07901                      Joint Sealers for Roofing

### **1.3 References**

1. CGSB-37-GP-56M / ASTM D6164 / ASTM 6163 - Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing.
2. CGSB 37-GP-9M / ASTM D41 - Primer, Asphalt for Asphalt Roofing, Dampproofing and Waterproofing.
3. CAN/ULC-S701 / ASTM C578 -Thermal Insulation, Polystyrene, Boards and Pipe Covering
4. CAN/ULC-S702 / ASTM C612 – Mineral Fibre Thermal Insulation for Buildings.
5. CAN/ULC-S704 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
6. CAN/ULC-S107 – Fire Test of Roof Covering.
7. ASTM E108/ANSI/UL 790–Standard Test Methods for Fire Tests of Roof Coverings.
8. CAN/CSA A123.21 – Dynamic Wind Uplift Resistance of Roof Membrane Systems.
9. CSA A231.1 / CSA A231.2 - Precast Concrete Paving Slabs.
10. CAN/CSA B149.1- Natural Gas and Propane Installation Code.
11. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
12. ASTM C1177- Glass Mat Gypsum Substrate for Use as Sheathing.
13. ASTM C1278 – Fiber Reinforced Gypsum Panels
14. Canadian Roofing Contractors Association (CRCA) – Specification Manual.



#### **1.4 Shop Drawings and Other Submittals**

1. Submit to *Consultant* for review, shop drawings, prior to commencement of work. Provide six (6) copies of the shop drawings. Indicate on shop drawings all insulation layers, slopes, crickets, insulation sumps and drainage patterns.
2. Submit Shop Drawings for: Tapered Insulation indicating on shop drawings all insulation layers, slopes, crickets, insulation sumps and drainage patterns.
3. Submit Shop Drawings for: Gas Line Supports and Roof Access Ladders, stamped by Professional Engineer licensed in province of Ontario.
4. **Submit Material List and Shop Drawings to *Consultant* for review prior to ordering materials and commencing Work.**
5. Construction Schedule: Submit required within 10 days of contract award.

#### **1.5 Quality Assurance**

1. Skilled trades and *Contractors* having a minimum of five (5) years related experience shall execute roofing Work.
2. *Contractors* shall be approved applicators of system specified. Documentation shall be provided prior to commencing Work.

#### **1.6 Roof System Compliance**

1. Roof system meets requirements of CAN/ULC-S107 "Fire Tests of Roof Coverings", Class A as listed in the ULC Directory.
2. Roof system is based on a 2-ply SBS Modified Bituminous Membrane System by Soprema Inc. IKO Industries is an acceptable alternate.
3. Alternatives from other manufacturers will be considered upon submittal and review of technical data sheets and fire resistance test results, and warranty specimen demonstrating product equality.

#### **1.7 Insulation Requirements**

1. Polyisocyanurate Roof Insulation Manufacturers shall be members of Polyisocyanurate Insulation Manufacturers Association (PIMA). Manufacturers shall submit documentation listing their LTTR values based on CAN/ULC and ASTM test methods for 2014.
2. When insulation thickness exceeds 69 mm (2.7 in.), it shall be installed in multiple layers. Minimum thickness for bottom layer shall be 33 mm (1.3 in.) and 38 mm (1.5 in.) for top layer.
3. In multiple layer applications, if thicknesses greater than 38 mm (1.5 in.) are required, thicker layer shall be installed in bottom followed by minimum 38 mm (1.5 in.) top layer.

4. Curing Time: Insulation shall be cured and delivered to site in accordance with Polyisocyanurate Insulation Manufacturers Association (PIMA).

### **1.8 Warranty**

1. Provide Standard Form of Warranty including all labour, material and workmanship and a Preventative Maintenance Manual.
2. Warranty shall be for a **period of two (2) years** from date of Substantial Performance, as certified by *Consultant*.
3. Provide **twenty (20) years with option for 25 years** roof membrane manufacturer's Warranty for labour, materials and workmanship with from date of Substantial Performance.
4. Repair leaks into building or roofing assembly within 24 hours of notification. Repair all roof membrane deficiencies, including ridges, blisters, splits and bare spots.
5. Carry out all repair work during warranty period as directed by *Consultant* and at no additional cost to *Owner*. *Contractor* shall extend Warranty on replaced parts and workmanship for a period of two (2) years from date of acceptance of replacement parts and workmanship.
6. Defects shall include but will not be limited to: leaking; failure to stay in place; lifting; blow off; deformation; and breaking of weathertight seals.

### **1.9 Delivery, Storage and Handling**

1. All materials shall be delivered, stored and handled in accordance with the Contract Documents, be in original manufacturer wrapping with labels intact and clearly identifying the product.
2. All modified bitumen membranes that will be used for installation on a daily basis must be stored at a minimum of 15°C (58°F) for a period of at least 4 hours prior to application. Stand rolled materials on end and protect edges.
3. Materials transported, stored or handled in a manner that contradicts Contract Documents, shall not be installed at the Place of the Work, shall be marked and removed from site.
4. Insulation, vapour retarders and roofing membranes must be kept dry under protective coverings or stored in trailers.
5. **Plastic wrapping installed at the factory is not to be used as an outside storage cover.** Emulsions must be maintained at temperatures above freezing.
6. Immediately remove and dispose of wet materials off site. Do not hoist materials with straps/ropes that damage materials. Use specialty supports.
7. Hoist material to roof surface on a daily basis, for same day use. **Do not 'drop' materials during handling and installation.**

### 1.10 Environmental Requirements

1. Do not install roofing when temperature remains below 0°F (-18°C) for torch applications and 23°F (-5°C) for asphalt applications.
2. Removal and installation of any roof components during inclement weather is not permitted.

### 1.11 Scaffolding, Ladders and Conveyances

1. Provide scaffolding, ladders and conveyances required for execution of Work and in accordance with the Contract Documents. Provide all hoisting equipment and barricades required to complete the Work.
2. Construct and maintain scaffolding in accordance with authorities having jurisdiction. If required, have scaffolding designed and stamped by Professional Engineer licensed in Province of Ontario.

### 1.12 Safety Barriers and Fire Protection

1. *Contractor* shall provide upstanding barrier protection at all perimeters, eaves and parapets. **Mesh, screen and tarpaulins shall also be provided to** prevent debris from blowing or falling over edge. Barriers shall be adequately constructed and secured to prevent toppling over.
2. Fire extinguishers must be on site within 3 m (10 ft.) and at same level as torch applicator. Maintain adequate fire watch (as recommended by membrane manufacturer) after each days roofing operations cease.
3. Torches must never be placed near combustible or flammable products. Torches should never be used where flame is not visible or cannot be easily controlled.
4. Never apply the torch directly to old and wood surfaces. Maintain adequate fire watch (as recommended by membrane manufacturer) during work and after each days roofing operations cease.
5. **Maintain minimum two (2) hour fire watch after torch applications have been completed.** Provide additional protection as required.
6. **Prior to leaving site, use digital thermometer to scan roof surface temperature for 'any hot spots' and address them accordingly.**

### 1.13 Protection

1. On a daily basis, provide interior protection to equipment, services, material, floors and walls by use of polyethylene or drop sheets, tape, tarps, plywood sheathing or other means to effectively protect contents.
2. Protect work of this section from damage. Damaged work which cannot be satisfactorily repaired, restored or cleaned shall be replaced at no cost to *Owner*.

3. Protect work of other sections from damage while performing roofing work. Provide tarpaulins and other coverings, as required, to protect lower and adjacent walls, finishes and surfaces. Additional protection shall be provided if instructed by *Consultant*.
4. Work is to be performed on occupied buildings. Take all reasonable precautions to protect against entry of elements and persons to unauthorized areas.
5. Prevent precipitation and debris entering openings and drains during work. Prevent damage to site, roads, curbs and building elements.
6. Protect finished roof surfaces with minimum 13 mm (1/2 in.) plywood sheathing with 25 mm (1 in.) polystyrene insulation board on underside.
7. Damaged areas and surfaces shall be repaired to satisfaction of *Consultant* at no additional cost to *Owner*.

#### **1.14 Temporary Facilities**

1. Provide temporary storage facilities for materials, tools and equipment. Location to be approved by *Owner*.
2. Provide temporary washroom facilities for workers. Secure portable washrooms to adjacent fences or walls to prevent toppling over.
3. Ground work stations shall be fully enclosed by temporary fencing and be manned at all times.
4. **Disposal bins shall be located minimum 2 m (6'-6") away from building walls.**

#### **1.15 Fastenings**

1. Fasteners, anchors and adhesives shall be of appropriate size and type and must be used in sufficient quantity to provide positive and permanent anchorage of component.
2. Fastenings which cause spalling or cracking of material to which anchorage is being made are not permitted. **Powder-actuated** fastening devices are not permitted on this project. Only low velocity plunger-type devices are permitted.

#### **1.16 Wiring Within Roof Assembly**

1. If electrical wiring is encountered within roof assembly, *Consultant* and *Owner* shall be contacted immediately.

### **Part 2 - PRODUCTS**

#### **2.1 Material**

1. Primer:
  1. Asphalt Cutback Primer

- 
2. Self-Adhesive Membrane Primer: Elastocol Stick by Soprema Inc.  
Approved equal: S.A.M. Adhesive by IKO Industries
  3. Modified Membrane Primer: Elastocol 500 by Soprema Inc. Approved equal by IKO Industries
  4. Metal Deck Primer: Rustguard Q.D. Shop Coat Primer by Devoe Coatings.
  2. Thermal Barrier: Fibreglass mat faced panel with a specially treated gypsum core that resists moisture. Minimum 13 mm (1/2") thickness. Accepted products:
    1. Dens-Deck Prime Roofboard by Georgia-Pacific
    2. Approved Alternate
  3. Mechanical Fasteners For Thermal Barrier and Base Layer Insulation:  
Factory Mutual (FM) Class 1, No.12 coated screws and 75 mm (3 in.) galvanized metal plate. Fasteners to be of sufficient length to penetrate through crests of metal deck 19 mm (3/4 in.).
  4. Vapour Retarder:
    1. On Metal Decks: Sopravap'r and Elastocol Stick Primer by Soprema Inc.  
Approved equal: M.V.P. and S.A.M. Adhesive by IKO Industries
    2. Concrete Decks: Elastophene SP 2.2 by Soprema Inc.  
Approved equal: Torchflex TF 95 –SF-Base by IKO Industries
  5. **Base Insulation:** 79 & 75 x 1220 x 1220 mm (3.1 in. & 3.0 in. x 4 ft. x 4 ft.), comprising of rigid closed cell polyisocyanurate foam core, bonded with **all fibre glass reinforced facer on each side**. Minimum long-term thermal resistance for 2014 material (LTTR) of RSI 1.00 (R 5.7) per 25 mm (1 in.) thickness. Provide 63 mm & 50 mm (2-1/2 in. & 2 in.) for 1220 x 1220 mm (48 x 48 in.) to create sump at drain.
    1. SOPRA-ISO by Soprema Inc.
    2. IKOTherm III by IKO Industries
    3. AC Foam III by Atlas Corporation Ltd.
    4. H-Shield by Hunter Panels

**Note: All polyisocyanurate insulation boards shall be provided by one manufacturer with same production dates and lot numbers and letter submitted regarding claimed R-values.**
  6. Insulation / Overlay Board Adhesive: A high elastomeric, two part component, one step low rise foamable adhesive that contains no solvents.
    1. Duotack by Soprema Inc.
    2. Millennium Adhesive by IKO Industries

7. Tapered Insulation, Crickets, Backslope and Sumps: Fabricated from rigid closed cell polyisocyanurate foam core, bonded with **all fibre glass reinforced facer on each side** to layouts and slopes (0.5%, 0.75%, 1.0%, 2.0% or 4.0%) as indicated on drawings. Minimum thickness 13 mm (1/2 in.). 1220 x 1220 mm (4 x 4 ft.).  
**Provide 2440 x 2440 (8 x 8 ft.) tapered sump at 1% at all drain locations)**

Acceptable Suppliers:

1. Accu-Plane Enterprises Inc.
2. Posi-Slope Enterprises Inc.
3. SOPRA-ISO Tapered by Soprema Inc.]\
4. IKOTherm III Tapered by IKO Industries

**Filler pieces shall not exceed 63 mm (2.5 in.) per layer and same as tapered.**

8. Overlay Board/Membrane Base Sheet: 27.6 x 914 x 4880 mm (91.09 in. x 3 ft. x 16 ft.) a high performance panel comprised of a non-woven polyester base sheet factory laminated to a high density mineral fibre insulation board, with thermofusible top surface.
1. 2-1 Soprasmart Rock by Soprema Inc.
  2. High density mineral wool fibre board and Modiflex MP-180-FS Base by IKO Industries installed on-site
9. Protection Board for Flashings: 6.4 x 1220 x 1524 mm (1/4 in. x 4 ft. x 5 ft.) semi-rigid protection board composed of a mineral fortified asphaltic core formed between two saturated fibreglass felts.
1. Sopraboard by Soprema Inc.
  2. Protectoboard by IKO Industries
10. Modified Bituminous Membrane Base Sheet Flashings:
1. Sopraply Flam Stick and Elastocol Stick Primer.  
Approved equal: Armourbond Flash HD and S.A.M. Adhesive by IKO Industries
  2. Sopralene Flam 180 by Soprema Inc. (Flanges, End Laps, Patching).  
Approved equal: Torchflex TP-180- FF Base by IKO Industries
11. Modified Bituminous Membrane Liquid Flashings: Polyurethane/bitumen resin 'Alsan Flash' and 152 mm (6 in.) wide fabric reinforcement by Soprema Inc. Approved Equal: MS Detail by IKO Industries
12. Modified Bituminous Membrane Cap Sheet and Cap Sheet Flashings: Sopralene Flam 250 FR GR by Soprema Inc. (Grey Colour). Approved Equal: Prevent TP HD Cap by IKO Industries

13. Mastic: Sopramastic by Soprema Inc. Approved equal: AquaBarrier Mastic by IKO Industries.
14. Pitch-Pans:
  1. Sopramasrtic Block and Sopramastic PF sealant by Soprema Inc.
  2. ChemCurb System by Chem Link, which shall include sealer and filler.
  3. Fabricated from 0.71 mm (24 gauge) stainless steel, 102 mm (4 in.) high with 152 mm (6 in.) wide flanges, all seams continuously soldered. Allow 52 mm (2 in) gap all around protrusion for pitch-pan filler.
15. Sopraguard Tape: Self-adhesive, flame-stop tape with glass mat reinforcement. Approved equal: Modiflex Roof Tapes by IKO Industries
16. Round Top Cap Nails: Ardox spiral shank with 25 mm (1 in.) steel washer
17. Bulk Granules: Coloured granules in bulk to match cap sheet.
18. Rough Carpentry: As per Section 06 10 00 – Rough Carpentry.
19. Metal Flashing: As per Section 07 62 00 – Sheet Metal Flashing and Trim.
20. Sealants: As per Section 07 92 00 – Joint Sealers.

## **2.2 Roofing Accessories**

1. New Roof Drain: refer to mechanical specified
2. Drain/Plumbing Couplings: 'Fernco Flexible Coupling', of appropriate size and type to suit site conditions by Fernco Connectors Ltd.
3. Vent (Soil) Pipe Sleeves: 1.6 mm (0.64 in.) thick, 75 or 102 mm (3 or 4 in.), one piece spun aluminum pre-insulated stack jack. To be minimum of 305 mm (12 in.) above finished roof surface. Diameter to suit site conditions. Acceptable Material:
  1. SJ-38 Insulated Stack Jack Flashing by Thaler Metal Industries Ltd.
4. Storm Collars and Clamps: Fabricated from same material as exhaust stacks and sleeves, with continuously soldered seams and extending a minimum of 52 mm (2 in.) down face of sleeve. Allow 6 mm (1/4 in.) gap between storm collar and sleeve.
5. Precast Concrete Pavers: 52 x 610 x 610 mm (2 x 24 x 24 in.) "Brooklin Roof Ballast" slabs with Built-In Pedslab Pedestal System", as manufactured by Brooklin Concrete Products Limited. Colour to be natural with standard diamond texture.
6. Paver / Gas Line Support Pedestals: 25 mm (1 in.) "Roofmate" as manufactured by Dow Chemical Canada Ltd. or Foamular 250 by Owens-Corning.

7. Sprayed polyurethane foam insulation: one component polyurethane foam insulating sealant.
  1. ENERFOAM by Abisko Manufacturing Inc.
  2. Duotack by Soprema Inc.
  3. Millennium Adhesive by IKO Industries
8. Mineral Batt Insulation: Rockwool Mineral Batt, of size and thickness to suit site requirements.
9. Aprons: Fabricated from 0.87 mm (0.034 in.) galvanized metal flashings to profile detailed.
10. Butyl Tape: 3 mm x 13 mm (1/8 x 1/2 in.) wide elastomeric butyl rubber.
11. Termination Bar: 3 mm x 25 mm (1/8 x 1 in.) 11 gauge extruded aluminum.

### **Part 3 - EXECUTION**

#### **1.1 Workmanship**

1. Do work in accordance with Canadian Roofing Contractors Association Roofing Specifications Manual (CRCA) and Manufacturer's requirements **except as specified within Contract Documents and to approval of Consultant.**
2. More stringent requirements shall govern.

#### **1.2 Examination and Preparation**

1. Examine site conditions and surfaces to ensure that they are in satisfactory condition for the commencement of Work of this section.
2. Ensure that substrates are smooth, clean and dry. Clean surfaces of all substances, which may be detrimental to new roof system. Clean adhesives with solvent and allow vapours to dissipate prior to membrane application.
3. Application of the Work, or any part of it will constitute acceptance of conditions upon which work is to proceed.

#### **1.3 General Requirements**

1. Complete new roof system, including vapour retarder, insulations and membrane and membrane flashings to each day's termination point and install temporary water cut-off. Remove water cut-off when work resumes.
2. No materials will be installed during inclement weather, rain or snowfall.
3. **Phased construction is not acceptable.**



#### 1.4 Primer

1. All surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.
2. Apply primer to curbs, wall, wood and metal at a minimum rate of 0.2 to 0.3 litres/m<sup>2</sup> (0.5-0.75 gal / 100 sq. ft.) with roller or spray. Do not allow primer to puddle.
3. Prevent primer from entering building interior through openings and joints in metal decks, by installing self-adhesive membrane at roof perimeters, walls, curbs and other roof openings.
4. Allow primer to cure prior to application of new roofing membrane or membrane flashings as detailed. Do not accelerate drying time by use of flame.
5. Self-adhesive membranes must be applied same day as primer.

#### 1.5 Thermal Barrier (Canopies Only)

1. Apply thermal barrier in urethane adhesive. Use designed applicator and apply Duotack at 20 mm (3/4 in.) wide ribbons at 305 mm (12 in.) on centre in field of roof and at 150 mm (6 in.) for 2440 mm (8 ft. perimeters) and at 100 mm, (4 in.) at 3050 mm (10 ft.) corners.
2. Thermal barrier shall be immediately placed into adhesive bead before a film (skin) starts to form on the adhesive bead. Install new thermal barrier panels with sides and ends supported by deck flutes and with panels placed together with moderate contact. Cut boards cleanly, avoid breaking boards to conform to roof layout.
3. Stagger end joints of adjacent rows of boards. Use largest pieces possible but no piece shall be smaller than 305mm x 305mm (12 in. x 1 in.). Fill in voids larger than 6 mm (1/4 in.) with spray foam or batt insulation.

#### 1.6 Vapour Retarder

1. At all roof perimeters, walls, curbs, dividers, movement and control joints and penetrations, **provide 200 mm (8 in.) self-adhesive reinforcing vapour retarder to seal openings/gaps at junction of wall and deck, to prevent primer/asphalt seepage into building.**
2. **Roll out vapour retarder on clean and fully primed surface.** Peel back first 1000 mm (3 ft.) of release paper and adhere vapour retarder in place. Hold vapour retarder tight and peel off remaining release film diagonally.
3. Apply additional rolls in similar fashion and maintain 75 mm (3 in.) side laps and 150 mm (6 in.) end laps. **Side laps shall bear on solid wood or crest of deck.** Roll vapour retarder onto deck and ensure all laps are sealed.
4. Seal vapour retarder to all penetrations by use of self-adhesive vapour retarder for all occasions. Prime surfaces as required.

5. **Vapour retarder shall provide a continuous and watertight seal if being used as a temporary roof.**

### 1.7 Base Insulation

1. Install first layer of base insulation over vapour retarder and mechanically secure into substrate to Factory Mutual FM 1-90 requirement layout pattern of five (5) fasteners per 1220 x 1220 mm (4 x 4 ft.) board, as per layout on drawing. Maintain fasteners a minimum of 150 to 305mm (6 to 12 in.) from all perimeters and corners. Provide 50% more fasteners for 2440 mm (8 ft.) perimeters and 75% more at corners for 3660 mm (12 ft.) each way.
2. Ensure fasteners adequately engage and penetrate crest of metal deck 19 mm (3/4 in.) or embedded into wood deck 25 mm (1 in.). Fasteners that do not engage the substrate, shall be removed and re-installed. **Do not overdrive or underdrive fasteners.**
3. Apply second and subsequent layers of insulation in urethane adhesive. Use designed applicator and apply Duotack at 20 mm (3/4 in.) wide ribbons at 305 mm (12 in.) on centre in field of roof and at 150 mm (6 in.) for 2440 mm (8 ft. perimeters) and at 100 mm, (4 in.) at 3050 mm (10 ft.) corners.
4. Insulation shall be immediately placed into adhesive bead before a film (skin) starts to form on adhesive bead.
5. **Stagger all joints in insulation boards within each adjacent layer and between lower and upper layers. Walk insulation into low rise adhesive to achieve solid bond, immediately after placement.**
6. Score and cut boards as required at all undulations in substrate to allow for full contact and walk in place to ensure full adhesion. At junction with wood blocking at parapets, walls and curbs, neatly trim insulation to suit profile of wood assembly and to provide a tight/butt joint.
7. Base insulation shall be reduced 13 mm (1/2 in.) for 1220 mm (4 ft.) centred at drain sump as noted on drawings. Transition shall be 'shaved' to provide a smooth surface for tapered insulation or overlay board.
8. Install insulation boards ensuring panels are tightly butted and end joints between panels are staggered 610 mm (24 in.), each way.
9. Cut insulation boards to fit snugly at all perimeters, roof openings, etc., but not oversized to damage the vapour barrier during installation.
10. Do not lay more insulation boards than can be covered with roof membrane base sheet on same day. Insulation, which is damaged by moisture, shall be marked and promptly removed from site.

### 1.8 Tapered Insulation

1. Tapered insulation shall be applied over base insulation and under overlay board.

2. Install tapered insulation, sumps, crickets and backslope in low rise foam adhesive. Use designed applicator and apply adhesive at 20 mm (3/4 in.) wide ribbons at 305 mm (12 in.) on centre in field of roof and at 150 mm (6 in.) for 2440 mm (8 ft.) perimeters and at 100 mm (4 in.) at 3050 mm (10 ft.) corners.
3. Insulation shall be immediately placed into adhesive bead before a film (skin) starts to form on the adhesive bead.
4. **Tapered sump shall be installed in its entirety same day.** Under no circumstance shall sump be installed in more than one application as to build-in a high point within sump area.
5. Install insulation ensuring panels are tightly butted and walk insulation low rise foam adhesive to achieve solid bond, immediately after placement.
6. Do not lay more insulation than can be covered with base sheet / overlay board on same day.

#### **1.9 Overlay Board / Membrane Base Sheet**

1. Top layer of base insulation shall be free of rust, dust or any residue that may hinder adherence of the base sheet / overlay board.
2. Apply overlay board in urethane adhesive. Use designed applicator and apply Duotack at 20 mm (3/4 in.) wide ribbons at 305 mm (12 in.) on centre in field of roof and at 150 mm (6 in.) for 2440 mm (8 ft. perimeters) and at 100 mm, (4 in.) at 3050 mm (10 ft.) corners.
3. Allow adhesive to slightly rise and then embed insulation into place and weigh down till good adhesion is attained.
4. Stagger side and end joints to adjacent boards and to underlying insulation joints. Immediately after placement, walk boards into adhesive to achieve solid bond.
5. Gradually peel back silicone release paper at laps, pressing down on membrane with an aluminum applicator to ensure good contact and adhesion. Heat weld exterior 25 mm (1 in.) edge of side lap with a hot-air gun or torch flame.
6. Where there is no factory lap, seal butt ends with a minimum 150 mm (6 in.) torch grade membrane base sheet centred over the lap to provide a watertight seal.
7. Roll side and end laps to ensure adequate adhesion in the self-adhesive laps of membrane. Laps shall be installed to shed water, commencing from low point and working upslope.
8. Do not lay more boards than can be covered with roof membrane base sheet on same day. Boards that are damaged shall be marked and promptly removed from site.

### **1.10 Protection Board on Perimeter Flashings, Mechanical Curbs, Sleepers, etc.**

1. Install protection board in adhesive and mechanically fasten to substrate.

### **1.11 Roof Membrane Base Sheet Flashings**

#### **General Application Guidelines**

1. Torch off poly of underlying membrane base sheet prior to primer application.
2. Apply appropriate primer to surfaces that are to receive membrane flashings at rates recommended by manufacturer. Allow primer to 'flash off' prior to membrane flashing application.
3. Apply membrane base sheet flashings in general conformance with details commencing from low point and working up-slope. Maintain minimum 75 mm (3 in.) side and 150 mm (6 in.) end laps. Laps shall be installed to shed water. Side laps shall be staggered minimum 305 mm (12 in.) from underlying membrane base sheet laps.
4. Apply base sheet in maximum 1 m (3.25 ft.) wide strips. Extending minimum of 150mm (6 in.) beyond toe of cant (or vertical transition) and onto field of roof.
5. At wall and curbs, provide mechanical fasteners within laps of base sheet flashing, prior to applying succeeding sheet. Fasteners shall be installed at maximum 100 mm (4 in.) on centre commencing from 200 mm (8 in.) above roof membrane.
6. Extend modified bituminous base sheet over parapet, perimeter and eaves down outside face of walls 38 mm (1 ½ in.) onto lower substrate. Secure membrane flashing with large head galvanized nails at 150 mm (6 in.) on centre.
7. At exterior face of parapets / perimeters, apply self-adhesive base sheet flashing, to provide continuous cover over exposed wood and joints between substrates as detailed. Overlap self-adhesive base sheet under overhang of membrane base/cap sheet flashings at top edge of parapets / perimeters.
8. Repair defects in applications with additional piece of self-adhesive base sheet. Carry out repairs to satisfaction of *Consultant*.

#### **Torching Applications**

9. **Fully torch base sheet flashing to underlying membrane base sheet.** Provide 3 mm (1/8 in.) 'bitumen bleed-out' at all side and end laps.

#### **Self-Adhesive Applications**

10. Apply self-adhesive base sheet flashing onto primed surfaces and roll into place with adequate pressure to ensure full contact and adhesion with substrate. Membrane must be rolled into place using manufacturer's approved roller.
11. Peel back 100 to 150 mm (4 to 6 in.) of silicone release paper to hold membrane in

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place. Gradually peel back remaining silicone release paper, pressing down on membrane with an aluminum applicator to ensure good contact/adhesion.

12. Heat weld exterior 25 mm (1 in.) of all side and end laps providing a 3 mm (1/8 in.) bitumen bleed out.
13. Thoroughly and effectively roll membrane (using manufacturer's recommended steel roller) to attain full contact and adhesion.

### **1.12 Reinforcement Gussets**

1. Apply gussets at every angle, on inside and outside corners in accordance with manufacturer's requirements.
2. Install self-adhesive or thermofusible gussets before application of membrane base sheet flashing,
3. Install self-adhesive or thermofusible gussets over base sheet flashing and before application of membrane cap sheet flashing.

### **1.13 Roof Membrane Cap Sheet**

1. Base sheet application shall be reviewed by manufacturer and *Consultant* prior to proceeding with membrane cap sheet.
2. Apply membrane cap sheet commencing from centre of drain or low end and working upslope. **Fully torch cap sheet** to base sheet and extend to edge of perimeter, after base sheet flashing has been completed.
3. Provide 3 mm (1/8 in.) 'bitumen bleed-out' at all side and end laps. Maintain minimum 75 mm (3 in.) side and 152 mm (6 in.) end laps. Laps shall be installed to shed water.
4. Maintain minimum 50% stagger from base sheet. Use chalklines to maintain neat and straight lines. Do not walk on or step into newly applied membrane.
5. Apply loose granules in areas where excess heat welding has occurred. Apply heat to affected area, place granules and embed them into warm membrane.
6. Apply membrane cap sheet without voids, wrinkles, buckles, fishmouths or any evidence of a lack of full adhesion. Repair defects to satisfaction of *Consultant*.

### **1.14 Roof Membrane Cap Sheet Flashings**

1. Apply membrane cap sheet flashings in general conformance with details commencing from low point and working up-slope.
2. Membrane base sheets/flashings with a poly on top face shall have poly burned off prior to applying cap sheet flashings. Maintain minimum 50% stagger from base sheet flashing. Use chalklines to maintain neat and straight lines. Do not walk on or step into newly applied membrane.
3. Fully torch modified bituminous cap sheet flashing to attain full bond.

4. Terminate cap sheet 13 mm (1/2 in.) back from outside edge of parapet blocking and past base sheet flashing 52 mm (2 in) onto flat of roof.
5. Provide 3 mm (1/8 in.) bleed out at all side laps. Maintain minimum 75 mm (3 in.) side and 152 mm (6 in.) end laps. Laps shall be installed to shed water.
6. At wall terminations, install and secure termination bar to adequately restrain the flashings. Secure termination bar at maximum 305 mm (12 in.) on centre. Apply sealant bead along entire length of termination bar.
7. Repair defects in applications with additional piece of torch grade base sheet. Carry out repairs to satisfaction of *Consultant*.

### 1.15 Drains

1. Cut opening through membrane base sheet, insulation, thermal barrier, vapour retarder and centre drain over pipe. Apply mastic on underside of flange.
2. Insert drain body into new drain pipe until flange is flush with roof membrane. Secure new drains with mechanical (MJ) connection and underside with deck clamp.
3. **Note: Overlay board to be completely cut-out under drain flange.**
4. Flash drain flange with one ply of torch grade base sheet. Extend membrane a minimum of 305 mm (12 in.) beyond the edge of drain flange. Membrane cap sheet to be extended continuously through drain area.
5. Install clamping ring, control flow and aluminum strainer over raised bosses and install screws to tighten ring against membrane and flashings until secure.
6. Ensure roof drains are clear of debris and free draining at project completion.

### 1.16 Sleeves

1. Provide all required vents, stacks and conduit sleeves and supports to suit site conditions.
2. At existing vent pipes, extend pipe with same material to 25 mm (1 in.) above top edge of sleeve. At existing exhaust stacks, extend pipe as required to allow for rain collar installation.
3. Prime stack flanges, top and bottom and set underside of flange in bed of mastic on membrane and position evenly around projection. Flash in flanges with one ply of torch grade base sheet. Extend membrane a minimum of 305 mm (12 in.) beyond the edge of drain flange.
4. Where stacks are installed on top of curbs, entire 'boxed curb' shall be covered with adequately secured overlay board and completely covered with torch grade membrane base sheet and cap sheet.

### **1.17 Parapets/Perimeters/Walls/Sleepers/Curbs**

1. At mechanical units, provide new wood sleepers as detailed that extend over minimum 3 joist supports to maximum length required to support units or match existing. Butt new insulation to sleepers by neatly cutting perimeter to fit profile of sleeper.
2. Provide 2-ply membrane flashings over all sleepers to fully encapsulate wood and in accordance with this section.
3. Construct parapet, perimeters, wall and curbs as detailed with new wood members constructed in accordance with Section 06 10 00 – Rough Carpentry.
4. Provide 2-ply membrane flashings at all noted locations in accordance with this section and as detailed.
5. Provide metal cap flashings at sleepers and curbs prior to re-installing units.

### **1.18 Dividers/Movement/Control Joints**

1. At all roof dividers, movement and control joints, construct as detailed with new wood members and frame in accordance with Section 06 10 00 – Rough Carpentry.
2. Provide 2-ply membrane flashings at all noted locations in accordance with this section and as detailed.

### **1.19 Overflow Scuppers**

1. Where indicated on drawings, install new scuppers and secure to substrate.
2. Flash in scupper flanges with one-ply of self-adhesive base and one ply torch grade cap sheet.

### **1.20 Storm Collars**

1. Install storm collars complete with clamping ring and sealant over stacks where caps cannot be installed.

### **1.21 Electrical/Mechanical and Gas Line Penetrations**

1. At pipe/conduit penetrations, provide prefabricated pitch-pan system, adhesive and mastic or insulated sleeve. Provide minimum 25 mm (1 in.) gap between penetration and inner face of pitch-pan.
2. Clean and seal the base of the penetration top the membrane and extend minimum 25 mm (1 in.) above the pitch-pan.
3. Adhere pitch-pan system to roof membrane with a continuous 6 mm (1/4 in.) sealant bead on underside of pitch-pan and all end joints. Embed onto membrane and press

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in place until sealant overflows from all sides. Apply continuous sealant bead at exterior face of all end joints and at junction of pitch-pan to membrane

4. Completely fill pitch-pan with required pourable sealer/mastic, with high point in the middle and sloped to exterior edge to adequately drain moisture over perimeter.

### **1.22 Precast Pavers**

1. Install new precast paver to required layout. Saw cut to fit at corners/walls or core hole where required to fit penetrations and field dimensions. No piece shall be smaller than 152 mm (6 in.) x 610 mm (2 ft.).
2. Set pavers on pedestals and adequately balance pavers so that 'rocking' does not occur. Pedestal shall be minimum 152 mm (6 in.) wide by 305 mm (12 in.) long. Maintain continuous drainage under all pavers.

### **1.23 Pitch – Pan Pockets**

1. New pitch-pan pockets are to be provided at penetrations where specified sleeves are not suitable. All surfaces shall be clean dry and free from all deleterious material. Galvanized metal penetrations and painted metal must be prepared using a grinding machine to bare metal. PVC pipe must be sanded with sandpaper.
2. All metal surfaces and the pitch-pan pocket must be cleaned with non-greasy solvent such as acetone or Methyl Ethyl Ketone (MEK). Place pitch-pan pocket at desired location and mark outside edge for reference. Pitch pocket shall be placed with minimum 25 mm (1 in) clearance from inside of pitch pocket and penetration.
3. Seal base of penetration with sealant to prevent potential of mastic flowing through openings. Apply sealant over entire granulated surface of membrane where pitch pocket will be installed, to avoid any water infiltration between pitch pocket and membrane.
4. Position pitch-pan pocket and apply a liberal bead of sealant at outside perimeter of pitch pocket. Use the tip of a trowel to adhere sealant to the membrane. Dispense an initial amount of mastic (equivalent to half of the nozzle), outside of the pitch pocket, to assure a homogeneous mixture of parts A and B.
5. Fill assembled pitch pocket with mastic until full, with a high point at middle and tapered to outside edge to allow for water flow over pitch-pocket.

### **1.24 Mechanical Equipment**

1. *Contractor* shall be responsible to remove and re-install roof mounted mechanical equipment and services necessary to facilitate application of new roof system. This includes temporary removal and replacement of all associated ductwork. Do not disconnect H.V.A.C. without approval of *Owner*.
2. Mechanical pipes and gas lines must be disconnected and sufficiently supported. Use treated wood blocks located on concrete pavers resting on top of pedestals to temporarily support equipment.



3. During roof replacement operations, all H.V.A.C. ducts are to be adequately supported. Temporary removal of gas piping is responsibility of *Contractor* and must be re-installed in accordance with applicable regulations and authorities having jurisdiction.
4. *Contractor* must provide for adjustments to ducting, duct supports and piping to suit new roof elevations and new mesh and mastic repairs to match existing duct coatings.
5. At wall junctions, ductwork is to be sealed with transition membranes that are secured to wall with termination bar or metal flashings and provide a watertight junction.
6. Submit certificate from licensed mechanical contractor stating that all modifications/connections comply with Building Automation System and that it is fully functional.

#### **1.25 Electrical Equipment**

1. *Contractor* must disconnect all wiring and junction boxes required to facilitate installation of new roof system. Prior to disconnecting electrical systems, obtain approval from *Consultant* or *Owner*. Provide minimum 48 hours' notice for clearance.
2. Submit certificate from licensed electrical contractor stating the all modifications/connections comply with the Electrical Safety Authority (ESA).

#### **1.26 Quality Control**

1. *Owner* may retain an independent *Consultant* to carry out periodic supervision during construction.
2. If requested by *Consultant*, take cut-test samples of roofing membrane and membrane flashings, wrap and label samples, identify locations and submit to *Consultant* for review and testing.
3. *Contractor* shall make an allowance for **minimum of one cut test per day** and all required patching to match existing assembly. Samples must be a minimum 305 x 305 mm (12 x 12 in.) and include all new roof components including asphalt pour and gravel. Failed test results will require remedial work acceptable to *Consultant* and may entail complete removal and replacement of failed areas.

#### **1.27 Clean-up**

1. Remove all excess materials, debris, tools and equipment as work proceeds and on completion, or sooner if requested by *Consultant*. Remove all stains, asphalt, caulking or other adhesive from all surfaces.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work**

- |  |                              |
|--|------------------------------|
| 1. Metal Decking:                        | refer to structural drawings |
| 2. Rough Carpentry:                      | Section 06100                |
| 3. Masonry:                              | Section 04200                |
| 4. Air Vapour Barrier Membrane:          | Section 07112                |
| 5. Modified Bituminous Membrane Roofing: | Section 07520                |
| 6. Building Insulation                   | Section 07212                |

### **1.2 Design Criteria**

1. Design metal siding system to provide for thermal movement of component materials caused by ambient temperature range of 100 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
2. Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
3. Design members to withstand dead load and wind loads calculated in accordance with NBC and applicable local regulations, to maximum allowable deflection of /180th of span.
4. Provide all necessary interior reinforcing girts to withstand all loads as described in item .3.
5. Design wall system to accommodate specified erection tolerances of structure.
6. Maintain following installation tolerances:
  - .1 Maximum variation from plane or location shown on approved shop drawings: 10mm/10m of length and up to 20mm/100m.
  - .2 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75mm.

### **1.3 Samples**

1. Submit duplicate 300 x 300 mm samples of each siding wall system, representative of materials, finishes and colors, in accordance with Section 01340.

### **1.4 Shop Drawings**

1. Submit shop drawings in accordance with Section 01340.
2. Indicate arrangement of sheets and joints, types and locations of fasteners and special shapes and relationship of panels to structural support members or support wall.
3. Clearly detail and indicate locations of all Z clips, J-closures and edge trims.
4. Describe in shop drawing details, suitable accommodation for the removal and joining of future cladding as described in 1.2.7 of this section and on drawings.

### **1.5 Acceptable Manufacturers**

1. Peerless Enterprises or VicWest Steel Inc., Flynn or Agway Metals Inc.

### **1.6 Extended Warranty**

1. Submit a warranty for metal siding system, covering materials and labour and the repair or replacement of defective work, but for five (5) years total.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. Prepainted Steel: Galvanized sheet steel minimum 0.76 mm (22 ga) thickness, complying with ASTM A526-80 with Z275 designation for zinc coating. Prepainted in Signature Series WXL Colour: selection by Architect.
2. A) Soffit profile VicWest Steel AD300R: locations as per drawings.  
B) Metal Roofing Profile VicWest Steel: Prestige 16 PR16 with square rib seam lock profile and colour to match existing.
3. For copings and flashings, provide prefinished metal 24 gauge thickness, colour from standard colour selection group.
4. Screws: to CSA B35.3-1962, head color same as exterior sheet, dished to CSA B35.3-1962.
5. Powder actuated fasteners: galvanized, peened ballistic point, plastic cap of same color as exterior sheet.
6. Sealants: in accordance with Section 07900, paragraph 2.1.4, colour selected by Architect. Allow for one (1) colour from manufacturers full range to match adjacent metal.
7. Gaskets: soft pliable arctic grade vinyl, extruded profile.

8. Touch-up paint: as recommended by panel manufacturer and Baycoat, compatible with prefinished coating.
9. Isolation coating: alkali resistant bituminous paint or epoxy resin solution.
10. Insulation: Semi-rigid. Fiberglass AF 530.

## **2.2 Components**

1. Exterior sheet: factory preformed coated metal, to profiles and thicknesses as indicated.
2. Exterior corners: of same profile, material and finish as adjacent siding material, shop cut and brake formed to required angle, concealed corner brace, hairline exposed joint, pop rivet connections with painted head to match siding.
3. Exposed joint ends of siding sheet shop cut clean and square, backed with tight fitting filler lapping back if joint, exposed components color matched to siding.
4. Accessories: cap flashings, drip flashings, internal corner flashings, copings and closures for head, jamb, eaves, soffits sill and corners, of same material and finish as exterior siding, brake formed to shape. Exposed cut edges of metal profiles will not be accepted.
5. Sub-girts: zinc coated to ASTM A525-78a, G90 coating designation, profile as indicated to accept exterior sheet with structural attachment to building frame.

## **PART 3 - EXECUTION**

### **3.1 Preparation**

1. Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

### **3.2 Installation**

1. Install sub-girts to masonry walls through air vapour barrier membrane.
2. Install exterior finish siding to internal sub-girts with concealed fasteners.
3. Install insulation using adhesive and ensure a continuous thermal barrier.
4. Provide notched and formed closures, sealed to arrest direct weather penetration at vertical profiles for exterior siding. Ensure continuity of "pressure equalization" of rain screen principle.
5. Provide alignment bars, brackets, clips, inserts, shims as required to securely and permanently fasten wall system to building structure.

6. Supply and install flashing at connection between roof and preformed metal siding.

### **3.3 Control Joints**

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

### **3.4 Cleaning**

1. Wash down exposed surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths.
2. Remove excess sealant with recommended solvent.

End of Section

## **PART 1 - GENERAL**

### **1.1 Section Includes**

1. This Section includes for provision of all labour, materials, equipment and services for sheet metal flashing and trim Work in accordance with Contract Documents.

### **1.2 Related Sections**

1. Section 06110                      Rough Carpentry for Roofing
2. Section 07520                      SBS Modified Bituminous Membrane Roofing
3. Section 07901                      Joint Sealers for Roofing

### **1.3 References**

1. ASTM A653M- Sheet Steel, Zinc Coated (Galvanized) by the Hot Dipped Process, General Requirements.
2. CAN/CGSB 37-GP-9M / ASTM D41- Asphalt Primer.
3. Canadian Sheet Steel Building Institute (CSSBI) Bulletin No. SSF-3, Core and Maintenance of Pre-finished Sheet Steel Building Products.
4. Canadian Roofing Contractors Specification Manual- 'FL' Series Details.
5. SMACNA Architectural Sheet Metal Quality Assurance Manual - 2015

### **1.4 Operations**

1. Perform operations, at times designated by the *Owner*, that will not adversely affect occupants of building and operations in and around site access and egress.

### **1.5 Protection**

1. Protect work of this section from damage. Damaged work which cannot be satisfactorily repaired, restored or cleaned, shall be replaced at no cost to *Owner*.

### **1.6 Submittals**

1. Submit samples of flashing and sheet metal type and colour to *Consultant* and *Owner* for review prior to commencing work.

### **1.7 Mock-Up**

1. Locate mock-ups at specific areas designated by *Consultant*.
2. Fabricate mock-ups in minimum 2440 mm (8 ft.) lengths with reviewed materials, approved methods including, joints, seams, expansion joints, starter strips and fasteners.

3. Mock-up, if accepted, shall represent the minimum standard for work. Mock-up may be included as part of final work.

### **1.8 Quality Assurance**

1. Flashing and Sheet Metal Work shall be executed in accordance with SMACNA Architectural Sheet Metal Quality Assurance Manual - 2015 by skilled trades having a minimum of five (5) years related experience.

### **1.9 Warranty**

1. Provide minimum two (2) year Warranty from date of Substantial Performance, as certified by *Consultant*. Warranty shall be submitted against defects in workmanship and materials.
2. *Contractor* must extend the Warranty on replaced parts and workmanship for a period of two (2) years from date of acceptance of replacement parts and workmanship. Defects will include but will not be limited to leaking, failure to stay in place, lifting, deformation and breaking of weathertight seals.
3. Provide all additional Warranties that may be available from manufacturer.

## **Part 2 - PRODUCTS**

### **2.1 Material**

1. Prefinished Steel Sheet: Galvanized steel, 0.71 mm (24 gauge) core nominal thickness, zinc coated (galvanized) to designation G90 by the hot dip process, with a prefinished coat. Profiles as detailed.
2. Pre-finished Coat and Primer: 8,000 series finish, factory applied coating on high grade primer. Colour to be approved by Consultant/Owner selected from standard colours listed in General Colour Card.
3. Starter (Hook) Strips: Fabricated from prefinished steel sheet, 0.87 mm (22 gauge) core nominal thickness. Minimum 100 mm (4 in.) wide face **or as detailed** and shall extend onto wall substrate minimum 38 mm (1-1/2 in.) and be continuous.
4. Termination Bar: 3 mm x 25 mm (1/8 x 1 in.) extruded aluminum bar.
5. Fasteners: In accordance with Section 06 10 00 – Rough Carpentry.
6. Touch-up paint: As supplied and recommended by sheet steel manufacturer.
7. Exposed Sheet Metal Fasteners: Self-Drilling Hex Head with washer and colour coded cap.
8. Cap, Counter and Fascia Metal to be fabricated to layouts and details shown on drawings and to extent required.

9. Overflow Scuppers: Overflow (Where Shown on Drawings): Fabricated from 0.71 mm (24 gauge) stainless steel. To be a minimum 203 mm wide x 104 mm high (8 x 4 in.) with continuously soldered seams with a 152 mm (6 in.) wide apron/flanges. Bottom edge to extend 38 mm (1-1/2 in.) past wall and top edge 25 mm (1 in.) with open end.
10. Sealants: In accordance with Section 07 92 00 – Joint Sealer.

### **Part 3 - EXECUTION**

#### **3.1 Fabrication**

1. Shop fabricate flashing, sheet metal and trim in accordance with requirements of SMACNA and the Contract Documents. Form sheet metal on bending brake, shaping, trimming and hand seaming on bench.
2. Fabricate cap flashings, counter flashings, closures, starter strips, and other miscellaneous sheet metal work with prefinished sheet metal in general accordance with applicable CRCA 'FL' series specifications and / or as indicated on Drawings.
3. Form sections square, true, and accurate to size. Flashings shall be free from distortion, oil canning, twists, buckles, discolouration and other defects detrimental to appearance and performance.
4. Double back all edges a minimum of 13 mm (1/2 in.).
5. Form joints with S-locks and make allowances for movement. Mitre and form standing seams at all corners. Make allowance for movement at joints.
6. Provide a counter flashing and an intermediate vertical flashing where the cap flashing is greater than 610 mm (24") above the top of the roofing membrane. Form vertical flashings in 1220 mm (4 ft.) maximum lengths.
7. Fabricate cap flashings, counter flashings and starter strips to details shown and where required.
8. Fabricate metal in 2400 mm (8 ft.) maximum lengths with an unbroken face less than 225 mm (9 in.). Form flashings with an exposed unbroken face exceeding 225 mm (9 in.) and a girth greater than 610 mm (24 in.) in 1220 mm (4 ft.) maximum lengths.
9. **Provide horizontal stiffening rib "V" on all face metal exceeding 225 mm (9 in.) in girth and where shown on drawings.**
10. Provide an 'S-Lock' joint at all end joints and at all horizontal joints between the cap flashing and the vertical flashing and between the vertical flashing and base counter flashing.



11. Where soldered joints are absolutely necessary and where approved for use in prepainted metal, clean paint off both surfaces before soldering for minimum area necessary.
12. Sheet metal coming in contact with a metal of a different type must be back painted with two (2) coats of isolation coating.

### **3.2 Sheet Metal Flashing and Trim**

1. Provide a continuous starter strip for all metal cap and counter flashings and gravel stops secured at a maximum 406 mm (16 in.) on centre in a zig-zag-pattern.
2. Install flashings and sheet metal that includes but not limited to; cap flashings, counter flashings, curb and sleeper counter flashings, starter strips and other miscellaneous trim work in accordance with Contract Documents.
3. Parapet and perimeter cap flashings shall be installed with a **minimum 10% positive slope** to interior of roof. Slope to be provided by installation of continuous wood shims, plywood and wood blockings as detailed and in accordance with Section 06 10 00 – Rough Carpentry.
4. Saw cut new reglet or re-use existing (where approved by *Consultant*), into masonry surfaces to accommodate installation of sheet metal flashings. Reglet is to be a minimum 19 mm wide x 25 mm deep (3/4 in. x 1 in.).
5. Install sheet metal work with concealed fasteners. Install exposed fasteners only when and where permitted by *Consultant*. Install fasteners in an approved manner as to prevent water penetration at point of fastening and to be evenly and neatly distributed. Provide fasteners with washers.
6. At reglets, return top edge of flashings into reglet 25 mm (1 in.). Secure flashings with pin grips, spaced at maximum 406 mm (16 in.) on centre and apply sealant bead to shed water.
7. Provide continuous termination bar at top edge of membrane flashings where indicated on Drawings and at locations where membrane flashings terminate at base of a wall and no other means of mechanical securement is specified or indicated. Fasten termination bar to substrate at a maximum 305 mm (12 in.) on centre with appropriate fasteners.
8. Fasteners are to be located a minimum of 305 mm (12 in.) above roof membrane – where possible.
9. End joints of adjacent lengths shall be completed using 'S-Lock' joints. This shall be accomplished by inserting the end of one length in a 25 mm (1 in.) deep "S" lock formed in the end of the adjacent length. Concealed portion of the "S" lock shall extend 25 mm (1 in.) outwards and shall be nailed to substrate. Face nailing of joints will not be permitted.
10. Top edge of counter flashing shall be inserted under cap flashings.

11. Provide three exposed fasteners on interior side of cap flashing, evenly spaced per 2400 mm (8 ft.) length.

### **3.3 Overflow Scuppers**

1. Where indicated on drawings, install new scuppers and secure to substrate.
2. Flash in scupper flanges in accordance with appropriate roof section.

### **3.4 Clean-up**

1. Remove all excess materials, debris, tools and equipment as work proceeds and on completion, or sooner if requested by *Consultant*.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work Specified Elsewhere**

1. Caulking in connection with roof flashing: Section 07901
2. Caulking between members of aluminum windows: Section 08520

### **1.2 Environmental Conditions**

1. Sealant and substrata materials to be minimum 5 deg. C.
2. Should it become necessary to apply sealants below 5 deg. C, consult sealant manufacturer and follow their recommendations.

### **1.3 Warranty**

1. Contractor hereby warrants that caulking work will not leak, crack, crumble, melt, shrink, run lose adhesion or stain adjacent surfaces in accordance with General Conditions, but for five (5) years total.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. Primers: type recommended by sealant manufacturer.
2. Joint Fillers:
  - .1 General: compatible with primers and sealants, oversized 30 to 50%.
  - .2 Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20, tensile strength 140 to 200 kPa.
  - .3 Neoprene or butyl rubber: round solid rod, Shore A hardness 70.
  - .4 Polyvinyl chloride or neoprene: extruded tubing with 6 mm minimum thick walls.
  - .5 Bond breaker: pressure sensitive plastic tape which will not bond to sealants.
  - .6 Sealant Type A: One component, chemical curing, conforming to CAN2-19.13-M82, Class C-2-25-B-N; multi-component, chemical curing, conforming to CAN2-19.24-M80, Type 2, Class B.
  - .7 Sealant Type B: Multi-component, chemical curing mildew resistant conforming to CGSB 19-GP-22M.
  - .8 Sealant type C: Multi-component, acrylic emulsion base, conforming to CGSB 19-GP-17M.
  - .9 Sealant type D: One component, polyurethane base, chemical curing, conforming to CAN2-19.13-M82, Class C-1-25-B-N; or multi-component, chemical curing, conforming to CAN2-19.24-M80, type 1.
3. Color of Sealants: to be selected by Consultant. Allow for a total of three (3) colours for Type A, two colours for Type B, two colours for Type C and one colour for Type D. Locations as directed on site by Consultant.

4. Joint cleaner: xylol, methylethyl-ketone or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.
5. Vent tubing: 6 mm inside diameter extruded polyvinyl chloride tubing.

### **PART 3 - EXECUTION**

#### **3.1 New Work**

1. Caulk where specified in 3.4 and everywhere required.
2. Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.
3. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
4. Remove oil, grease and other coatings from non-ferrous metals with joint cleaner.
5. Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.
6. Examine joint sizes and correct to achieve depth ratio 1/2 of joint width with minimum width and depth of 6 mm, maximum width 25 mm.
7. Install joint filler to achieve correct joint depth.
8. Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
9. Apply bond breaker tape where required to manufacturer's instructions.
10. Prime sides of joints to sealant manufacturer's instructions immediately prior to caulking.

#### **3.2 Application**

1. Apply sealants, primers, joint fillers, bond breakers, to manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
2. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.
3. In masonry cavity construction, vent caulked joints from cavity to 3 mm beyond external face of wall by inserting vent tubing at bottom of each joint and maximum to 1500 mm o.c. vertically. Position tube to drain to exterior.
4. In precast concrete panel facing, vent space behind panels by inserting vent tubing at bottom of each vertical caulked joint and at every second intersection of horizontal and vertical joints. Position tube to drain to exterior.

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5. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings using recommended cleaners as work progresses. Remove masking after tooling of joints.

6. Use sealants specified in the following locations:

Type A: Joints between windows or door frames and adjacent building components; control and expansion joints and all other locations where sealing is required, except in locations designated for Type B, C and D. Ensure that sealant chosen (from the several specified under "MATERIALS") for each location is recommended by manufacturer for use on surfaces encountered.

Type B: Joints between splash backs and walls.

Type C: Joints between interior metal door frames and partitions.

Type D: Joints in horizontal surfaces between concrete slabs, pavers and precast concrete panels.

End of Section

## **1. GENERAL**

### **1.1 Section Includes**

1. Section includes for provision of all labour, materials, equipment and services for joint sealers in accordance with Contract Documents.

### **1.2 Related Sections**

1. Section 06110                      Rough Carpentry for Roofing
2. Section 07520                      SBS Modified Bituminous Membrane Roofing
3. Section 07620                      Sheet Metal Flashing and Trim

### **1.3 References**

1. Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualifications Board for Joint Sealant.
2. CAN/CGSB-19.24 - Multi-Component, chemical curing sealing compound.
3. CAN/CGSB-19.13 - Single Component, elastomeric, chemical curing sealing compound.
4. CGSB 19-GP-14 - Sealing Compound, One-Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
5. CAN/ULC-S115-05 Standard Method of Fire Tests of Firestop Systems.
6. ULC List of Equipment and Materials, Firestop Systems and Components.

### **1.4 Operations**

1. Perform operations, at times designated by the *Owner*, that will not adversely affect occupants of building and operations in and around site access and egress.

### **1.5 Protection**

1. Protect work of this section from damage. Damaged work which cannot be satisfactorily repaired, restored or cleaned, shall be replaced at no cost to *Owner*.

### **1.6 Submittals**

1. Submit samples of sealant type and colour to *Consultant* and *Owner* for review prior to commencing work.

### **1.7 Quality Assurance**

1. Skilled trades with minimum five years related experience shall execute Work.

### **1.8 Mock-Up**

1. Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, sealant and tooling. Mock-up may be included as part of finished work.

### **1.9 Warranty**

1. Provide minimum two (2) year Warranty from date of Substantial Performance, as certified by *Consultant*. Guarantee shall be submitted against defects in workmanship and materials.
2. *Contractor* must extend Warranty on replaced parts and workmanship for a period of two (2) years from date of acceptance of replacement parts and workmanship. Defects will include but will not be limited to; joint leakage, hardening, cracking, crumbling, melting, bubbling, shrinkage, running, sagging, change of colour, loss of adhesion, loss of cohesion and staining of adjoining or adjacent materials on surfaces.
3. Provide all additional Warranties that may be available from manufacturer.

### **1.10 Environmental Requirements**

1. Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for application and curing of sealants.
2. Materials must be stored at minimum of 20°C (68°F) immediately prior to application. Sealant applications must be carried out when ambient temperature is above 0°C (32°F).

## **2. PRODUCTS**

### **2.1 Material**

1. All materials in a sealant system shall be compatible with each other and with substrate.
2. Colour(s) of sealants shall be selected to match adjacent substrate and shall be approved by *Consultant* or *Owner*.
3. Elastomeric Sealants: One part elastomeric, non-sag urethane based sealant, for masonry to masonry, masonry to metal junctions. Acceptable Material:
  1. Dymonic as manufactured by Tremco Incorporated.
  2. Vertical Wall Joints - Three-component, chemically curing, epoxidized polyurethane sealant, 'Dymeric 240' by Tremco Incorporated.

4. Silicone sealants: Silicone based sealant, for metal to metal junctions and glazing. Acceptable Material:
  1. Spectrum 2 as manufactured by Tremco Incorporated.
  2. Dow Corning 999-A Silicone Building & Glazing Sealant by Dow Corning Canada Inc.
5. Butyl sealants: Butyl rubber and polyisobutylene blend sealant. Butyl sealant to be compatible with modified bituminous membrane flashings. Acceptable Material:
  1. Tremco Butyl Sealant as manufactured by Tremco Incorporated.
  2. Modified Membrane manufacturer's approved sealant.
6. Firestop Sealant: By Tremco, Dow Corning Canada Inc., GE Silicone, 3M Corporation or approved equal, to CAN/ULC-S115-05.
7. Joint Backing: Polyethylene, urethane, neoprene or vinyl, extruded foam recommended by sealant manufacturer. Circular shape with diameter 25% greater than joint width before installation.
8. Primer: As recommended by sealant manufacturer to assure adhesion of compound and to prevent staining of substrate materials.
9. Joint Cleaner: Non-corrosive and non-staining type, compatible with joint forming materials and sealant as recommended by sealant manufacturer.
10. Bond Breaker Tape: Polyethylene bond breaker tape, which will not bond to sealant.

### **3. EXECUTION**

#### **3.1 Removal of Existing Sealants**

1. Remove existing sealants, backing material, dust, oil, grease, oxidation, millscale, coatings and all other loose material by cutting, brushing, scrubbing, scraping and grinding.
2. Rake out joints, cracks and crevices to receive sealant, to a depth measuring half the joint width. Clean out existing reglets to satisfaction of *Consultant*.

#### **3.2 Preparation**

1. Examine joint sizes and conditions to establish correct depth to width ratio for joint backing and sealant. Clean joint surfaces of deleterious material and substances including dust, rust, oil grease, and other matter that may impair work.
2. Ensure joint surfaces are dry and frost free. Prepare substrate as recommended by sealant manufacturer ensuring adjacent surfaces are not damaged.



3. Commencement of Work implies acceptance of existing conditions and assuming full responsibility for finished condition of the Work.

### **3.3 Priming**

1. To prevent staining, mask adjacent surfaces prior to priming and caulking.
2. Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
3. Prime copper, concrete and masonry surfaces to receive sealant.

### **3.4 Application**

1. Install joint backing all joints prior to applying sealants. Diameter of backing material shall be 25% more than width of joint.
2. **Maintain minimum 2:1 width to depth ratio for sealant.**
3. Apply bond breaker tape where joints are of insufficient size to install joint backing or at 90° junctions or where required by sealant manufacturer or *Consultant*. Ensure bond surface area meets the minimum required size recommended by sealant manufacturer.
4. Where required, mix materials in strict accordance with sealant manufacturer's instructions. Apply sealant using appropriate gun with proper size nozzle.
5. Apply sealant in continuous beads, in solid contact to underlying surfaces with sufficient pressure to fill voids and joints solid.
6. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets and embedded impurities. Superficial skin bead is not acceptable.
7. Tool exposed surfaces before skinning occurs to attain concave shape using approved tools.
8. Cure sealant in accordance with the manufacturer's requirements. Do not cover up sealants until proper curing has taken place.

### **3.5 Clean-up**

1. Clean adjacent surfaces immediately and leave work neat and clean.
2. Remove excess and droppings using recommended cleaners as work progresses.
3. Remove bonding tape after initial set of sealant.
4. Remove all excess material, debris, tools and equipment as work proceeds and on completion, or sooner if requested by *Consultant*.

End of Section

## **PART 1 - GENERAL**

### **1.1 Work Included**

1. A single manufacturer shall fabricate products included within the scope of this Section.
2. Manufacturer shall be a member in good standing of the Canadian Steel Door Manufacturers Association (CSDMA).
3. Supply only of steel frame products including frames, transom frames, sidelight and window assemblies with provision for glazed, paneled or louvered openings, fire labeled and non-labeled, as scheduled or detailed by the Architect.
4. Supply only of flush steel doors with provision for glazed, paneled or louvered openings, insulated and un-insulated, fire labeled, with or without temperature rise ratings and non-labeled, as scheduled or detailed by the Architect.
5. Supply only of steel panels, similar in construction to steel doors, with flush or abetted bottoms for steel frames, transom frames, sidelight and window assemblies, fire labeled and non-labeled, as scheduled or detailed by the Architect.
6. Doors and frames shall be prepared for, but not limited to, preparation for continuous hinges, heavy weight hinges, cylindrical locks, rim and concealed vertical rod/ mortise lock case exit devices, surface door closers and concealed overhead stops.

### **1.2 Related Work**

1. Building-in of frame product into unit masonry, previously placed concrete, structural or steel or wood stud walls.
2. Supply and installation of wood, plastic or composite core doors.
3. Supply and installation of builders' hardware except as specified for acoustic assemblies.
4. Drilling and tapping for surface mounted or non-templated builders' hardware.
5. Caulking of joints between frame product and other building components.
6. Supply and installation of gaskets or weather-strip.
7. Supply and installation of louvers or vents.
8. Supply and installation of glazing materials.
9. Site touch-up and painting.
10. Wiring for electronic or electric hardware.
11. Field measurements.

12. Fasteners for frame product in previously placed concrete, masonry or structural steel.
13. Steel lintels, posts, columns or other load-bearing elements.
14. Field welding.

### **1.3 Requirements of regulatory agencies**

1. Install fire labeled steel door and frame product in accordance with NFPA-80, current edition, unless specified otherwise.

### **1.4 References**

1. ANSI A115.IG-1994 Installation Guide for Doors and Hardware
2. ANSI A250.4-1994 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.
3. ASTM A653-M97 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM A924-M97 Standard Specification for General Requirements for Sheet, Metallic-Coated by the Hot-Dip Process.
5. ASTM B117-95 Method of Salt Spray (Fog) Testing.
6. ASTM C177-97 Test Method for Steady-State heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
7. ASTM C518-91 Test method for Steady State Heat Flux Measurements and Thermal Transmission properties by means of the heat Flow Meter Apparatus.
8. ASTM C578-95 Specification for Rigid, Cellular polystyrene Thermal Insulation.
9. ASTM C665-95 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
10. ASTM D1735-92 Practice for Testing Water Resistance of Coating Using Water Fog Apparatus.
11. CAN4-S104-M80 Fire Tests of Door Assemblies.
12. CAN4-S105-M85 Standard Specification for Fire Door Frames Meeting the performance required by CAN4-S104.
13. CAN4-S106-M80 Standard Method for Fire Tests of Window and Glass Block Assemblies.

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14. CGSB 41-Gp-19Ma Rigid Vinyl Extrusions for Windows and Doors
  15. CGSB 82.5-M88 Insulated Steel Doors.
  16. CSA A101-M83 Mineral Fiber Thermal insulation for Buildings.
  17. CSA W59-M89 Welded Steel Construction (Metal Arc Welding)
  18. ISO 9001:1994 Quality Systems – Model for Quality Assurance.
  19. NFPA-80, 1999 Fire Doors and Windows
  20. CSDMA Dimensional Standards for Commercial Steel Doors and Frames.
  21. Manufacturers Standard and Galvanized Sheet Gauges
  22. Fleming Fire Labeling Specifications
  23. ULC List of Equipment and Materials, Volume 2

### **1.5 Testing and Performance**

1. Door constructions covered by this specification shall be certified as meeting Level “A” (1,000,000 cycles) and Twist Test Acceptance Criteria (deflection not to exceed 6.4 mm /13.6kg force, total deflection at 136.1kg force not to exceed 63.5 mm and permanent deflection not to exceed 3.2 mm) when tested in strict conformance with ANSI-A250.4-1994. Test shall be conducted by an independent nationally recognized accredited laboratory.
2. Fire labeled product shall be provided for those openings requiring fire protection and temperature rise ratings, as determined and scheduled by the Architect. Doors, frames, transom frames and sidelight assemblies shall be tested in strict accordance with CAN4-S106. Product shall be listed by Underwriters Laboratories of Canada under an active Factory Inspection Program and shall be constructed as detailed in Follow-Up Service procedures issued to the manufacturer.
3. Should any door or frame specified by the Architect to be fire rated, not qualify for labeling due to design, hardware, glazing or any other reason, the Architect shall be so advised before manufacturing commences.
4. Core materials for exterior doors shall attain a thermal resistance rating of RSI 1.06 (R6.0) when tested in accordance with ASTM C177 or ASTM C518.
5. Product shall be manufactured by a firm experienced in the design and production of standard and custom commercial steel door and frame assemblies, the integration of builders’ or electronic hardware and glazing materials and their impact on the scope of work.
6. Manufacturer shall be assessed and registered as meeting the requirements of Quality Systems under ISO 9001.

7. Product quality shall meet standards set by the Canadian Steel Door Manufacturers Association.

### **1.6 Test Reports**

1. All alternates to this specification shall be submitted to the Architect for acceptance ten (10) days prior to bid date, complete with test reports from independent, nationally recognized testing authorities, certifying that:
  - .1 Steel door and frame assemblies furnished under this section meet the acceptance criteria of ANSI-A250.4-1994, Level "A".
  - .2 Insulated door cores furnished in exterior doors under this Section meet the specified thermal resistance rating.
2. All reports shall include name of testing authority, date of test, location of test facility, descriptions of test specimens, procedures used in testing and indicate compliance with acceptance criteria of the test.

### **1.7 Submittals**

1. Submit shop drawings in accordance with the General Conditions of the Contract.
2. Indicate each type of door, frame, steel, core, material thickness, mortises, reinforcements, anchorages, locations of exposed fasteners, openings (glazed, paneled or louvered) and arrangement of standard builders' hardware.
3. Include a schedule identifying each unit, with door marks or numbers referencing the numbering in Architect's schedules or drawings.
4. Provide confirmation in writing that all aspects to reinforcing, construction, and gauge of metal are met as written in this section.

### **1.8 Warranty**

1. All steel door and frame product shall be warranted from defects in workmanship for a period of one (1) year from date of shipment.
2. All steel door and frame product shall be warranted against rust perforation for a period of five (5) years when the installed and finish painted with a commercial quality paint to the manufacturers recommendations.
3. Finish paint adhesion on all door and frame product shall be warranted for a period of five (5) years when the product has been properly cleaned and finish painted with a commercial quality paint applied as recommended by the paint manufacturer. This warranty shall not exceed that provided by the paint manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 Doors**

## 1. Materials

- .1 Doors shall be fabricated from tension leveled steel to ASTM A924-M97, galvanized to ASTM A653-M97, Commercial Steel (CS), Type B, coating designation ZF75, known commercially as paintable Galvanneal.
- .2 Door Cores:  
Honeycomb:  
Structural small cell (25.4 mm maximum) kraft paper "honeycomb". Weight: 36.3 kg per ream (minimum), density: 16.5 kg/m<sup>3</sup> (minimum), sanded to the required thickness.
  - .1 Polystyrene:  
Rigid extruded, fire retardant, closed cell board, density 16kg/m<sup>2</sup>, thermal values: RSI 1.06 minimum, conforming to ASTM C578.
  - .2 Temperature Rise Rated (TRR):  
Solid slab core of non-combustible, inorganic composite to limit temperature rise on the "unexposed" side of door to 250°C at 30 or 60 minutes, as required by governing building code requirements and determined and scheduled by the Architect.
- .3 Adhesives:
  - .1 Honeycomb Cores and Steel Components:  
Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement or ULC approved equivalent.
  - .2 Interlocking Edge Seams:  
Resin reinforced polychloroprene (RRPC), fire resistant, high viscosity, sealant/adhesive or UL approved equivalent.
  - .3 Polystyrene Cores:  
Heat resistant, epoxy based, low viscosity, contact cement.
4. Primer:  
Rust inhibitive touch-up only.
5. Exterior Top Caps:  
Rigid polyvinylchloride (PVC) extrusion.

## 2. Construction

- .1 General:
  - .1 This section is based on doors and frames as manufactured by Fleming. Doors and frames by other manufacturers are acceptable subject to be similar to the one specified and meeting the terms of this section.
  - .2 Doors shall be swinging, 44.4 mm thick of the types and sizes indicated on the schedules or drawings.
  - .3 Exterior doors shall be lock seam, flush.
  - .4 Face sheets for exterior doors shall be fabricated from (16) gauge steel.
  - .5 Longitudinal edges of exterior doors shall be mechanically interlocked, fully welded, ground smooth with no visible seams. Do not fill seams.
  - .6 Face sheets of interior doors shall be fabricated from 18 gauge steel, except for heavy traffic doors (noted **HT** in Door Schedule) face sheet to be 16 gauge. **Note HT at all interior and exterior exit stair doors at both levels.**

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- .7 Longitudinal edge of heavy traffic doors (noted **HT** in Door Schedule) shall be mechanically interlocked, fully welded, ground smooth with no visible seams. Do not fill seams.
  - .8 Interior doors shall be stiffened, insulated and sound deadened with honeycomb core laminated under pressure to each face sheet.
  - .9 Stiffened, insulated and sound deadened with core where Temperature Rise Rated (TRR) fire labeled doors are specified.
  - .10 Longitudinal edges of interior doors shall be mechanically interlocked, adhesive assisted with edge seams visible.
  - .11 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.
  - .12 Formed edges shall be true and straight with a minimum radius for the thickness of steel used.
  - .13 Lock and hinge edges shall be beveled 3 mm in 50 mm unless builders' hardware or door swing dictates otherwise.
  - .14 Top and bottom of doors shall be provided with inverted, recessed, 16 gauge steel end channels, welded to each face sheet at 150 mm on center maximum.
  - .15 Exterior doors shall be provided with factory installed flush PVC top caps. Fire labeled exterior doors shall be provided with factory installed flush steel top caps.
  - .16 Unless ineligible due to design, size, hardware or glazing specified on the Architects' or hardware Suppliers' schedules or details, fire labeled doors shall be provided for those openings requiring fire protection ratings and temperature rise ratings, as determined and scheduled by the Architect.
  - .17 Exterior doors shall be internally reinforced with 20 gauge continuous; interlocking steel stiffeners at 150mm O.C. max, with voids between stiffeners filled and insulated with 24kg/m<sup>3</sup> density loose batt type fiberglass material to suit fully welded design.
- .2 Hardware Preparations:**
- .1 Doors shall be factory blanked, reinforced, drilled and tapped for fully templated mortised hardware only, in accordance with the final approved schedule and templates provided by the hardware supplier.
  - .2 Doors shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
  - .3 Doors shall be factory reinforced only for surface mounted hardware.
  - .4 Templated holes 12.7mm diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by the contractor responsible for installation on site, at the time of application. Templated holes less than 12.7mm diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
  - .5 Drilling and tapping for surface mounted hardware or mortised hardware that is not fully templated shall be by the contractor responsible for installation on site, at the time of application.
  - .6 Hinge and pivot reinforcements shall be 10 gauge steel minimum high frequency type reinforcing.

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- .7 Hinge reinforcements for acoustic doors and doors in excess of 2450mm rabet height shall be 10 gauge minimum with each cutout provided with 114.3mm heavy weight (4.6mm) high frequency type.
  - .8 Lock, strike and flush bolt reinforcements shall be 12 gauge steel minimum.
  - .9 Reinforcements for concealed closers and holders shall be 12 gauge steel minimum.
  - .10 For surface mounted hardware, reinforcements shall be 16 gauge steel minimum.
  - .11 All pairs of fire labeled doors shall be provided with 12 gauge steel surface mounted flat bar astragal, shipped loose for application on site, by the contractor responsible for installation.
  - .12 Pairs of doors up to 2450mm x 2450mm, to 1½ hour fire rating maximum shall be provided without astragals. Lock edge seam of such doors shall be tacked-welded and ground smooth. All other fire labeled pairs shall be provided with 12 gauge steel surface mounted flat bar astragal, shipped loose for application on site, by the contractor responsible for installation.
  - .13 Where electrically or electronically operated hardware is specified on the Architects' schedules or details of the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on the templates, shall be provided and interconnected with CSA Approved 12.7mm diameter conduit and connectors.
  - .14 Prepare doors to receive security door contacts – refer to electrical drawings for locations. Door contacts to be installed at 100 mm from the latch side door edge.
  - .15 Doors and Frames shall be prepared for, but not limited to preparations for heavy weight oversized Butt Hinges, Continuous Hinges, Cylindrical Locksets, Concealed Vertical Rod and Mortise Lock Case Exit Devices, Surface Door Closer and concealed Overhead Stops.
- .3. Glazing:
- .1 Where 6mm thick glazing materials are specified on the Architects schedules or details, doors shall be provided with 20 gauge steel glazing trim and snap-in glazing stops.
  - .2 Where other than 6mm glazing is specified on the Architect's schedules or details, doors shall receive 20 gauge steel trim and screw fixed glazing stops. Screws shall be #6 x 32mm oval head scrulox (self-drilling) type at 300mm on center maximum.
  - .3 Glazing trim and stops shall be accurately fitted, butted at corners, with removable glazing stops located on the 'push' side of the door.
- .4 Louver Preparations:
- .1 Where specified on the Architect's schedules or details, non-labeled doors shall be prepared in accordance with the louver manufacturer's details.
  - .2 Where specified on the Architect's schedules or details, fire labeled doors shall be prepared for UL listed sight-proof fusible link louvers in accordance with the louver manufacturer's details.
  - .3 Louvers shall be supplied and installed by others.



- .5 Finishing:
  - .1 Remove weld slag and splatter from exposed surfaces.
  - .2 All tool marks, abrasions and surface blemishes shall be filled and sanded to present smooth uniform surfaces.
  - .3 On exposed surfaces where zinc coating has been removed during fabrication, doors shall receive a factory applied touch-up primer.
  - .4 Primer shall be fully cured prior to shipment.

## **2.2 Panels**

- 1. Panels shall be fabricated from the same materials, construction and finished in the same manner as doors as specified in Section 2.1.

## **2.3 Frame Product**

### **1. Materials**

- .1 Steel:  
Frame product shall be fabricated from tension leveled steel to ASTM A924-M97, galvanized to ASTM A653-M97, Commercial Steel (CS), Type B, coating designated ZF75, known commercially as paintable Galvanneal.
- .2 Primer:  
Rust inhibitive touch up only.
- .3 Miscellaneous:
  - .1 Door Silencers:  
GJ-64, Single Stud rubber/neoprene type
  - .2 Thermal Breaks:  
Rigid polyvinylchloride (PVC) extrusion
  - .3 Fiberglass:  
Loose batt type, density: 24kg/m<sup>3</sup> (minimum), conforming to ASTM C665

### **2. Construction**

- .1 General:
  - .1 All steel frame product shall be as manufactured by Fleming of the types, sizes and profiles indicated on the Architects' schedules or details.
  - .2 Exterior frames shall be thermally broken, Fleming *Therma-Frame* Series, fabricated from 16 gauge steel.
  - .3 Exterior frame product shall be supplied profile welded (PW)
  - .4 Interior and exterior sections of thermally broken frames shall be separated by a continuous PVC thermal break.
    - .1 Thermally broken sections shall not be assembled by means of screws, grommets or other fasteners and welds shall not cause thermal transfers between interior and exterior surfaces of the frame sections.
    - .2 Closed sections (mullions and center rails) of thermally broken frames shall be factory insulated with 24kg/m<sup>3</sup> loose batt type fiberglass material.

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- .5 Insulation of open sections (jambs, heads and sills) on exterior frame product shall be provided and installed by the contractor responsible for installation.
  - .6 Interior frames shall be Fleming F-Series, fabricated from 16 gauge steel.
  - .7 Interior frame product shall be supplied profile welded (PW)
  - .8 Knocked-down and knocked-down drywall frames shall not be acceptable.
  - .9 Jambs, heads, mullions, sills and center rails shall be straight and uniform throughout their lengths.
  - .10 Frame product shall be square, free of defects, wraps or buckles.
  - .11 Corner joints shall be profile welded (PW) (continuously welded on the inside of the profiles' faces, rabbets, returns and soffit intersections with exposed faces filled and ground to a smooth, uniform, seamless surface)"
  - .12 Joints at mullions, transom bars, sills or center rails shall be coped accurately, butted and tightly fitted, with faces securely welded, matching corner joint faces.
  - .13 All steel mullions will be fabricated from the same materials as specified for the steel frames. Steel mullions will be fabricated as a fully assembled three piece unit consisting of a front, back and full height one piece attachment clip as per Fleming F Series. The attachment clip will completely fill the stop area of the mullion on both sides and span the void between each side forming a grid channel like structure. Mullions used as hinge mullions or strike mullions between doors will be filled with grout by the general contractor either prior to or following installation of the frame. The head of the frame shall have an opening sufficient for the grout to be poured in to the mullion.
  - .14 Mullions shall be fabricated with continuous 20 gauge galvaneal steel internal reinforcing clips.
  - .15 Frame product shall be fabricated with integral door stops having a minimum height of 16mm.
  - .16 Glazing stops shall be formed 20 gauge steel, 16mm height channel, accurately fitted, butted at corners and fastened to frame sections with #6 x 32mm oval head scrulox (self-drilling) type screws at 300mm on center maximum.
  - .17 Where required due to site access, as indicated on the Architects' schedules or details, when advised by the contractor responsible for co-ordination or installation, or when shipping limitations so dictate, frame product shall be fabricated in sections for splicing in the field.
    - .1 Field spliced jambs, heads and sills shall be provided with 16 gauge steel splice plates securely welded into one section, extending 100mm minimum each side of splice joint.
    - .2 Field splices at closed sections (mullions or center rails) shall be 16 gauge steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100mm minimum into closed sections when assembled.
    - .3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the contractor responsible for installation after assembly.
  - .18 Each door opening shall be provided with two (2) temporary steel jamb spreaders welded to the base of the jambs or mullions to maintain proper

- alignment during shipping and handling. Spreaders shall be removed by the contractor responsible for installation prior to anchoring of frame to floor.
- .19 Each door opening shall be prepared for GJ-64 or equivalent, single stud door silencers, three (3) for single door openings, two (2) for double door openings. Silencers shall be shipped loose for installation by the contractor after finish painting.
  - .20 Unless ineligible due to design, size, hardware or glazing specified on the Architects' or Hardware Suppliers' schedules or details, fire labeled frame product shall be provided for those openings required fire protection ratings as determined and scheduled by the Architect.
- .2 Hardware Preparations
- .1 Frame product shall be blanked, reinforced, drilled and tapped for fully templated mortised hardware only, in accordance with the final approved schedule and templated provided by the hardware supplier.
  - .2 Frame product shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
  - .3 Frame product shall be reinforced only for surface mounted hardware.
  - .4 Drilling and tapping for surface mounted hardware or mortised hardware that is not fully templated shall be by the contractor responsible for installation on site, at the time of application.
  - .5 Frames shall be prepared for 127mm (5 inch) standard weight hinges (minimum).
  - .6 Hinge and pivot reinforcements shall be 10 gauge steel minimum reinforcing, high frequency type shall be provided.
  - .7 Hinge reinforcements for acoustic frames and frames in excess of 2450mm rabet height shall be 10 gauge minimum with each cutout provided with 127mm (5 inch) heavy weight (4.6mm) high frequency type.
  - .8 Strike reinforcements shall be 16 gauge steel minimum.
  - .9 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 12 gauge steel minimum.
  - .10 Mortised cutouts shall be protected with 22 gauge steel minimum guard boxes.
  - .11 Where electrically or electronically operated hardware is specified on the Architects schedules or details or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on templates, shall be provided and inter-connected with CSA Approved 12.7mm diameter conduit and connectors.
  - .12 Prepare frames to receive security door contacts – refer to electrical drawings for locations. Door contacts to be installed at 100 mm from the latch side door edge.
- .3 Anchorage:
- .1 Frame product shall be provided with anchorage appropriate to floor, wall and frame construction.
  - .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb, except as indicated below.

- .3 Frame product installed in unit masonry partitions shall be provided with 4.0mm diameter steel wire anchors, 18 gauge steel adjustable stirrup and strap or "T" type anchors as conditions dictate.
  - .4 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 16 gauge steel floor anchors. Each anchor shall be provided with two (2) holes for mounting to the floor and shall be securely welded to the inside of the jamb.
  - .5 Floor anchors for thermally broken exterior frames shall be designed so as not to permit thermal transfers from exterior to interior surfaces of the frame sections.
  - .6 Frame product installed in drywall partitions shall be provided with 20 gauge steel snap-in or "Z" type stud type anchor.
  - .7 Jamb of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4mm diameter, located not more than 150mm from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcements and directly opposite on the strike jamb. Each preparation shall be provided with 16 gauge anchor bolt guides.
  - .8 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the contractor responsible for installation.
  - .9 After sufficient tightening of the anchor bolts, the heads shall be welded do as to provide a non-removable application. Welded bolt head and dimple shall be filled and ground to present a smooth uniform surface by the contractor responsible for installation, prior to finish painting.
  - .10 Where indicated on the Architects' schedules or details, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 12 gauge steel formed channel, mounting angles welded to inside of frame head and adjusting brackets. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.
- .4 Finishing:
- .1 Remove weld slag and spatter from exposed surfaces.
  - .2 All tool marks, abrasions and surface blemishes shall be filled and sanded to present smooth and uniform surfaces.
  - .3 On exposed surfaces where zinc has been removed during fabrication, frame product shall receive a factory applied touch-up primer.
  - .4 Primer shall be fully cured prior to shipment.

## **2.4 Sizes and Tolerances**

1. All sizes and tolerances shall be in accordance with the Canadian Steel Door Manufacturers Association "Recommended Dimensional Standards for Commercial Steel Doors and Frames" as follows:
  - .1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of +1.6mm, -0.8mm.

- .2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of  $\pm 1.2\text{mm}$ .
- .3 Unless builders' hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3mm clearance at jambs and head. A clearance of 19mm between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be  $\pm 1.2\text{mm}$ .
- .4 Manufacturing tolerances on formed frame profiles shall be  $\pm 0.8\text{mm}$  for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbet shall be  $\pm 1.6\text{mm}$  and  $\pm 0.4\text{mm}$  respectively. Hardware cutout dimensions shall be as per template dimensions, +0.4mm, -0.

## **2.5 Hardware Locations**

1. Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in 2.4.
2. Top of upper hinge preparation for 114.3mm hinges shall be located 180mm down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3mm hinges shall be located 310mm from finished floor as defined in 2.4.3. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts. For dutch door frames, top and bottom hinge locations shall be as above, with the tops of intermediate hinges located at 930mm and 1403mm from finished floor.
3. Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033mm from finished floor. Strikes for deadlocks shall be centered at 1200mm from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
4. Push and/or pulls on doors shall be centered 10701mm from finished floor.
5. Preparations not noted above shall be as per hardware manufacturer's templates.
6. Hardware preparation tolerances shall comply with the ANSI A115 series standards.

## **PART 3 - EXECUTION**

### **3.1 Site and Protection of Materials**

1. The contractor responsible for installation shall remove wraps or covers from door and frame product upon delivery at building site.
2. All materials shall be thoroughly inspected upon receipt and all discrepancies, deficiencies and/or damages shall be immediately reported in writing to the supplier. All damage shall be noted on the carriers' Bill of Landing.
3. Contractor responsible for installation shall ensure all materials are properly stored on planks or dunnage in a dry location. Product shall be stored in a vertical position,

spaced with blocking to permit air circulation between them. Materials shall be covered to protect them from damage from any cause.

4. Contractor shall notify the supplier in writing of any errors or deficiencies in the product itself before initiating any corrective work.

### **3.2 Installation**

1. Install doors and frames in accordance with the Door and Hardware Institute "Installation guide for doors and hardware".
2. Set frame product plumb, square, aligned, without twist at correct elevation.
3. Frame Product Installation Tolerances:
  - .1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be  $\pm 1.6\text{mm}$ .
  - .2 Squareness tolerance, measured through a line  $90^\circ$  from one jamb at the upper corner of the product, to the opposite jamb, shall be  $\pm 1.6\text{mm}$ .
  - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be  $\pm 1.6\text{mm}$ .
  - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be  $\pm 1.6\text{mm}$ .
4. Fire labeled product shall be installed in accordance with NFPA-80.
5. Secure anchorages and connections to adjacent construction.
6. Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at mid points of frame rabbet height and at floor level to maintain frame widths. Provide vertical support at center of head for openings exceeding 1250mm in width. Remove wood spreaders after product has been built-in.
7. Frame product in unit masonry shall be fully grouted in place.
8. Install doors maintaining clearances outlined in Section 2.4.
9. Install louvers and vents.
10. Adjust operable parts for correct clearances and function.
11. Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
12. Any grout or other bonding material shall be cleaned from products immediately following installation.
13. Exposed field welds shall be finished to present a smooth uniform surface and shall be touched-up with a rust inhibitive primer.

14. Exposed surfaces that have been scratched or otherwise marred during shipment, installation or handling shall be touched-up with a rust inhibitive primer.
15. Finish paint in accordance with Section 09900.
16. Install glazing materials and door silencers.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work**

- |                                 |               |
|---------------------------------|---------------|
| 1. Final cleaning:              | Section 01710 |
| 2. Sealants:                    | Section 07900 |
| 3. Glazing:                     | Section 08800 |
| 4. Air Vapour Barrier Membrane: | Section 07112 |

### **1.2 Design Requirements**

1. This specification section is based on following aluminum glazing types:
  - .1 Bullnose fixed window - typical unit:
    - .1 E.g. Alumicor 970 Series, Kawneer 518 Isoport.
    - .2 Typical for punched openings fixed windows.
  - .2 Operators: Kawneer - 518 Isoport Casement at W1B unit with lockset.  
Rotator: fixed window rotor type ventilator – Acceptable unit 512 Ventro by Kawneer or approved equal by Alumicor.
  - .3 Curtain wall frame entrances and opening infills:
    - .1 E.g. Kawneer 1600, Alumicor 2500 Series, Oldcastle CW250,
    - .2 Typical for Entrance Vestibule glazing.
2. Design all framing and glazing to withstand design loads as per the Ontario Building Code and regulations of authorities having jurisdiction.
3. Work of this Section must be designed by a Professional Engineer licensed to design structures in the Province of Ontario.
4. Design and locate all sealants, gaskets, air/vapour seals, thermal barriers and separations, drainage slots and holes, as shown or specified or as required to obtain design requirements. Ensure all components and assemblies exterior to air barrier drain to building exterior.
5. Provide aluminum closer angles and trims to suit.
  1. Aluminum Exterior Doors - Aluminum Doors and Frames:
    - .1 This specification is based upon Alumicor Limited doors – Canadiana Series 600B
    - .2 Doors to be thermally broken and to have insulated sealed units at exterior location only
    - .3 Acceptable Equal Alternates: Kawneer and Windspec.”



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### **1.3 Shop Drawings**

1. Submit shop drawings in accordance with Section 01340 and to be prepared and stamped by a Professional Engineer licensed to design structures in the Province of Ontario.
2. Clearly indicate materials and large scale details for head, jamb and sill, profiles of components, elevations of unit, fully dimensioned layouts positioning brackets and anchorage details, glazing details, and location of isolation coating, description of related components and exposed finishes and fasteners.

### **1.4 Certificates**

1. Submit manufacturer's certificate, certifying compliance with specification requirements, for:
  - .1 windows.
  - .2 finishes.
  - .3 insect screens.
  - .4 infiltration/exfiltration rates.
  - .5 thermal transfer resistance of frames.
  - .6 locking hardware.

### **1.5 Performance**

1. In addition to all requirements of these specifications, the design of glazing shall take into consideration the characteristics of the mullions and effects of the connection and sealants at the frame junctions. Provide thermal breaks between exterior and interior components and sufficient metal on interior side of glass.
2. Fenestration shall meet CAN/CSA – A440 windows:
  - .1 Air Leakage: A3
  - .2 Water Leakage: B7
  - .3 Wind Load Resistance: C5
  - .4 Condensation Resistance: fixed frame: 53 minimum  
glass: 53 minimum
  - .5 Window shall also meet the requirements for blocked operation, ease of operation, sash strength, stiffness and resistance to forced entry.
3. Submit manufacturer's certificate, certifying compliance with the above-noted requirements.

### **1.6 Quality Assurance**

1. All design, fabrication and installation of this work to be carried out by qualified workers and trades experienced in the application and erection of the products, systems and assemblies specified.
2. Make provisions to drain to the exterior face any water entering in at joints and any condensation occurring within curtain wall construction while maintaining air seal between interior and exterior. Drain holes shall adequately drain all water.
3. At design conditions, no water penetration to interior side of assembly shall occur.

4. Curtain wall systems shall be designed, fabricated, and installed under design conditions to be watertight in combination with movements occurring due to wind loads imposed on the system.
5. Formed aluminum components shall be sheet of alloy and temper suitable for their purpose and finish.

### **1.7 Warranty**

1. Provide written warranty stating that aluminum windows are guaranteed against leakage, defects and malfunction under normal usage for a period of ten (10) years from the date of completion.

### **1.8 Maintenance Material**

1. Provide data for maintenance and cleaning in accordance with general conditions.

## **PART 2 – PRODUCTS**

### **2.1 Manufacturers**

1. Equivalent Equal Manufacturers for the work of this sections:
  - .1 Kawneer Company Canada
  - .2 Oldcastle Glass
  - .3 Sherwood Windows Ltd.
2. Refer to requirements for equivalent products in section 01030.

### **2.2 Materials**

1. Extrusions shall be 6063 T54 alloy and temper.
2. Formed aluminum components shall be sheet of alloy and temper suitable for their purpose and finish.
3. Fasteners shall be 300 series stainless steel or 400 series stainless steel cadmium plated and of sufficient size and quantity to perform their intended function.
4. Weathering and glazing gaskets shall be extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
5. Glazing tapes shall be macro-polyisobutylene, highly adhesive and elastic with built in shim.
6. Exterior Sills: extruded aluminum, minimum 3 mm thick, complete with joint covers, jamb drip deflectors, chairs, anchors, anchoring devices. All lower level sills to have exterior corners rounded to 6mm radius.
7. Sealants: in accordance with Section 07900, paragraph 2.1.3. Color to match window frame.

8. Foam Sealants: Urethane expanding foam sealant.
9. Bedding Compound: to CGSB 19-GP-14M.
10. Isolation Coating: alkali resistant bituminous paint.

### **2.3 Finish**

1. Exposed aluminum sections shall be given an anodic oxide treatment in accordance with Aluminum Association specification AA-M12C22A31.  
Kawneer - Classic Bronze ORSL 42952 to match existing window colour.

### **2.4 Fabrication**

1. Fabricate framing from extrusions of size and shape shown on shop drawings. Interior and exterior extruded aluminum framing sections shall be integrated with a glass reinforced nylon thermal break to form a rigid composite assembly without the use of fasteners or other thermal bridging elements.
2. Composite frame assembly shall have a minimum of 1100 lbf/4 in. (4815N/ 100 mm) resistance to shear between the aluminum and the thermal break materials.
3. Dry shrinkage of the thermal break shall not exceed 0.10% of the framing member length.
4. Fixed framing shall be designed for screw spline corner construction.
5. All framing joints shall be accurately machined, assembled, and sealed to provide neat weathertight connections. Coupling mullions shall be designed to provide a functional split to permit modular construction and allow for thermal expansion. Glass stops shall be lock-in screwless type.
6. All glazing pockets shall be vented, pressure equalized and drained to the exterior.
7. Elastomeric air seal gasket shall be installed around the full perimeter of glass and sealed at corners with silicone sealant. Air seal gasket must provide adhesion with silicone sealant.
8. Fabricate Rotator unit from extrusions of size and shape shown on shop drawings. Head and sill sections shall be one part construction with a two part chemically curing high density polyurethane thermal barrier. The thermal integrity shall be maintained by the mechanical removal of bridging element after curing. All joints shall be accurately machined, assembled and sealed to provide neat weathertight connections. The ventilator shall be a two part pivoted component with no operating hardware. Include insect mesh.

### **2.5 Isolation Coating**

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

## **2.6 Glazing**

1. Prepare windows to receive 25 mm thick double glazed insulating glass specified under Section 08800.

## **PART 3 - EXECUTION**

### **3.1 Preparation**

1. Protect adjacent surfaces from damage resulting from work under this specification.

### **3.2 Installation**

1. Install the windows in accordance with the manufacturer's instructions. Install the windows plumb, level and true relative to building structure. Do not exceed 3mm in 3050 mm (1/8" in 10'0") variation from plumb and level. Foam insulate between the frame members and the window opening using a single component polyurethane foam, insulating sealant.

### **3.3 Sill Installation**

1. Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces.

### **3.4 Caulking**

1. Seal joints between frame members and other non-operating components with sealant to provide weathertight seal at outside.
2. Seal joints between windows and windowsills with sealant. Bed sill expansion joint cover plates and drip reflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.

### **3.5 Clean Up**

1. Clean glass at the factory. Final cleaning of glass to remove job site soiling shall be the responsibility of the owner. Leave all surfaces reasonably clean, free from sealants, caulking or other foreign material. Remove all surplus materials and debris resulting from the work of this Trade.

### **3.6 Protection and Cleaning**

1. Aluminum shall be isolated from concrete, mortar, plaster or dissimilar metals with bituminous paint or epoxy solution. Framing shall be protected from other building materials during and after installation until acceptance.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work**

- |                                       |               |
|---------------------------------------|---------------|
| 1. Final Cleaning:                    | Section 01710 |
| 2. Commercial Steel Doors and Frames: | Section 08100 |
| 3. Aluminum Windows:                  | Section 08520 |

### **1.2 Submittals**

1. Submit a 300 x 300 sample of all glass products in accordance with Section 01340.

### **1.3 Warranty**

1. Contractor hereby warrants glass against defects and failure, including leakage, under normal conditions of use, in accordance with Division 1, but for five (5) years total

## **PART 2 - PRODUCTS**

### **2.1 Material**

1. Exterior Tempered Safety Glass: All exterior Vision Glass to exterior doors, windows and screens to be sealed insulating units conforming to CAN/CGSB-12.8. Exterior lite 6 mm tempered grey float glass, 12 mm air filled space, inner lite 6 mm clear tempered float glass conforming to CAN/CGSB-12.3. All units to receive Low Emissivity coating on inner pane (3rd surface).
2. Interior Tempered Safety Glass: 6 mm tempered clear float glass complete with etched tempered glass designation visible.
3. Polished Plate or Float Glass: To CAN/CGSB-12.3 clear.
4. **Wired Glass:** to CAN2-12.11-M76, Georgian-wired, polished, 6 mm, wires running parallel to frames. Locations: all fire rated doors and screens and where indicated on drawings.
5. **Fire Rated Glass:** To CAN 4 S-104 and CAN 4 S-106 to meet ANSI Z97.1. Shall be 3/16" (5mm) thick FireLite-Premium supplied by TechniGlas.
6. Low E Glass: to CAN/CGSB-12.4; tempered clear, sputtered coating; eg. AGC Glass Comfort TI-PB; PPG Sungate 100
7. Setting blocks: neoprene, 80 durometer hardness, 102 mm x 6 mm width to suit glass.
8. Glazing tape: preformed butyl with continuous spacer, 10-15 durometer, hardness, paper release, black color, 3 x 10 mm.
9. Gasket: black neoprene "U" cavity type with lock strip.

## **PART 3 - EXECUTION**

### **3.1 Installation**

#### 1. Double Sealed Units

- .1 Install glass as per aluminum window manufacturer's instruction to provide complete rain screen and air/ water barrier.

#### 2. Other Glass

- .1 Clean and dry surfaces.
- .2 Apply glazing tape to fixed stops. Place setting blocks at 1/3 points.
- .3 Set glass on setting blocks against tape.
- .4 Apply glazing tape to glass.
- .5 Install stops.
- .6 Install glass in doors and screens with neoprene gasket.
- .7 Clean glass prior to building occupancy in accordance with Section 01710.

End of Section

## **PART 1 - GENERAL**

### **1.1 General Finish Notes**

1. The Material and Colour Schedule will be issued by the Consultant after tender. It shall be read in conjunction with the Drawings, Specifications, Room Schedule and Door Schedule. Colour and material references named will be based on one manufacturer, as carried by the Contractor or, in the case that no specific manufacturer is carried, based on the Consultant's choice.
2. Approved alternative manufacturers will be acceptable only as indicated in the specifications. However, approved alternate products submitted must match the products named in the Specification to the Consultant's selection. Alternate products other than those named in the specifications will not be allowed unless previously approved by the Consultant.
3. Consult Architect prior to painting any surface not included in the formulae as listed.
4. Final colour for exterior painted surfaces and prominent interior areas shall be approved on the job site by the Architect.
5. Paint samples: Contractor to submit paint samples for all areas required to "Match Adjacent Finish".
6. All similar paint formulations are to be identical when dry. Variations in tone, texture or sheen shall not be accepted.
7. Submit two 300 mm x 300 mm paint samples of each colour required for approval by the Architect.
8. Exact locations of accent paint called for in the Material and Colour Schedule, to be issued after Contract award, not specifically identified on the drawings are to be verified on site with the Architect.

### **1.2 Exterior Finish Notes**

1. All exposed metal (doors, frames, lintels, stairs, handrails, mechanical equipment, etc.) to be painted except for prefinished metal louvres, stainless steel, and aluminum. Mechanical equipment is to be painted whether delivered to the site pre-painted or not (exhaust fans, goosenecks, exhaust stacks, supports, HVAC units, HRU units, etc.). Colours to match adjacent material—generally either to match brick or tan to match flashing or siding material. Do not paint exposed white PVC pipe covers on interior. Architect will advise on jobsite which other items mentioned above, if any, do not require painting.
2. All unfinished metal work provided by landscaping is to be painted by Section 09900.

**1.3 Interior Finish Notes:**

1. All heating units, recessed convectors, grilles, pipes, access panels, hangers and miscellaneous exposed metal work (except stainless steel or anodized aluminum) to be painted to match the surfaces on which they occur unless noted otherwise on the colour schedule, prefinished in suitable colour or directed by the Architect. If prefinished equipment is damaged, it shall be re-painted. Painting to be by formulations specified in Section 09900.
2. All interior fitments, casework, millwork, etc. to be melamine unless otherwise noted. Refer to Sections for specific requirements regarding materials, construction, finishes and hardware. Note that drawer and cupboard interiors are to be considered as exposed surfaces and will therefore be finished.
3. Do not paint over nameplates, identification tags, etc.
4. Make good all existing surfaces and finishes that are damaged during construction.

**1.4 Abbreviations Legend**

1. Refer to Room Finish Schedule for abbreviations Legend.

End of Section



## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Gypsum Board: Section 09250

### **1.2 Reference Standards**

1. Do work to CSA A82.31, except where specified otherwise.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. Non-load bearing channel stud framing: to ASTM C645, roll formed from 0.59 mm thickness electro-galvanized steel sheet for screw attachment of gypsum lath and metal lath. Knock out service holes at 150 mm o.c.
2. Floor and ceiling tracks: to ASTM C645-76 in width to suit stud sizes, 30 mm legs for floor track, 50 mm for ceiling track.
3. Metal channel stiffener: 38 mm size, 2 mm thick cold rolled galvanized steel.
4. Furring channels (channels, hangers, tie wire, insert, anchor): CSA A82.30 (R-1971).
5. Metal Accessories: CSA A82.30-1965 (R-1971).

## **PART 3 - EXECUTION**

### **3.1 Stud Partitions**

1. Align partition tracks at floor and underside of structure above and secure at 600 mm o.c. maximum. All partitions to extend to underside of structure above.
2. Place studs vertically at 400 o.c. and not more than 50 mm from abutting walls and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs, as required, to provide rigid installation to manufacturer's instructions.
3. Erect metal studding to tolerance 1:1000.
4. Attach studs to bottom track using screws.
5. Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs, ensure web openings are aligned.
6. Install steel frames and anchor frames securely to studs using minimum of three (3) anchors per jamb for jambs up to 2100 mm high and a minimum of four (4) anchors per jambs for jambs over 2100 mm high.

7. Provide two (2) studs at each side of openings wider than stud centre specified.
8. Install, cut to length, piece of runner horizontally over door frames and at top and bottom of rough opening in glazed partitions.
9. Provide 38 mm x 89 mm vertical and horizontal wood studs secured between metal studs for attachments of bathroom fixtures, accessories, cabinet work, and other fixtures, including grab bars, towel rails, attached to steel stud partitions.
10. Install steel stud or furring channel between studs for attaching electrical and other boxes.
11. Extend all partitions to underside of deck above for sound and fire separation. Fill deck flutes with rockwool.
12. Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

### **3.2 Ceiling Furring**

1. Install runners level to tolerance of 3 mm over 3.5 m. Provide runners at interruptions of continuity and change in direction.
2. Frame with furring channels, perimeter of openings to accommodate access panels, light fixtures, diffusers, grilles, etc.
3. Furr for bulkheads within or at termination or ceilings.
4. Install furring channels at 400 mm o.c. maximum.

### **3.3 Wall Furring**

1. Install steel furring, as indicated.
2. Frame opening and around built-in equipment on four (4) sides with channels.
3. Box-in beads, columns, pipes, and around exposed services.

### **3.4 Fire-rated Assemblies**

1. If required, install Metal Stud System and Furring in accordance with appropriate ULC Design and with supplement to the National Building Code of Canada 2015.

End of Section

## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Masonry: Section 04200
2. Metal Stud System: Section 09111
3. Supply of access doors for mechanical and electrical devices Divisions 15 and 16

### **1.2 Reference Standards**

1. Do work to CSA A82.31-1977, except where specified otherwise.

## **PART 2 - PRODUCTS**

### **2.1 Gypsum Board**

1. Plain: to CSA A82.27-M1977 standard, 16 mm or 19 mm thick or as indicated, tapered edges.
2. Plain: to CSA A82.27-M1977, Fire-rated Type X, 16 mm thick or as indicated, tapered edges.
3. Plain: to CSA A82.27-M1977 standard, 13 mm water resistant, tapered edges. (W.R.G.B. in Finish Schedule)
4. Plain: to CSA A82.27-M1977, walls 5/8" dens-shield or as indicated, tapered edges.
5. Two Hour Shaft Wall to CSA A82.27-M1977 – ULC W452 System B/W506, W507 UL Design 415 System B or U438

### **2.2 Fastenings and Adhesives**

1. Screws: to CSA A82.31-1977.
2. Adhesive: to CGSB 71 GP 25M.
3. Laminating Compound: to CSA A82.31-1077.
4. Concrete Anchors: Phillips Red Head TW-614 or equivalent. Do not use powder activated fasteners for ceiling support.
5. Tie Wire: #16 ga. galvanized soft annealed steel wire.

### **2.3 Accessories**

1. Casing Beads and Corner Beads: 0.5 mm base thickness commercial sheet steel with G90 zinc finish to ASTM A 525-78 A.

2. Joint compound and tape: Compound to CSA A82.31-1977, asbestos-free. Perforated 50 mm gypsum board joint tape.
3. Caulking: Acoustical sealant.

#### **2.4 Insulation Blanket**

1. 38 mm thick mineral wool batts ULC labelled, if indicated on drawings.

### **PART 3 - EXECUTION**

#### **3.1 Gypsum Board Application**

1. Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
2. Install metal studs plumb and true to sizes and locations indicated on drawings.
3. Apply single and double layers gypsum board to metal furring or framing, using screw fasteners and laminating adhesive. Maximum spacing of screw 300 mm oc.
4. Apply gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
5. Apply type X gypsum board where indicated, in accordance with U.L.C. requirements and with supplement to the National Building Code of Canada to obtain the required fire protection, fire rating and fire separation.

#### **3.2 Insulation and Blanket Application**

1. Where indicated on drawings, staple blanket to wallboard in accordance with ULC design requirements. Blanket shall be continuous and tightly fitted between studs and at perimeter.

#### **3.3 Accessories**

1. Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces, where practical. Make joints tight, accurately aligned and rigidly secure. Mitre and fit corners accurately, free from rough edges.
2. Install casing beads around perimeter of suspended ceilings.
3. Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.

#### **3.4 Access Doors**

1. Install access doors to electrical and mechanical fixtures specified in respective Sections.
2. Rigidly secure frames to furring or framing systems.

**3.5 Taping and Filling and Sound Seal**

1. Seal with acoustical sealant at ceilings, floors, wall intersections and all penetrations such as electrical outlets.
2. Above partitions fill flutes of steel deck with rock wool and cover with non-sagging sealant on at least one side of the partition.
3. Finish face panel joint and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
4. Finish corner beads, control joints and trim as required with two (2) coats of joint compound and one (1) coat of taping compound, feathered out onto panel faces.
5. Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after painting is completed.
6. Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
7. Completed installation to be smooth, level or plumb, free from waves and other defects and ready for painting.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Sealants: caulking Section 07900

### **1.2 Reference Standards**

1. Do tile work to Installation Manual 200-1979, "Ceramic Tile," produced by Terrazzo Tile and Marble Association of Canada (TTMAC), except where specified otherwise.

### **1.3 Maintenance Material**

1. Provide maintenance data for tile work for incorporation into Maintenance Manual specified in Section 01720.
2. Provide 12 additional tiles of each type and color of tile required for project for maintenance use. Store where directed. Clearly identify each box.
3. Maintenance material to be of same production area as installed material.

### **1.4 Environmental Requirements**

1. Air temperature and structural base temperature at tile installation area must be above 13 degrees C for 24 hours before, during and 24 hours after installation.

### **1.5 Extended Warranty:**

1. Submit a warranty for entire flooring tile installation, covering materials and labour and the repair or replacement of defective work for three (3) years total.

## **PART 2 - PRODUCTS**

### **2.1 Tiles**

1. Designation PT: 300 mm x 300 mm porcelain tile to CAN 2-75-1M77.
  - .1 Acceptable material: Spectra Series, distributed by Olympia Tile +Stone: Size 300 mm x 300 mm, plus trim and 300 mm x 100 mm bullnosed base, slate finish. Allow for up to 4 colours from manufacturer's full line.
  - .2 Acceptable Alternates: Cross Colors-porcelain stone by Crossville Group 2  
Porcelato Solid and Grani Series Allow for all price  
groups By Daltile.  
Savoia Canada – Corindo Series

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## **2.2 Accessories**

1. Control Joints – Schluter – Dilex –KSN for floors and walls with Tiles.

## **2.3 Setting Materials**

1. Cement Mortar: Mixture of 1 part Portland cement, 4 parts dry sand and 1/10 hydraulic lime. Materials shall conform to the following:
2. Portland Cement: To CAN3-A, Type 10.
3. Hydrated Lime: To ASTM C-206 or 207, Type 5.
4. Sand: To CSA A82.56, passing 1.6 mm sieve.
5. Water: Potable, containing no contaminants which cause efflorescence.
6. Thin Set Mortar: field mixed, blended sand-Portland cement-latex mortar, “Kerapoxy” by Mapei, distributed by Midgley and West, Hamilton Ontario.
  - .1 Acceptable Alternates: “Laticrete 4237 distributed by Ceratec Inc., or Flextile 52 thin set.
  - .2 Latex Additive: “Cemtex” by Master Builders, Laticrete 2022” distributed by Ceratec Inc.

## **2.4 Grout**

1. Sanded, Portland cement based with Plastijoints acrylic additive, Kerncolour / Floor by Mapei or similar by Laticrete. Colour as selected by Architect.

## **PART 3 - EXECUTION**

### **3.1 Workmanship**

1. Apply tile to clean and sound surfaces.
2. Fit tile units around corners, fitments, fixtures, drains and other built-in objects to maintain uniform joint appearance. Make cut edges smooth, even and free from chipping. Edges resulting from splitting not acceptable.
3. Maximum surface tolerance: 1:800.
4. Make joints between tiles uniform and approximately 3 mm wide, (maximum 4 mm) plumb, straight, true, even and with adjacent units flush. Align patterns.
5. Lay out units so perimeter tile are minimum 1/2 size.
6. Install floor tiles as per pattern. Pattern will be supplied by architect at a later date.
7. Sound tiles after setting and replace hollow sounding units to obtain full bond.

- 
8. Make internal angles square, external angles chamfered at 45° with narrow tile strip.
  9. Construct base, as indicated on drawings, with rounded top edge.
  10. Use bullnose edged tiles at termination of wall tiles, except where tiles abut projecting surface or differing plane.
  11. Seal grouted joints with sealer.
  12. Clean installed tile surfaces after installation cured.
  13. Keep building expansion joints free of mortar or grout.
  14. Tiles must be flush with adjacent dissimilar finishes. Add leveler at lower floor finishes to porcelain tile at all door openings, feather back as required to eliminate visible elevation difference around doorways. Typical at all locations.
  15. Install steel floor termination strip at all door openings where porcelain tile meets VCT.

### **3.2 Setting System**

1. Install porcelain floor tiles in accordance with TTMAC applicable thinset detail.

End of Section



## **PART 1 - GENERAL**

### **1.1 Reference Standards**

1. Fabrication: to ASTM 365-78 and CAN/GSB-92.1-M77.
2. Installation: to ASTM C636-76, except where specified otherwise.

### **1.2 Design Criteria**

1. Maximum deflection 1/360 of span to ASTM 365-78 deflection test.

### **1.3 Samples**

1. Submit two each 300 x 300 mm samples of each individual tile and grid type in accordance with Section 01340.

### **1.4 Warranty**

1. Submit an extended warranty covering materials and labour and the repair or replacement of defective work but for two (2) years total.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

#### **1. Ceiling Types:**

**Ceiling Type 1 (ACT-1):** Panels: 610 mm x 1220 mm x 15mm, medium textured non directional fissured, square lay-in, Cortega #823 by Armstrong. Suspension system: 15/16" Prelude ML, white, by Armstrong.

**Ceiling Type 2 (ACT-2):** Panels: 610 mm x 1220 mm x 15mm, Clean Room VL, unperforated #870". by Armstrong. Suspension system: 15/16" Prelude ML, white, by Armstrong.

Equivalent ceiling types by CGC and Celotex are acceptable.

2. **Hangers:** 2.6 mm galvanized soft annealed steel wire.
3. **Accessories:** splices, clips, retainers, etc., to complement suspension system components.

### **2.2 Installation**

1. Co-ordinate suspension system with related components.
2. Install acoustic units parallel to building lines with edge unit not less than 50% or unit width.

3. Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.
4. Support suspension system main runners at 1200 oc maximum with hangers from structure. Assembly shall support super-imposed loads. Maximum permissible deflection, 1/360 of span.
5. Attach cross member to main runner to provide rigid assembly.
6. Install suspension assembly to manufacturer's written instructions.
7. Install flush edge moulding at junction of acoustic unit ceiling and other materials around entire length of joint. Secure to construction. Butt joints neatly, square and true in alignment.
8. Set acoustic units in place.
9. Set all ceiling levels by the use of transit or laser level.
10. Provide for Owner one FULL (1) complete carton of each type of ceiling tile.

End of Section

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## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Concrete Floors refer to drawings

### **1.2 Maintenance Data**

1. Provide data for maintenance of resilient flooring for incorporation into Maintenance Manual.

### **1.3 Environmental Requirements**

1. Maintain minimum 20 deg. C air temperature at flooring installation area for three (3) days before, during and for seven (7) days after installation.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. **Vinyl composition tile (VCT):** to ASTM F 1066-1995 a, Type A design, asbestos free, 3 mm thick, 300 mm x 300 mm size Standard Excelon, Imperial Texture for field and Multicolour for accent and pattern by Armstrong. Allow for total of three (3) colours from full line. Allow 90% of area in Imperial texture and 10% in Multicolour.  
**Acceptable Alternate:** Mannington Commercial: Designer Essentials Series.  
Azrock Collection by Johnsonite
2. **Resilient rubber base (RB):** top set coved, 3 mm thick, rubber, 100 mm high minimum 1200 mm long, including premoulded end stops and external corners. Acceptable materials: non-shrink Rubber Wall Base with toe as manufactured by Johnsonite. Colours: Three (3) from full Johnsonite "Coloright" colour line. Use straight base at carpet flooring.
3. **Base Accessories:** Pre-moulded end stops and external corners, of same material, size, and colour as base.
4. **Transition Strips:** thermoset vulcanized rubber, smooth, purpose made to accommodate wheeled traffic and prevent tripping; tapered designs to suit nature of transition; colour as selected by Consultant.
5. **Primers and adhesives:** waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade. Use Johnsonite 990 Solvent Free Environmentally Safe White Acrylic Cove Base Adhesive for rubber base.

## **PART 3 - EXECUTION**

### **3.1 Inspection**

1. Ensure concrete floors are dry, by using test methods recommended by tile manufacturer, and inspect for negative alkalinity, carbonization or dusting.

2. Commencement of work indicates acceptance of conditions by flooring installer.

### **3.2 Subfloor Treatment**

1. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.
2. Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured.
3. Ensure of smooth transition between any raised surfaces at door ways. Prepare subfloor with leveling compound to ensure smooth transition. Typical where VCT meets PT floors.

### **3.3 Tile**

1. Apply adhesive uniformly using recommended notched trowel in accordance with Flooring Manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
2. Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles - minimum half tile width or as indicated by drawings and Finish Schedule.
3. Cut tile and fit neatly around fixed or excessively heavy objects.
4. Install flooring in pan type floor access covers and all clean out covers, where applicable. Maintain floor pattern.
5. Terminate flooring at center line of door in openings where adjacent floor finish or color is dissimilar.
6. Install metal edge strips at unprotected or exposed edges where flooring terminates.
7. At doorways to incrapack units, extend tile and base fully into door opening to incrapak classroom.

### **3.4 Base Application**

1. Set base in adhesive tightly against wall and floor surfaces. Use lengths as long as practicable and not less than minimum 500 mm long.
2. Install straight and level to variation of 1:1000.
3. Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
4. Miter internal corners. Use premoulded corner pieces at all external corners and ensure full adhesion through to ends of corner pieces. See detail for termination at door frames.

5. Leave in the building one (1) complete carton of each of two (2) colours of floor tile and twelve (12) tiles of each of the remaining colours. Colours of extra tile to be specified by Architect.

### **3.5 Initial Maintenance after Installation**

1. Broom sweep or vacuum thoroughly.
2. Do not wet mop, wash, scrub, or strip the floor. These procedures will be done by the Owner.

### **3.6 Protection of Work**

1. Following broom sweeping, protect new floors with 0.15 mm thick Polyethylene cover and lay planking in all necessary traffic areas to minimize damage by other trades. Maintain until just before final inspection.

### **3.7 Preparation for Inspection**

1. Only if so notified by Architect, and in the presence of the Owner, scrub the floor using a neutral detergent and a floor machine of 170-250 rpm capability equipped with a scrub brush or a scrubbing pad (3M blue or equal).
2. Lightly rinse and allow to dry. Note: Do not flood the floor with rinse water, scrubbing, or stripping solutions. Final re-washing, if required, and waxing will be done by owner.

End of Section

## **PART 1 – GENERAL**

### **1.1 Section Includes**

1. Supply and installation of the indoor resilient multipurpose surfacing.
2. Application of the game lines.
3. References for the correct construction and preparation of concrete slabs to receive resilient flooring.

### **1.2 Submittals**

1. Product Data: Manufacturer's promotional brochures, specifications and installation instructions
2. Samples:
  - .1 Submit for selection and approval two (2) sets of the indoor resilient multipurpose surfacing, manufacturer's brochures, samples or sample boards of all of the available colors, textures and styles.
  - .2 Submit color samples of all the available game line paint colors for selection and approval.
3. Closeout Submittals:
  - .1 Submit two (2) copies of the indoor resilient multipurpose surfacing and manufacturer's maintenance instructions.
  - .2 Submit two (2) copies of the material and installation warranties as specified.

### **1.3 Quality Assurance**

1. The installer of the indoor resilient multipurpose surfacing shall have a minimum of five (5) years experience in the field installing the specified indoor resilient multipurpose surfacing and have worked on at least five (5) projects of similar size, type and complexity.

### **1.4 Delivery, Storage and Handling**

1. Delivery: Material shall not be delivered until all related work is in place and finished and/or proper storage facilities and conditions can be provided and guaranteed stable according to Tarkett Sports' recommendations.
2. Storage: Store the material in a secure, clean and dry location. Maintain temperature between 18° and 30° Celsius. Store the indoor resilient athletic surfacing rolls in an upright position on a smooth flat surface immediately upon delivery to jobsite. Rolls shipped in rigid protective cardboard containers can be laid horizontally prior to unpacking and installation.

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### **1.5 Project / Site Conditions**

1. It is the responsibility of the general contractor/construction manager to maintain project/site conditions acceptable for the installation of the indoor resilient multipurpose flooring.
2. The area in which the indoor resilient multipurpose surfacing will be installed shall be dry and weather tight. Permanent heat, light and ventilation shall be installed and operable.
3. All other trades shall have completed their work prior to the installation of the resilient athletic flooring. The general contractor or Construction Manager shall maintain a secure and clean working environment before, during and after the installation. Suspension of other trades' work may be authorized providing their work will not damage the new flooring.
4. Maintain a stable room temperature of at least 18°C for a minimum of one (1) week prior to, during and thereafter installation.
5. An effective low-permeance vapor barrier is placed directly beneath the concrete subfloor. For "on" or "below grade" installations, it is recommended to provide a permanent vapor barrier resistant to long term hydrostatic pressure/moisture exposure. Protrusions should be sealed to prevent moisture migration into the slab. Moisture should not be allowed to enter the slab after the completed construction.
6. Concrete subfloor surface pH level within the 7 to 9 range dependent upon installation type.
7. Concrete subfloor should be no greater than 3 mm within a 3050 mm diameter. This tolerance can be measured in accordance with ASTM E1155. A specified ( $F_F$ ) of 50 and an ( $F_L$ ) of 30 should reach this degree of floor flatness and floor level. There is no numerical correlation between F numbers and the deviation from the straight edge, however the above specified numbers should achieve a flat floor with minimal deviation in the slab. Reference ACI 117 and ACI 302.1R. The general contractor should provide a certificate of compliance with the above recommendations.
8. Concrete subfloor must be clean and free of all foreign materials or objects including, but not limited to, curing compounds and sealers.
9. Fill cracks, grooves, voids, depressions, and other minor imperfections with Ardex (or equal) cement-based patching/leveling compounds. Follow the manufacturer's directions. Moveable joints must be treated utilizing specific transition joint devices depending upon the architect's recommendations. Follow current ASTM F710 guidelines for the preparation of concrete slabs to receive resilient flooring.
10. Refer to ACI 302.2R "Guidelines for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials" for concrete design and construction.

11. Concrete slab shall be fortified with continual steel reinforcement. Fiber reinforcement alone shall not be considered adequate fortification.

### **1.6 Warranty**

1. Submit an extended system warranty in accordance with the General Conditions of the Contract.
2. Extended Warranty: for a period of two (2) years, including coverage against punctures, tears, delamination, and excessive wear.

## **PART 2 - PRODUCTS**

### **2.1 Manufacturers**

1. Sheet Flooring Taralay Impression Comfort by Gerflor is the basis of the design for the indoor resilient acoustic surfacing.  
Acceptable Alternate: Sarlon by Forbo  
Acceptable Alternate: Polyflor – Acoustix FX

### **2.2 Materials**

1. Taralay impression Comfort – multi-layered antistatic, acoustic foam backed sheet vinyl floorcovering providing 18dB sound insulation. The product comprises a Very High Density (VHD) foam reinforced with glass fibre grid and a printed design that is protected by a transparent wearlayer. It is treated with a UV cured surface treatment, which facilitates ease of maintenance and eliminates the need for acrylic emulsion (metallisation). The product has antistatic properties (AS Class 1) and incorporates an antibacterial and fungicidal treatment.
  - .1 Physical properties:
    - .1 Total thickness: 3.35 mm
    - .2 Width of sheet: 2 m
    - .3 Length of sheet: 25 m
    - .4 Wear resistance:  $\leq 0.08$  mm (EN 660.1)
    - .5 Impact sound insulation: 18 dB (EN ISO 717-2)
    - .6 Colour fastness:  $\geq 6$  degree (EN 20 105-B02)
    - .7 Anti-bacterial and fungicidal
    - .8 Surface treatment for UV protection.
  - .2 Colour: As available from the sheet flooring manufacturer's standard range. Allow for three (3) colours from full range of standard selection.
  - .3 Hardwood Design Series: A wood look design as available from the sheet flooring manufacturer's standard range including Maple Design and Oak Design
  - .4 Texture: Slightly grained (Hardwood Design Series) or textured (Solid Colors)
2. Welding Rod: As supplied by the manufacturer or supplier. Colour to blend with the product color or design. All seams shall be welded to create a monolithic and impermeable surface.



3. Adhesive: As approved by the manufacturer.

## **PART 3 – EXECUTION**

### **3.1 Examination**

1. It is the responsibility of the general contractor/construction manager to ensure that project/site conditions are acceptable for the installation of the indoor resilient athletic flooring.
2. Verify that the area in which the indoor resilient athletic surfacing will be installed is dry and weather tight. Verify that permanent heat, light and ventilation is installed and operable.
3. Verify that all other work that could cause damage, dirt and dust or interrupt the normal pace of the indoor resilient athletic flooring installation is completed or suspended.
4. Verify that there is a stable room temperature of at least 18° C.
5. Verify that there are no foreign materials or objects on the subfloor and that the subfloor is clean and ready for installation.
6. Direct Full Spread Adhering to Concrete Subfloor: moisture content less than 6 pounds/1,000 sq.ft./24 hours when tested using calcium chloride per ASTM F 1869 or no more than 83% RH when tested per ASTM F2170.
7. If both tests are performed, use the highest value. Do not average the results of the tests. Report all field test results in writing to the General Contractor, Architect, and End User prior to installation.
8. Verify that the concrete subfloor surface pH level is within the 7-9 range.
9. Document the results indicating the slab is within manufacturer's tolerances for slab deviation.

### **3.2 Preparation of Surfaces**

1. Sand the entire surface of the concrete slab.
2. Sweep the concrete slab so as to remove all dirt and dust. If a sweeping compound is to be used it must be a sweeping compound that does not contain oil or other items that may inhibit the adhesive bond.
3. Slab must be dust free. In the event that dust impairs adhesive bond, priming the slab prior to application of adhesive may be necessary. Follow installation guidelines.

### **3.3 Options for Moisture Mitigation**

1. For projects with moisture conditions higher than the specified tolerances TARKOLAY may be used for conditions that do not exceed 12lbs per ASTM F1869 and/or 92% per

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ASTM F2170. Use only approved two component urethane adhesives as directed by the manufacturer.

### **3.4 Installation**

1. The installation area shall be closed to all traffic and activity for a period to be set by the indoor resilient athletic surfacing installer. The indoor resilient athletic surfacing installation shall not begin until the installer is familiar with the existing conditions.
2. All necessary precautions should be taken to minimize noise, smell, dust, the use of hazardous materials and any other items that may inconvenience others.
3. Install the indoor resilient athletic surfacing in strict accordance with the indoor resilient athletic surfacing manufacturer's written instructions.
4. Install the indoor resilient athletic surfacing minimizing cross seams. Provide a seam diagram during the submittal process for approval prior to installation.
5. Paint game lines using approved game line paint primer and game line paint in strict accordance with the game line paint manufacturer's instructions.
6. Install appropriate threshold plates or transition strips where necessary.

### **3.5 Cleaning**

1. Remove all unused materials, tools, and equipment and dispose of any debris properly. Clean the indoor resilient athletic surfacing in accordance with the manufacturer's instructions.

### **3.6 Protection**

1. If required, protect the indoor resilient athletic surfacing from damage using coverings approved by the manufacturer until acceptance of work by the customer or their authorized representative.

### **3.7 Related Standards and Guidelines**

1. ASTM F1869 "Standard Test Method for Measuring Moisture Evaporation Rate of Concrete Subfloor Using Anhydrous Calcium Chloride"
2. ASTM F2170 "Standard Test Method for Determining Relative Humidity In Concrete Floor Slabs Using In-Situ Probes"
3. ASTM F170 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring"
4. ACI 302.2R-06 "Guideline for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials"

End of Section

## **PART 1 - GENERAL**

### **1.1 Related Work**

1. Shop priming structural steel: refer to drawings
2. Shop painting miscellaneous metals: Section 05500
3. Door Schedule refer to drawings
4. Shop priming of ferrous doors and door frames: Section 08100
5. Room Finish Schedule refer to drawings

### **1.2 Reference Standard**

1. CAN/CGSB-85.100-93: Painting.
2. Underwriters Laboratories of Canada: List of Equipment and Materials.
3. Ontario Painting Contractors' Association (OPCA) Architectural Specification Manual.

### **1.3 Product Data**

1. Submit to Architect, for review, product data for all formulas, including manufacturer's trade names.
2. Paint Manufacturer will provide periodic reviews and reports to Architect regarding work in this Section and adherence to manufacturer's product specifications.

### **1.4 Qualifications**

1. Manufacturer: use only paint manufacturers and products listed in the OPCA Architectural Painting Specification Manual – Paint Product Recommendation section.
2. Applicators: company specializing in the work of this Section, and with a minimum of ten years documented experience. Employ only qualified journeymen and apprentices having a provincial Tradesmen Qualification certificate of proficiency.

### **1.5 Environmental Requirements**

1. Do not apply paint finish in areas where dust is being generated.
2. Conform to requirements of OPCA Manual.
3. Comply with the requirements of Section 01570 Health and Environmental Specifications.

### **1.6 Extent of painting**

1. For new construction, for rooms shown in room finish schedule to have painted walls, paint all non prefinished surfaces unless indicated otherwise, and repaint prefinished surfaces where indicated.

### **1.7 Finishes and Colours**

1. Allow for 10 colours total from all formulations for this project. Doors, door frames, walls and ceilings will have different colors. Colors may change from room to room.

### **1.8 Warranty**

1. Provide a two (2) year warranty on completion stating that the work has been performed with respect to the standards and requirements incorporated in the OPCA specification manual latest edition.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

1. Acceptable products: Per Chapter 5 OPCA Manual as listed.
2. Paint materials for each paint system to be products of a single manufacturer.
3. Use low-VOC and low-odour paints only.

## **PART 3 - EXECUTION**

### **3.1 Preparation of Surfaces in new Construction**

1. Prepare surfaces to receive paint per Chapter 3 OPCA Manual.
2. Prepare wood surfaces to CGSB 85-GP-1M.
  - .1 Use CGSB 1-GP-126M vinyl sealers over knots resinous areas.
  - .2 Apply wood paste filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
3. Touch up shop paint primer on steel with CGSB 1-GP-40M to CGSB 85-GP-14M.
4. Prepare galvanized steel and zinc coated surface to CGSB 85-GP-16.
5. Prepare wallboard surfaces to CGSB 85-GP-33M. Fill minor cracks with plaster patching compound.

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### **3.2 Application**

1. Sand and dust between each coat to remove defects visible from distance up to 1.5 m.
2. Finish closets and alcoves as specified for adjoining rooms.
3. Apply each coat at the proper consistency. Each coat of finish should be fully dry and hard before applying the next coat, unless the manufacturer's instructions state otherwise.

### **3.3 Mechanical and Electrical Equipment**

1. Paint exposed conduits, pipes, hangers and other mechanical and electrical equipment occurring in finished areas as well as inside cupboards and cabinet work. Colour and texture to match adjacent surfaces, except as noted otherwise. Coordinate with mechanical trades applying banding and labeling after pipes have been painted. Do not paint white PVC covers on exposed mechanical water, drain and other lines
2. Paint gas piping standard yellow where visible on roof or in service spaces.
3. Paint surfaces inside of ductwork and elsewhere behind grilles where visible using primer and one coat of matte black paint.
4. Paint both sides and edges of plywood backboards for equipment before installation.
5. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

### **3.4 Paint Systems**

1. System references listed are based on Chapters 4A and 4B of OPCA Manual and are OPCA Premium Grade, unless noted otherwise.

### **3.5 Interior Finishes**

1. Wood, where applicable: INT. 1-A, Alkyd Semi-Gloss Finish, Premium Grade.
2. Wood, where applicable, INT-1E, lacquer finish semi gloss.
3. Gypsum board - Ceilings and bulkheads - INT. 4-B, Latex Flat Finish, Premium Grade.
4. Gypsum board – partitions INT-4B latex semi-gloss, Premium Grade.
5. Gypsum board – partitions where noted GF in room finish schedule. INT 4A, alkyd gloss finish, Premium Grade.
6. Concrete Block: INT. 8-A, Latex Semi-Gloss Finish, Premium Grade.
7. Concrete Block – Where noted GF in room finish schedule: INT.8B, Alkyd Gloss finish, Premium grade.

8. Structural Steel and Miscellaneous Metal:

- .1 Primed: INT. 12-A, Alkyd Semi-Gloss Finish, Premium Grade, four coats.
- .2 Galvanized: INT. 13-A, Alkyd Semi-Gloss Finish, Premium Grade, four coats.

9. Galvanized metal: INT. 13-A, Alkyd Semi-Gloss Finish, Premium Grade, four coats.

10. Galvanized steel deck: INT 13E, Alkyd dry fall.

**3.6 Exterior Finishes**

1. Wood: EXT. 1-A-Gloss, Premium Grade.

2. Metal:

- .1 Primed: EXT. 11-A-Glos, Premium Grade.
- .2 Galvanized: EXT. 12-A-Gloss, Premium Grade.

End of Section

## **PART 1 - GENERAL**

### **1.1 Shop Drawings**

1. Submit shop drawings in accordance with Section 01340.

## **PART 2 - PRODUCTS**

### **2.1 Fixtures**

#### **1. Window Coverings:**

- 1) Manufacturer - Stevans Sales & Marketing [www.stevansinc.com](http://www.stevansinc.com)
- 2) Model: SheerWeave – Style 4800, made from vinyl-coated polyester yarns.
- 3) Fire Classification – CAN/ULC-S109-03 – NFPA 701 TM#2 Large Scale, ASTM E 84 Class 1
- 4) Bacteria and Fungal Resistance and Microban antimicrobial additives
- 5) Roll up shades with 10 year interior warranty.
- 6) Size to suit window openings.
- 7) Openness Factor- approx. 1%
- 8) UV Blockage: approx. 99%
- 9) Fabric Thickness: 0.036 in. or (0.91mm)
- 10) Location: as noted on drawings.
- 11) Colour: By architect from standard selection.

## **PART 3 – EXECUTION**

### **3.1 Installation**

1. Install where indicated on drawings and as per manufacturer's instructions.

### **3.2 Demonstration and Training**

1. Provide demonstration of operation to the Owner and his representatives.
2. Provide training for operation, maintenance and repairs.

End of Section

## **PART 1 - GENERAL**

### **1.1 General Requirements**

1. Division One, General Requirements is part of this Section and shall apply as if repeated here.

### **1.2 Related Work**

1. Washroom Accessories: Section 10800

### **1.3 Submittals**

1. Shop Drawings: Submit shop drawings in accordance with Section 01340, for Consultant's review before fabrication, indicating material, finish, dimensions, details of connections and fastenings, elevations, plans, sections, thicknesses, hardware and other pertinent information.
2. Samples: Submit samples of finish hardware and powder-coated sample in selected colour and finish in accordance with Section 01340, for approval of Consultant.

## **PART 2 - PRODUCTS**

### **2.1 Material Description**

1. Manufacturers of metal toilet partitions having product considered acceptable for use:
  - a. Bradley Corporation
  - b. Global Steel Products Corporation
  - c. Hadrian Manufacturing
  - d. General Storage Systems
  - e. ASI/Watrous
  - f. Shanahan's
- .1 **Divider Panels: 900mm wide x 1500mm high**: 25 mm thick and 0.76 mm thick steel sheet faces with honeycomb core and internal reinforcing. Mounted 300mm from finished floor.
- .2 Hardware: .67 institutional extra heavy duty, type 304 satin finish stainless steel, angle brackets, U-channels and spring-loaded, self-closing hinge run full height of panel and door; for emergency access, door lift from outside. All fasteners to be pin-head Torx screws.

## **PART 3 – EXECUTION**

### **3.1 Installation**

1. Install compartments in accordance with reviewed shop drawings and in a neat, rigid manner free of defects.



2. Install units secure, accurately positioned, plumb, level, square and free from sag and distortion.
3. Perform drilling of steel, masonry and concrete necessary to install this work.
4. Ensure spaces between panels and pilasters, between panels and walls and between pilasters and walls are of uniform consistent width and sized to ensure it is not possible to see persons using the compartments.
5. Coordinate installation with the work of trades providing ceilings, wall and floor finishes, shower accessories and other adjacent components and construction.

### **3.2 Adjustment**

1. Upon completion of the work or when directed, remove all traces of protective coating or paper.
2. Clean exposed surfaces and fittings.
3. Test hinges, locks and latches and where necessary, adjust and lubricate. Set hinges so that doors stand open maximum 30 degrees when compartment is not in use. Ensure that partitions are in working order.

End of Section

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## **PART 1 - GENERAL**

### **1.1 General Requirements**

1. Division One, General Requirements is part of this Section and shall apply as if repeated here.

### **1.2 Related Work Specified Elsewhere**

1. Electrical conduit and wiring to junction boxes and hand dryers: refer to Electrical

### **1.3 Referenced Standards**

1. ASTM A167-87: Specification for Stainless and Heat Resisting Chromium -Nickel Steel Plate, Sheet and Strip
2. ASTM A525: Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process (Metric)
3. CAN/CSA-G164-M92: Hot Dip Galvanizing of Irregularly Shaped Articles.

### **1.4 Shop Drawings**

1. Submit shop drawings in accordance with Section 01340, for Consultant's review before fabrication. Shop drawings of units for use by the handicapped shall be distinctly marked and cross-referenced to the corresponding article in the specifications.

### **1.5 Quality Standard**

1. This specification section is based generally on Bobrick equipment. Similar equipment and accessories by ASI Group Watrous Inc. and American Specialties Inc. are also acceptable.

## **PART 2 - PRODUCTS**

### **2.1 Materials - Generally**

1. Ferrous Steel: Sheet, cold-rolled furniture steel, double annealed, mill stretched and leveled, and fully pickled. Otherwise, steel shall be hot-rolled or cold-rolled of alloy to suit needs of fabrication, use, and appearance.
2. Stainless Steel: Type 304, conforming to ASTM A167-87, No. 4 finish.
3. Galvanized Steel: For sheet, Z275 zinc coating designation in accordance with ASTM Specification A525. For irregular sections, hot dip galvanized to comply with CSA G164.
4. Anchors and Fastenings: Where exposed, use stainless steel and otherwise to match metal anchored. Where non-exposed, use the same as that specified for exposed, or

use galvanized steel. Anchors and fastenings shall be of the type appropriate for the substrate to which accessory unit is secured.

## **2.2 Products**

### **1. Mirrors**

- .1 **(M1)** B-290 series by Bobrick, stainless steel frame, vandal resistant mounting, 6 mm glass mirror with 15 year guarantee against silver spoilage.  
Size: 600 x 910 mm. Quantity: refer to drawings
- .2 Handicapped mirror **(M2)**: B-293 series by Bobrick (tilt mirror), stainless steel.  
Size: 600 x 910 mm. Quantity: Refer to drawings.  
Quantity: refer to drawings.

### **2. Handicapped Grab Bars (GB): Series B-5806 by Bobrick**

- .1 GB-1: B-5806 x 600 mm long bar behind water closet. Installed as per drawing.  
GB-2: B-5898 x 750 mm x 750 mm "L" shaped grab bar beside water closet mounted as per OBC requirements.
- .2 All bars to have concealed mounting hardware.
- .3 Quantity: refer to drawings.
- .4 All bars to withstand horizontal and vertical pull of 2.2 kN

### **3. Vandal Resistant Clothes Hooks (CH): Model B-983**

- .1 Stainless steel
- .2 Quantity: 1, Universal and Barrier-free washroom. Mounting height to be 1200 max.

### **4. Stainless Steel Shelf (WSH): Bobrick B-295 x 400mm**

Location: Universal Washroom.

### **5. Toilet Tissue Dispenser (TPD): install only – Allow for installation of Owner supplied units.**

### **6. Paper Towel Dispensers (PTD): Install only - Allow for installation of Owner supplied units.**

### **7. Soap Dispensers: Not in Contract (NIC) - Allow for installation of Owner supplied units**

### **8. Sanitary Napkin Disposal (ND): Model B-270 by Bobrick**

- .1 Stainless steel, recessed.
- .2 Quantity: 2, refer to drawings

### **9. Mop and Broom Holder (MH): Model B-223 x 24**

- .1 Quantity: 1

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### **2.3 Component Minimum Requirements**

1. **Construction:** Fabricate with materials, component sizes, metal gauges, reinforcing, anchors and fasteners of adequate strength to withstand intended use.
2. Where specified as frameless, provide stainless steel accessories with one-piece fronts having 90 degree formed returns at their edges and openings.
3. Where accessory fronts are framed, frame edges, both inside and outside, with 90 degree formed returns continuously welded and ground smooth at the corners. Doors shall also have 90 degree formed returns as specified.
4. Unless otherwise specified, hinges shall be semi-concealed stainless steel piano hinges extending full-length of hinged element. Provide hinged elements with concealed, mechanically-retained rubber bumpers for silent closing, and shall close flush with faces of fronts or frames.
5. Ensure that work will remain free of warping, buckling, opening of joints and seams, distortion and permanent deformation.
9. No exposed fixings permitted. Cut edges and openings square and smooth. Chamfer corners of edges and cut-outs 1.6 mm.
7. **Assembly:** Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.
8. Fasten work with concealed methods, unless otherwise indicated on Drawings.
9. Weld all connections where possible, bolt where not possible and cut off bolts flush with nuts. Countersunk bolt heads, and provide method to prevent loosening of nuts. Ream holes drilled for fastening.
10. Welded joints shall be tight, flush, and in true planes with base metals. Make welds continuous at joints where entry of water into voids of members or assemblies is possible.
11. Provide for differential movements within assemblies and at junctions of assemblies with surrounding work.
12. Welds in exposed locations shall be ground and polished smooth.
13. **Finish Work:** Provide holes and connections for related work installed under other Sections of this specification, if applicable.
14. Cleanly and smoothly finish exposed edges of materials, including holes.

## **PART 3 - EXECUTION**

### **3.1 Inspection of Site**

1. Take site measurements to ensure that work is fabricated to fit surrounding construction around obstructions and projects in place, or as shown on drawings, and to suit service locations.

### **3.2 Installation**

1. Install all accessories in accordance with manufacturers' instructions at their recommended mounting heights unless noted otherwise on drawings.
2. Securely fasten accessories plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding work. Install in locations shown and specified herein. Mounting heights as shown or in accordance with the OBC in the case of barrier-free accessories.
3. Work shall include anchor bolts, bolts, washers and nuts, lag screws, expansion shields, toggles, straps, sleeve brackets, clips, and other items necessary for secure installation, as required by loading and by Jurisdictional Authorities.
4. Attach work at wood by screws through countersunk holes in metal.
5. Attach work to masonry with lead plugs and non-corrosive fastenings, to support load with a safety factor of 3. Perform all drilling necessary to install the work.
6. Insulate between dissimilar metals or between metals and masonry or concrete with bituminous paint, to prevent electrolysis.
7. Coordinate installation with the work of other trades adjacent to accessories to achieve the reveals or other edge conditions shown, where their front faces are flush with the finished wall surfaces.
8. Owner to supply and install remainder of washroom accessories not specified here (toilet paper dispensers, etc.). Cooperate with Owner as required.

### **3.3 Cleaning Up and Adjustment**

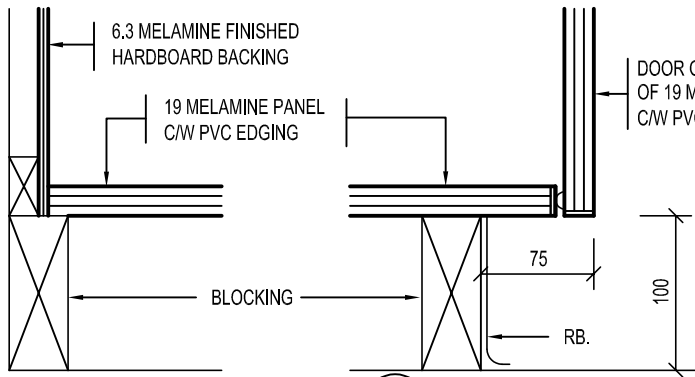
1. Upon completion of the work, or when directed, remove all traces of protective coatings or paper.
2. Test mechanisms, hinges, locks and latches, and where necessary, adjust and lubricate and ensure that accessories are in perfect working order.

End of Section

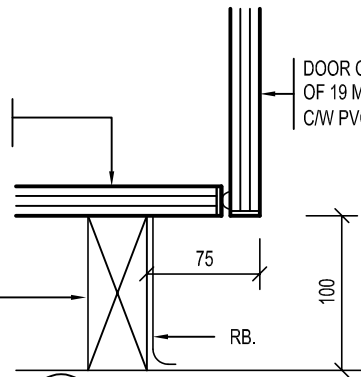
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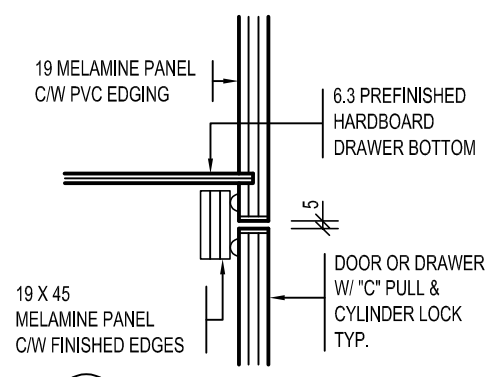
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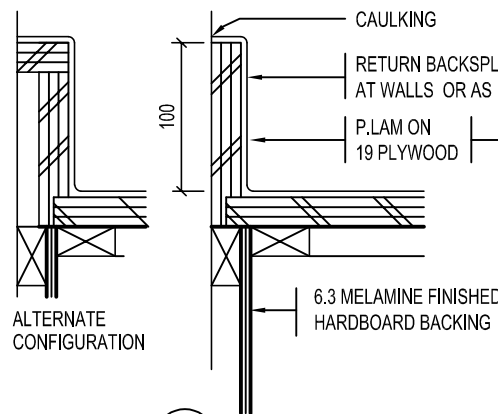
1 COUNTER AT WALL



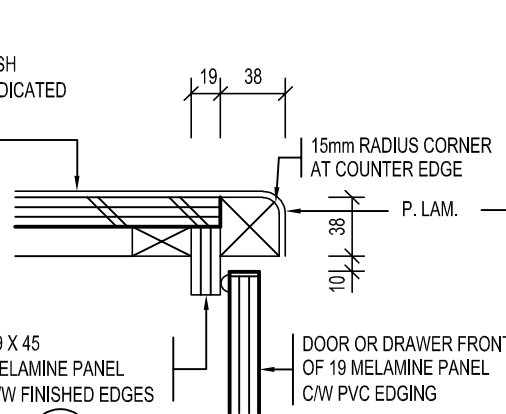
2 BASE



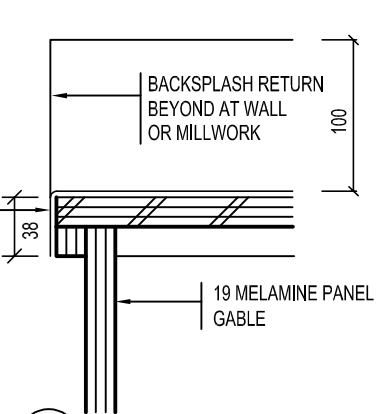
3 DRAWER FACE



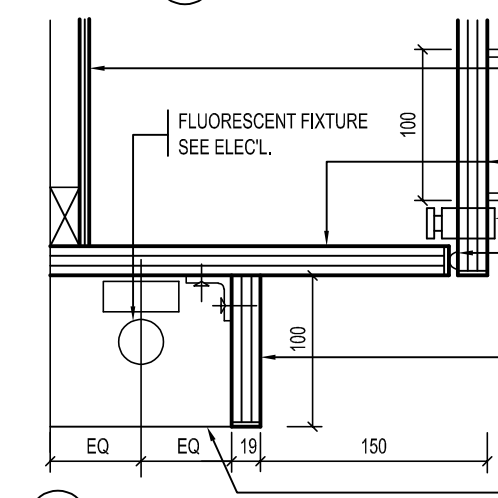
4 BACKSPASH



5 COUNTER EDGE



6 END OF COUNTER



7 UPPER CUPBOARD  
(VALANCE WHERE SHOWN ON ELEVATIONS)

**TYPICAL NOTES:**

- 1) MILLWORK IS 19mm CONSTRUCTION UNLESS OTHERWISE NOTED. REFER TO SPECIFICATIONS FOR MATERIAL TYPES & FINISHES
- 3) ALL MILLWORK TO BE MELAMINE FINISHED UNLESS OTHERWISE NOTED.
- 2) MILLWORK FILLER PANEL (FP) TO BE PROVIDED ON ALL EXPOSED FACES (TOP, BOTTOM, AND VERTICAL FACES) WHERE SHOWN

**ABBREVIATIONS:**

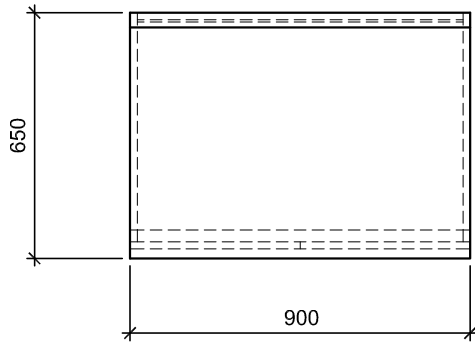
CLR	CLEAR
C/W	COMPLETE WITH
DIA	DIAMETER
ELEV	ELEVATION
EQ	EQUAL
EQ(x)	EQUAL
FFE	FINISHED FLOOR ELEVATION
FP	FILLER PANEL
MIN	MINIMUM
MAX	MAXIMUM
MTP	METAL TOILET PARTITION
N.I.C.	NOT IN CONTRACT
O/C	ON CENTER
O.C.	ON CENTER
P.LAM	PLASTIC LAMINATE
RB	RUBBER BASE
RM	ROOM
S.S.	STAINLESS STEEL
TYP	TYPICAL
W/	WITH

**BANBURY ELEMENTARY SCHOOL  
CHILD CARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**TYPICAL DETAILS**  
(REFERENCE: )

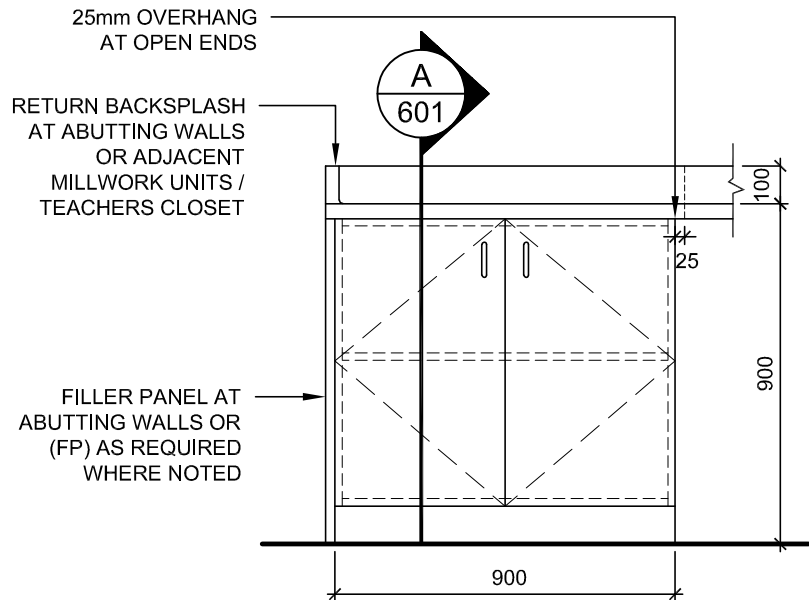
PROJ:	2022-08
SCALE:	AS NOTED
DRAWN:	DW
DATE:	2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

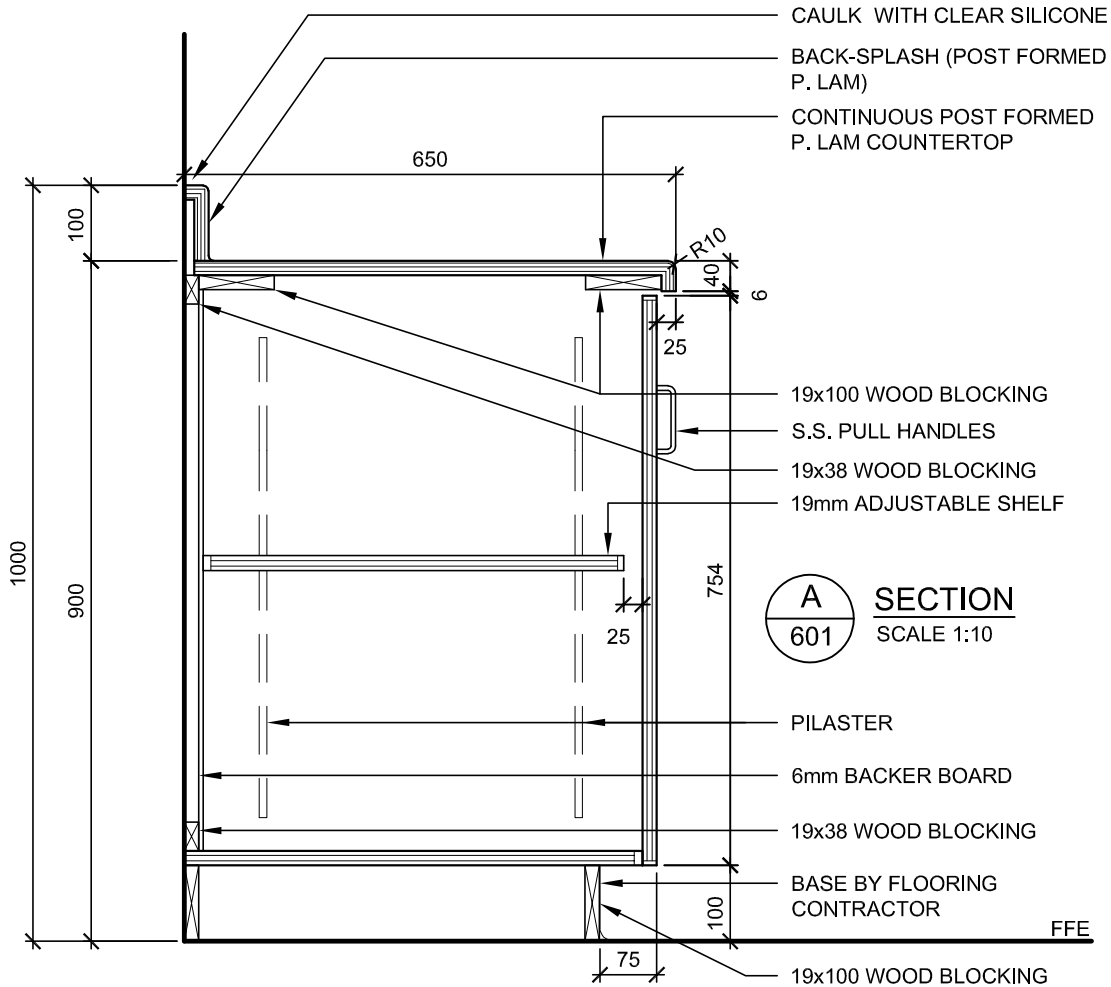
**AD  
600**



**PLAN VIEW**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20



**A SECTION**  
601 SCALE 1:10

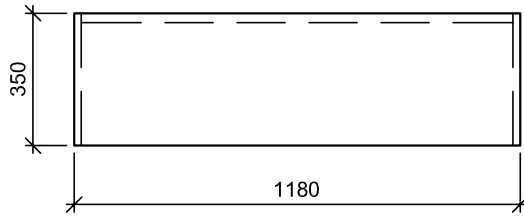
**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE B1**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

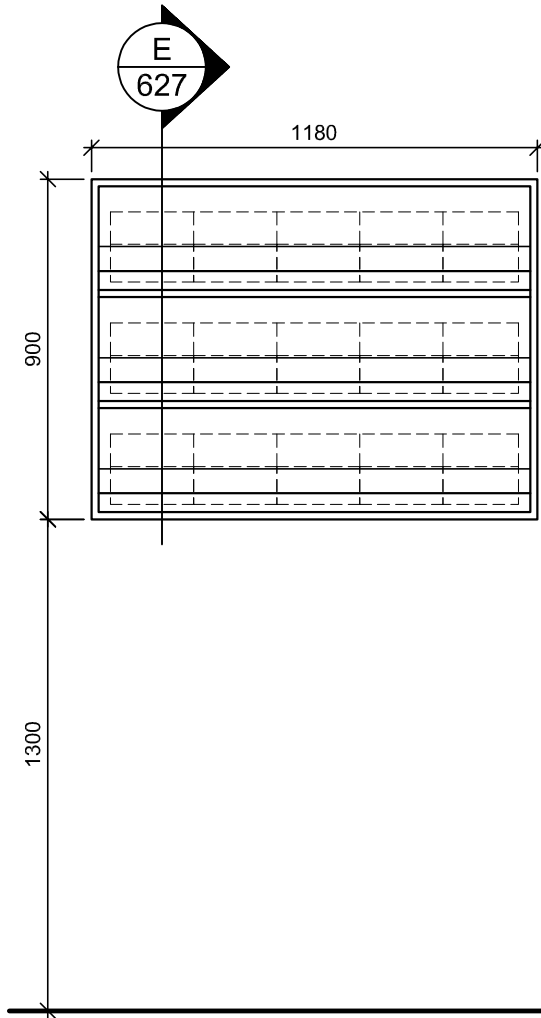
**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
601**

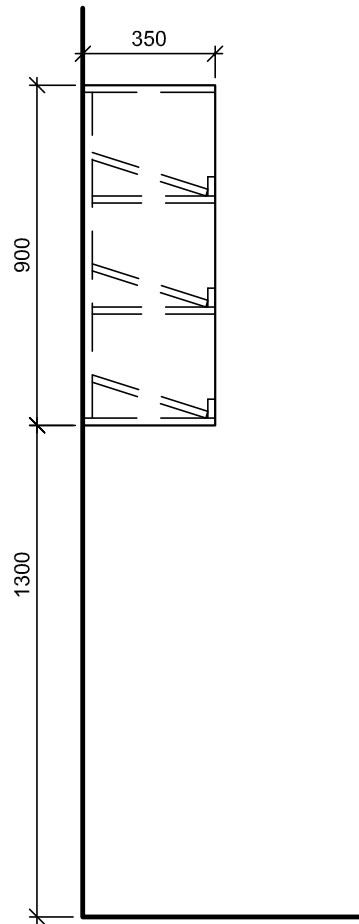




**PLAN**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20



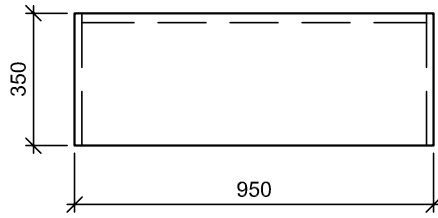
**SIDE ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE - U1**  
(REFERENCE: A2.20)

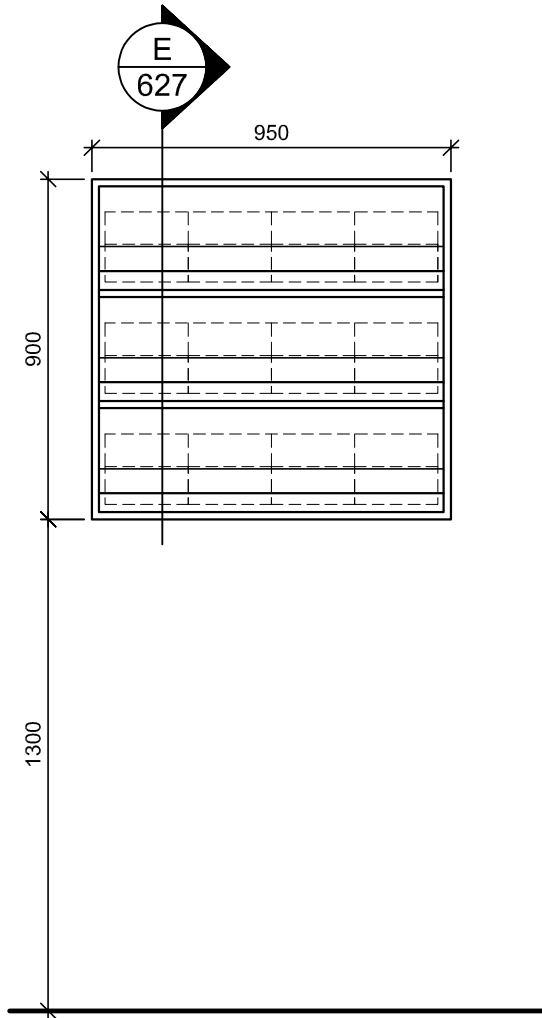
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
Web: [www.2gai.com](http://www.2gai.com)

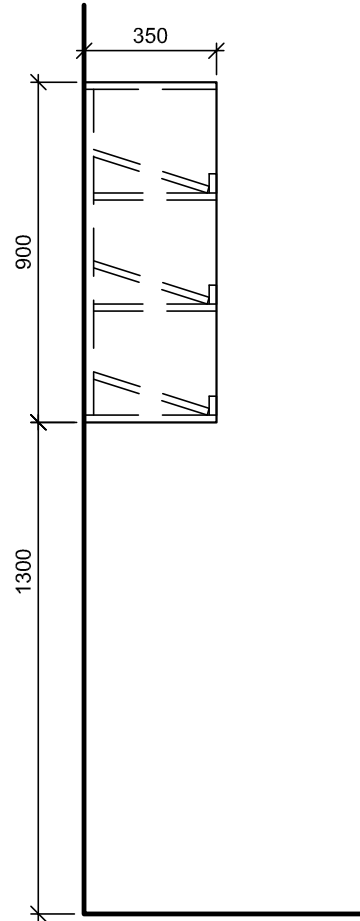
**AD**  
**602**



**PLAN**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20



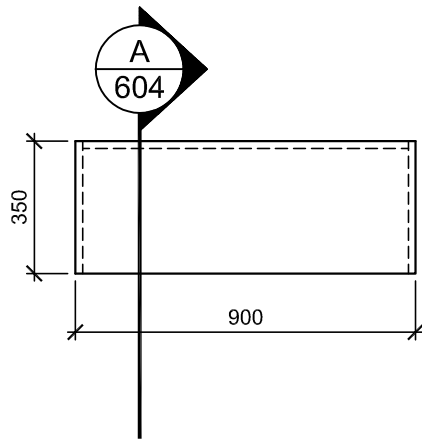
**SIDE ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE - U2**  
(REFERENCE: A2.20)

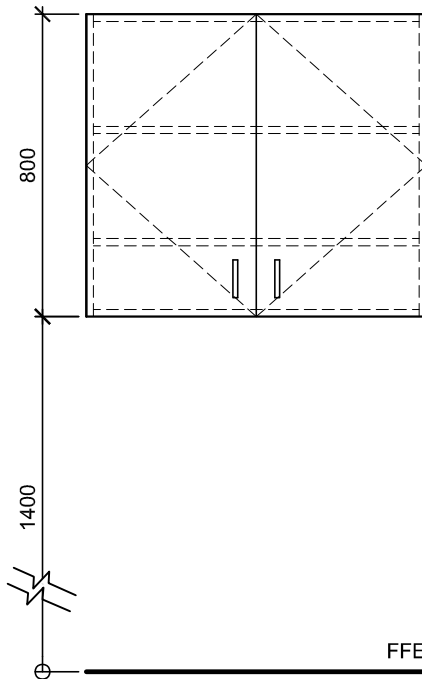
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
Web: [www.2gai.com](http://www.2gai.com)

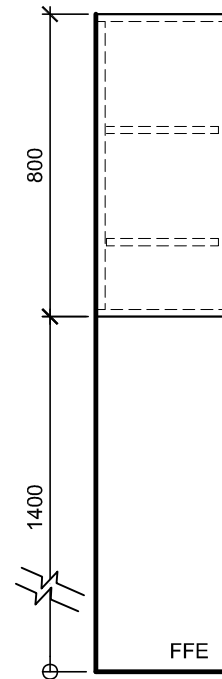
**AD**  
**603**



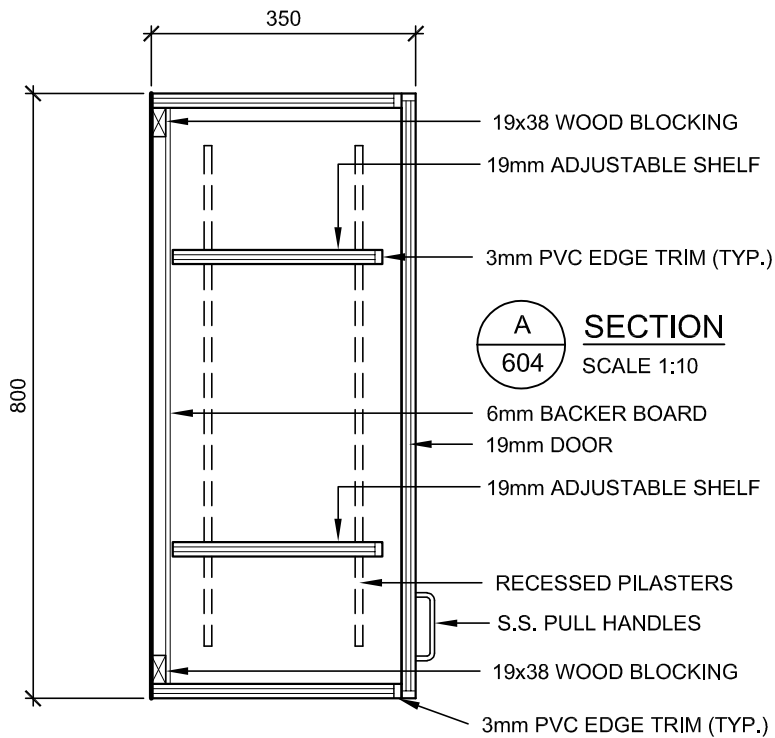
**PLAN**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20



**SIDE ELEVATION**  
SCALE 1:20



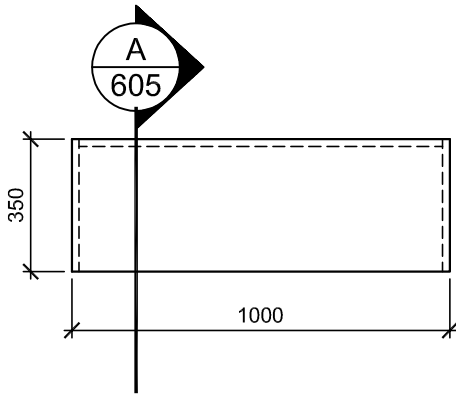
**SECTION**  
SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE - U3**  
(REFERENCE: A2.20)

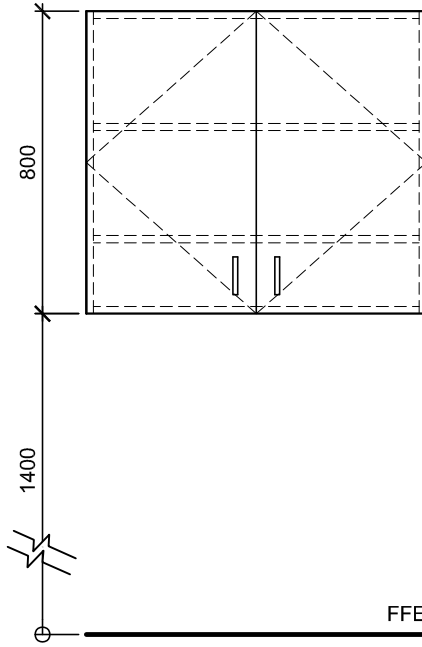
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

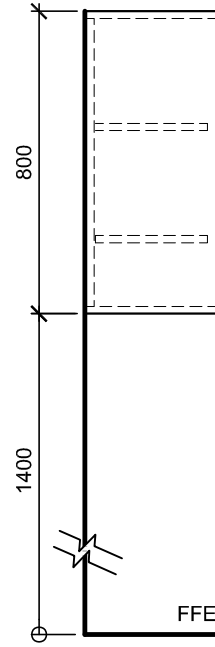
**AD  
604**



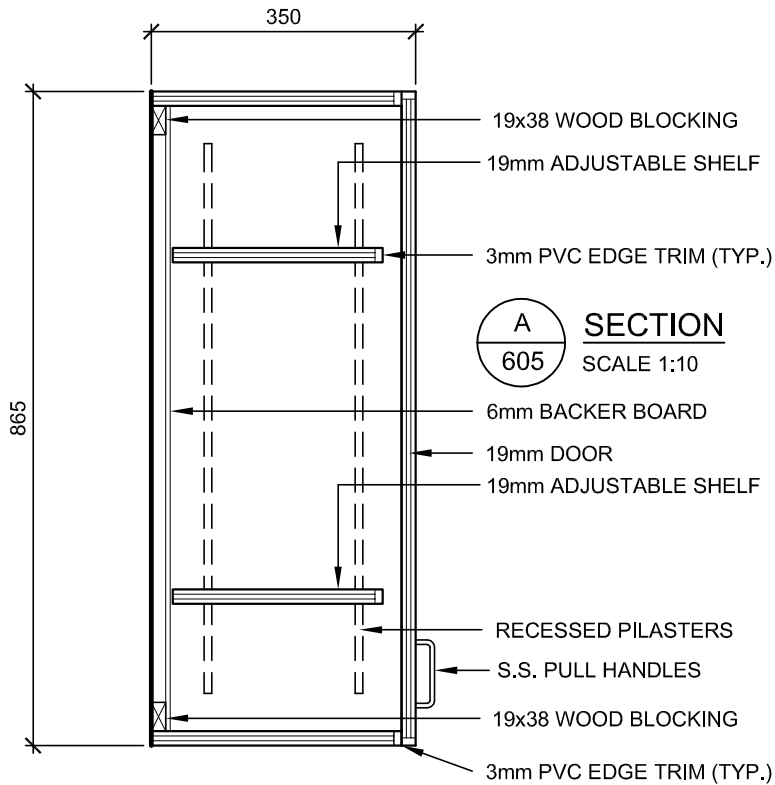
**PLAN**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20



**SIDE ELEVATION**  
SCALE 1:20



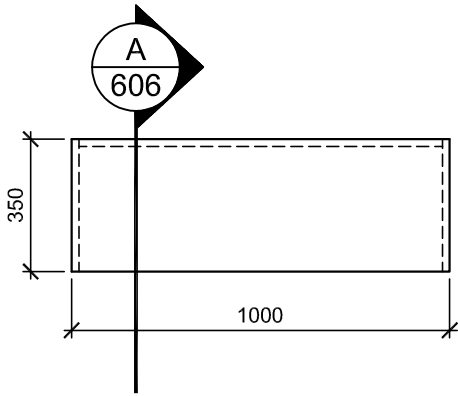
**A**  
**605** **SECTION**  
SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE - U4**  
(REFERENCE: A2.20)

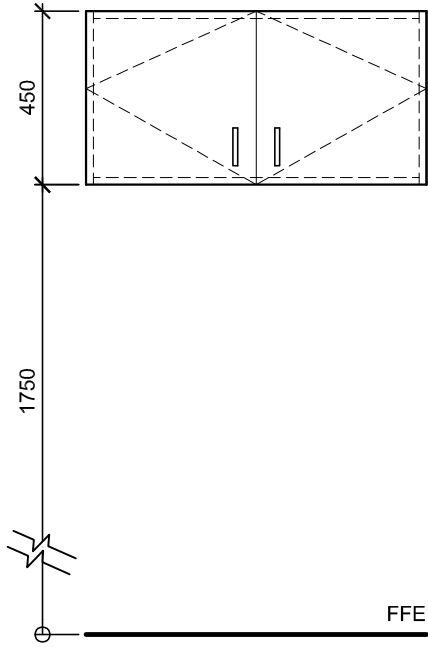
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

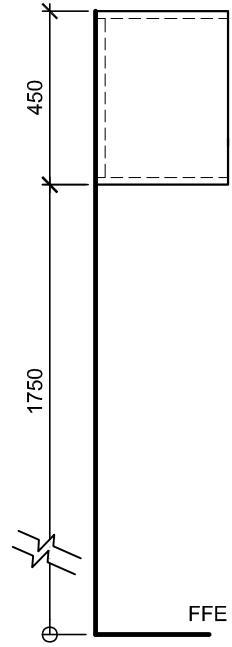
**AD  
605**



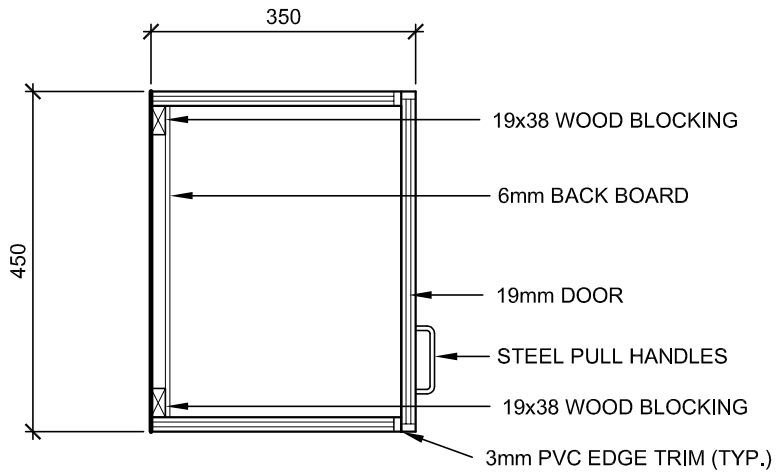
**PLAN**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20



**SIDE ELEVATION**  
SCALE 1:20



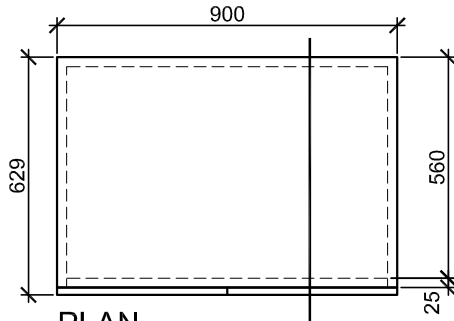
**SECTION**  
SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE - U5**  
(REFERENCE: A2.20)

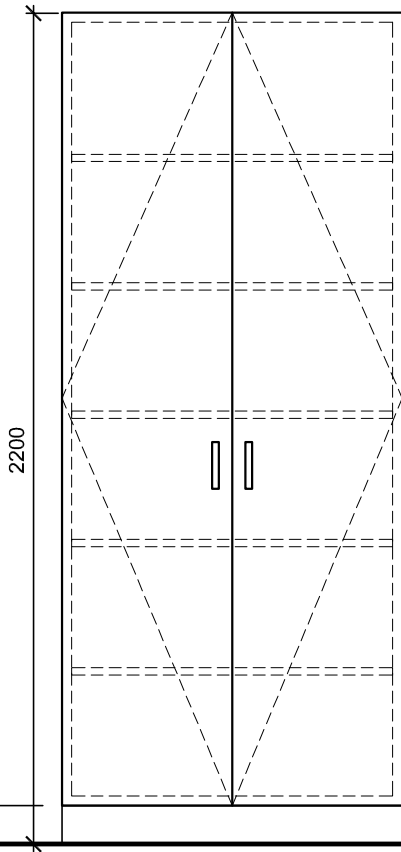
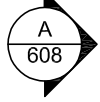
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

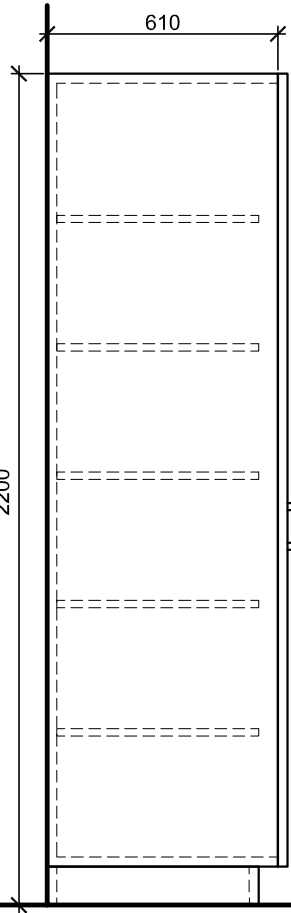
**AD  
606**



**PLAN**  
SCALE 1:20



**FRONT ELEVATION**  
SCALE 1:20



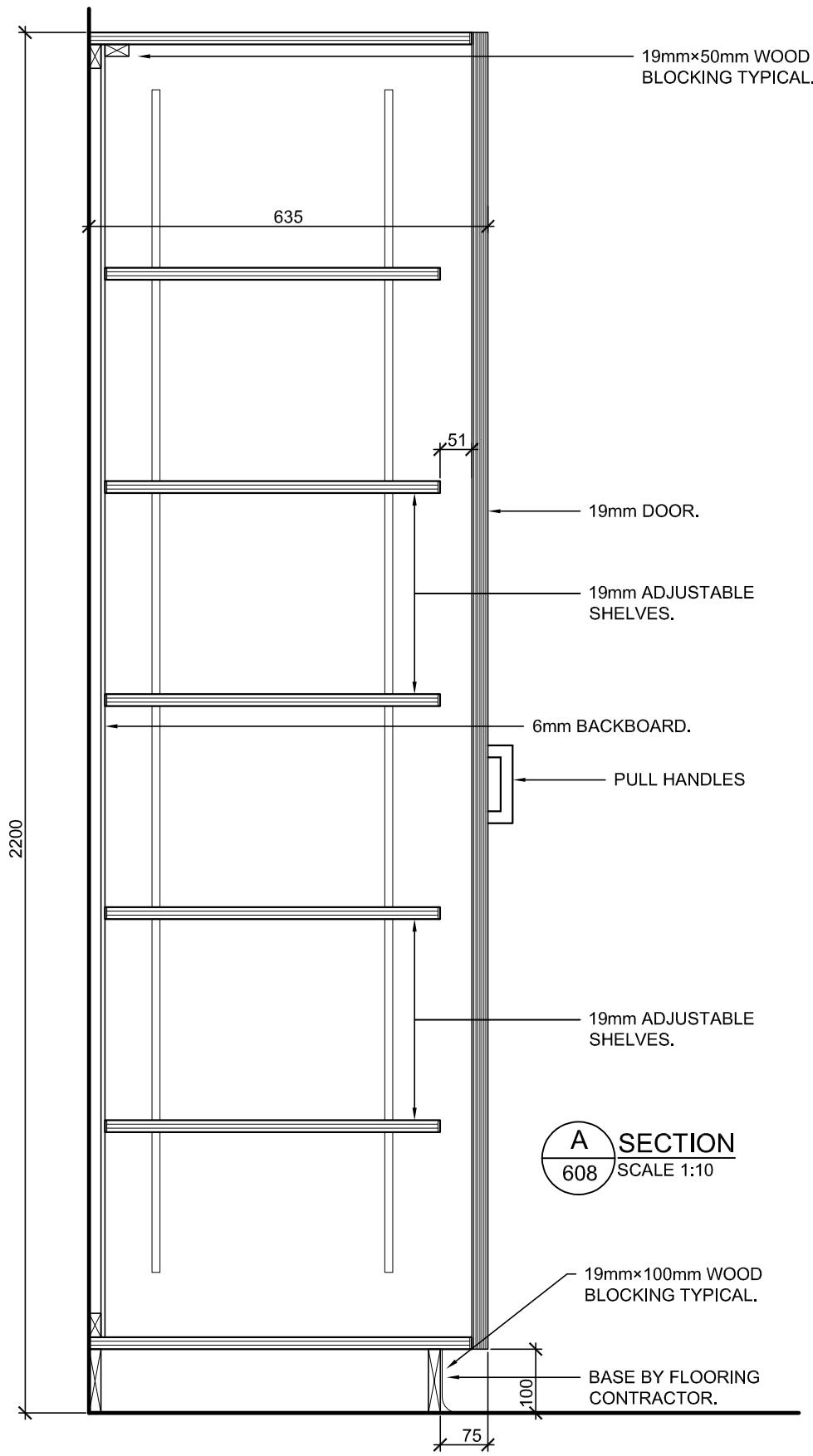
**SIDE ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILWORK TYPE T1**  
(REFERENCE: A2.20)

PROJ:	2022-08
SCALE:	AS NOTED
DRAWN:	DW
DATE:	2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
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**AD**  
**607**



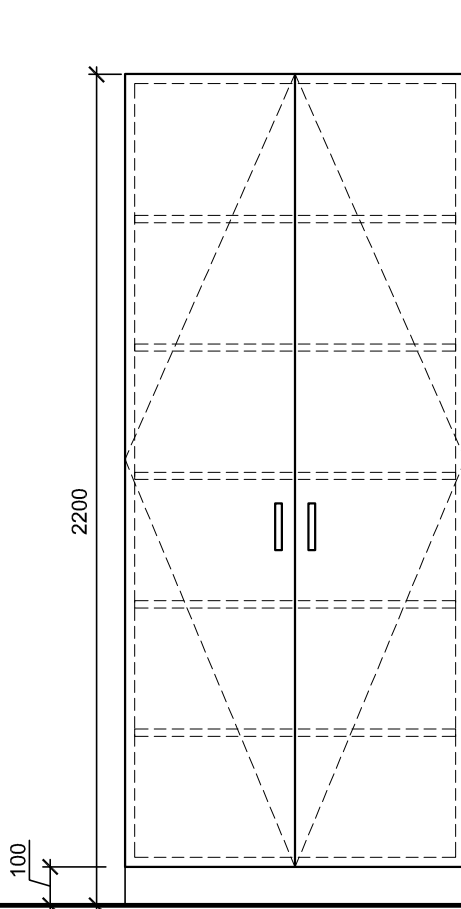
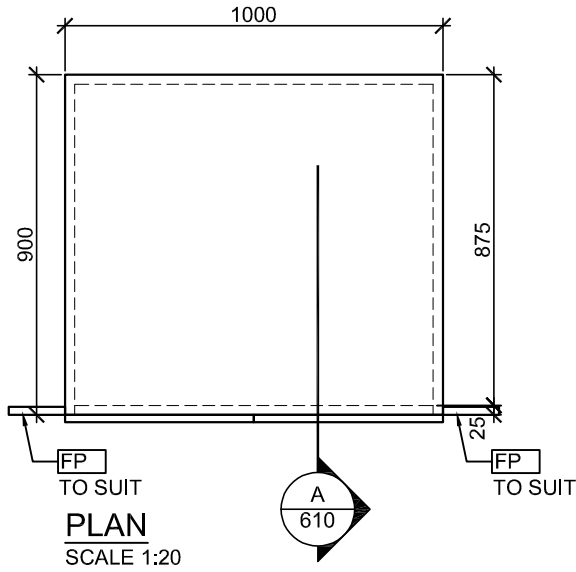
**A** SECTION  
608 SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE T1 (SECTION A)**  
(REFERENCE: AD 607)

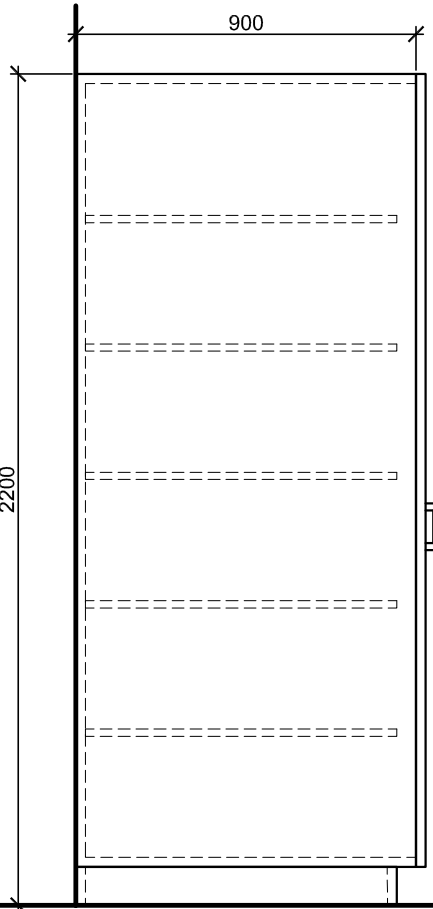
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
608**



**FRONT ELEVATION**  
SCALE 1:20



**SIDE ELEVATION**  
SCALE 1:20

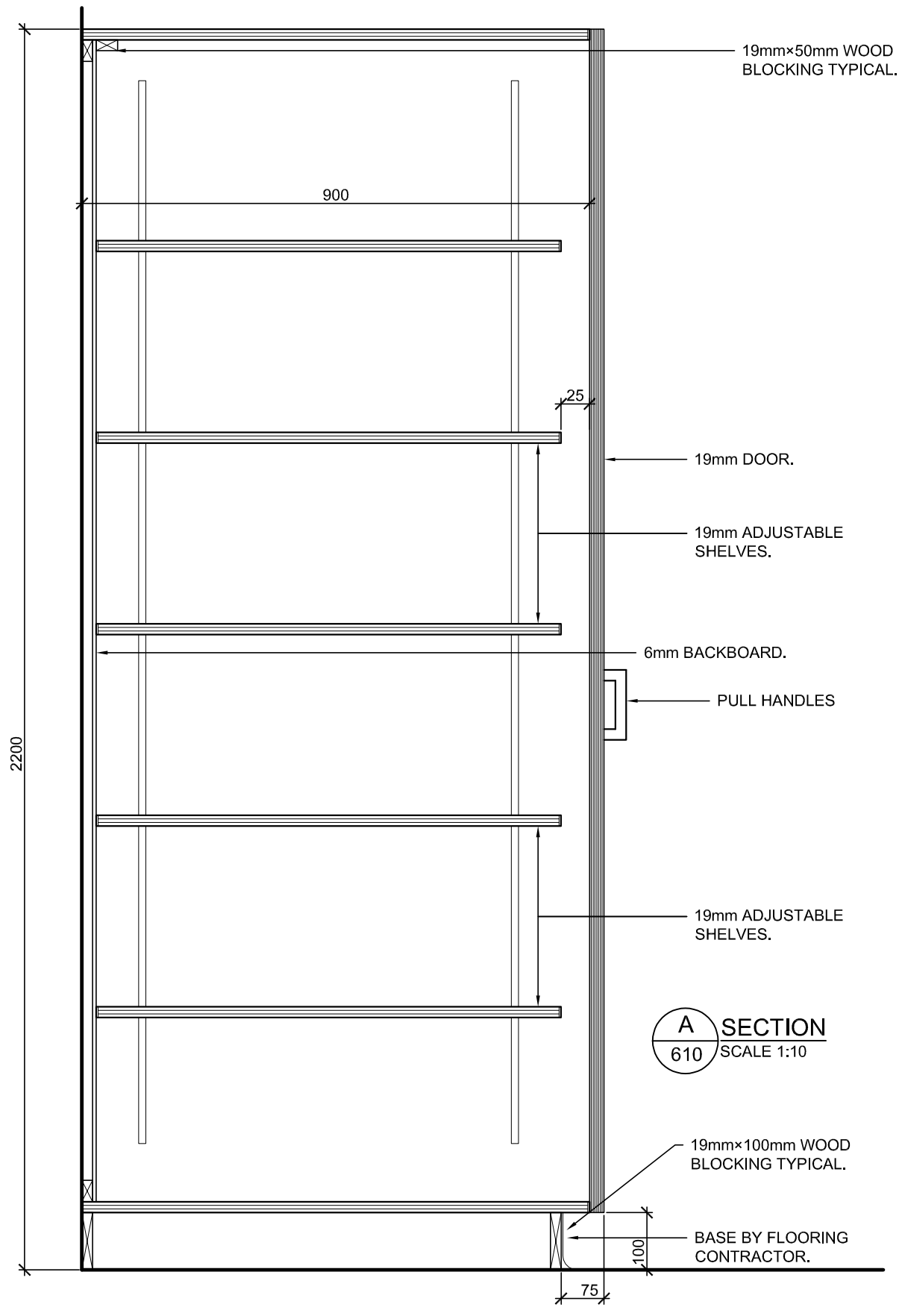
**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE T2**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
Web: www.2gai.com

**AD**  
**609**





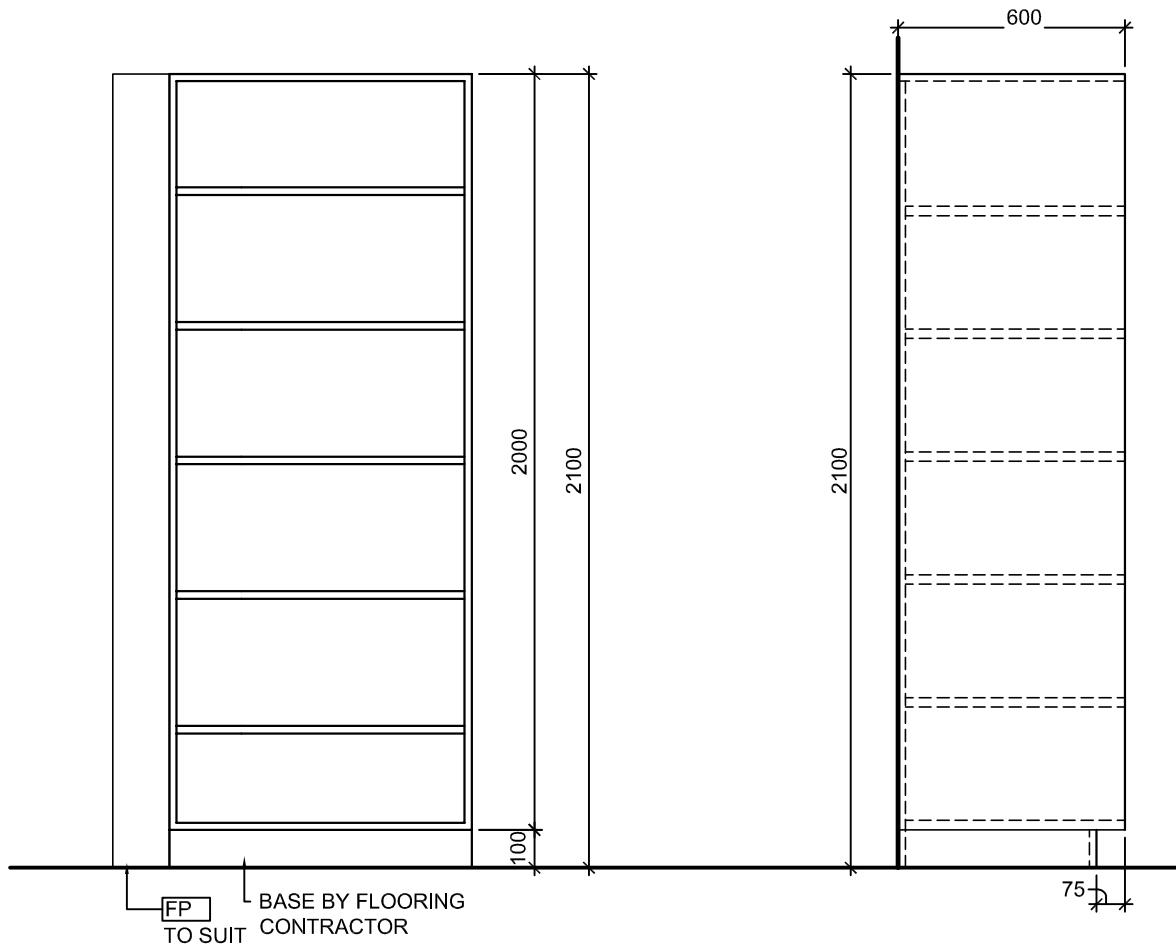
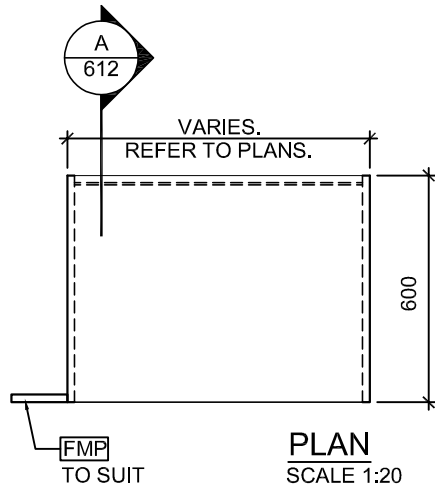
**A** SECTION  
610 SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE T2 (SECTION A)**  
(REFERENCE: AD 609)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
610**



**ELEVATION**  
SCALE 1:20

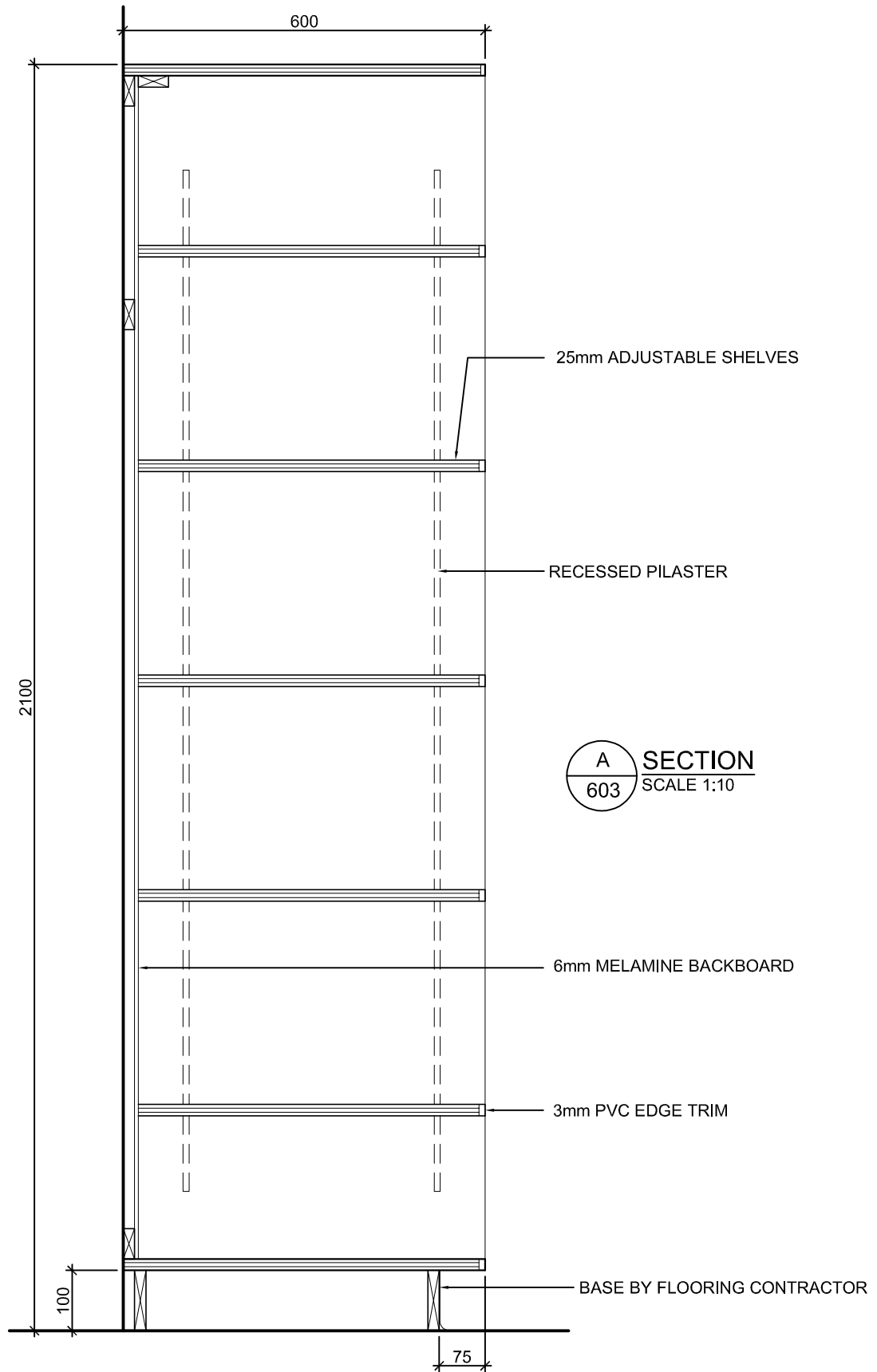
**SIDE ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE SH1**  
(REFERENCE: AD 638)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
Web: [www.2gai.com](http://www.2gai.com)

**AD**  
**611**

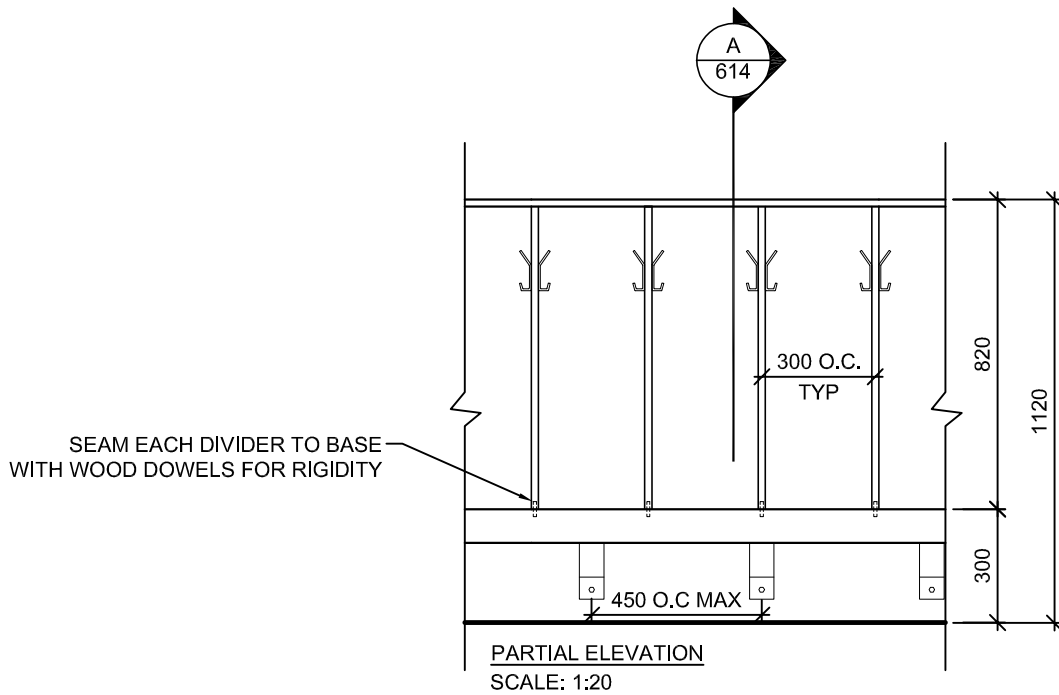
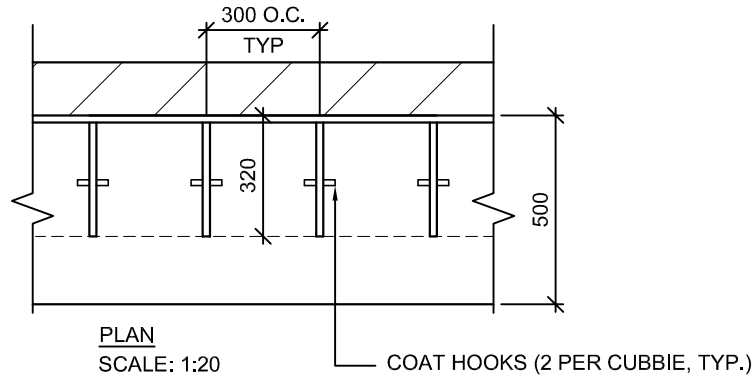


**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE SH1 (SECTION A)**  
(REFERENCE: AD 611)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
612**

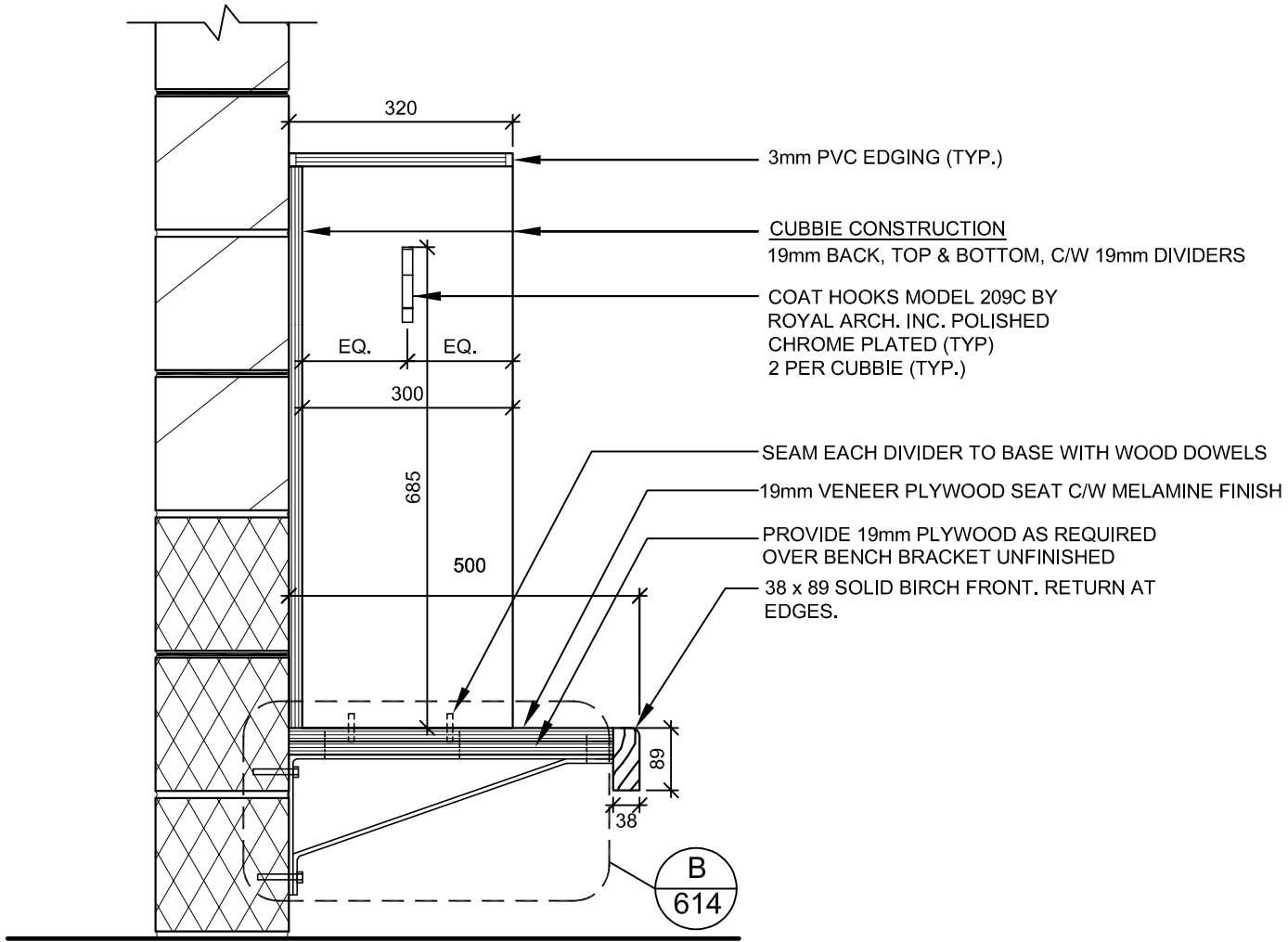


**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE C1**  
 (REFERENCE:A2.20 )

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
 Web: www.2gai.com

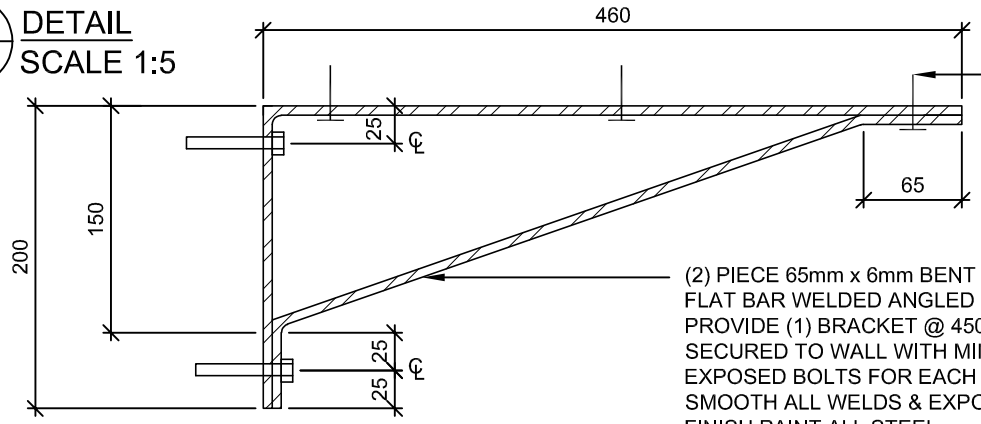
**AD**  
**613**



- 3mm PVC EDGING (TYP.)
- CUBBIE CONSTRUCTION  
19mm BACK, TOP & BOTTOM, C/W 19mm DIVIDERS
- COAT HOOKS MODEL 209C BY  
ROYAL ARCH. INC. POLISHED  
CHROME PLATED (TYP)  
2 PER CUBBIE (TYP.)
- SEAM EACH DIVIDER TO BASE WITH WOOD DOWELS
- 19mm VENEER PLYWOOD SEAT C/W MELAMINE FINISH
- PROVIDE 19mm PLYWOOD AS REQUIRED  
OVER BENCH BRACKET UNFINISHED
- 38 x 89 SOLID BIRCH FRONT. RETURN AT  
EDGES.

**SECTION A**  
SCALE 1:10

**B**  
**614** DETAIL  
SCALE 1:5



SCREW & FASTEN SECURELY  
TO WOOD BLOCKING ABOVE  
AS REQUIRED.

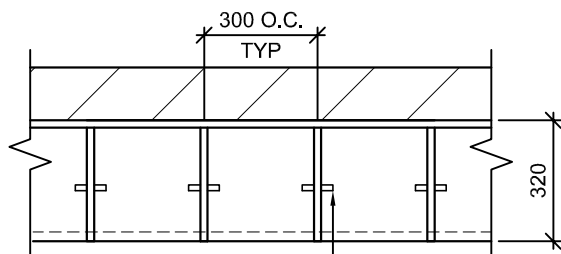
- (2) PIECE 65mm x 6mm BENT STEEL  
FLAT BAR WELDED ANGLED BRACKET  
PROVIDE (1) BRACKET @ 450 O/C. MAX.  
SECURED TO WALL WITH MIN. (2) 15mm DIA.  
EXPOSED BOLTS FOR EACH BRACKET. GRIND  
SMOOTH ALL WELDS & EXPOSED CORNERS.  
FINISH PAINT ALL STEEL

**BANBURY ELEMENTARY SCHOOL  
CHILD CARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE C1 (SECTION A)**  
(REFERENCE: AD 613)

PROJ:	2022-08
SCALE:	AS NOTED
DRAWN:	DW
DATE:	2024-04-22

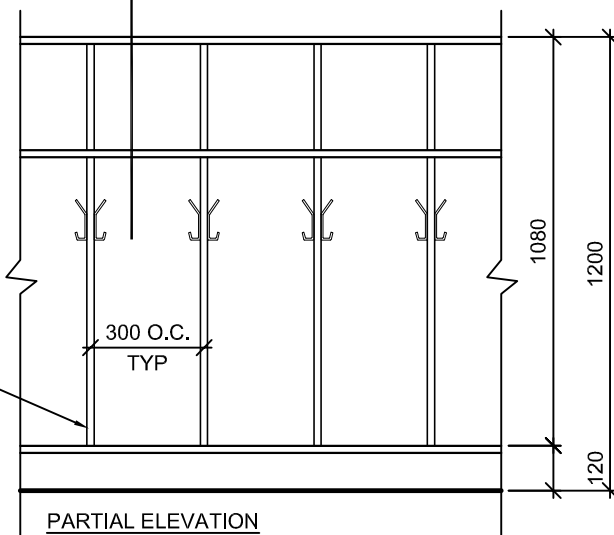
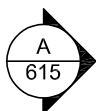
**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
614**



PLAN  
SCALE: 1:20

COAT HOOKS (2 PER CUBBIE, TYP.)



SEAM EACH DIVIDER TO BASE  
WITH WOOD DOWELS FOR RIGIDITY

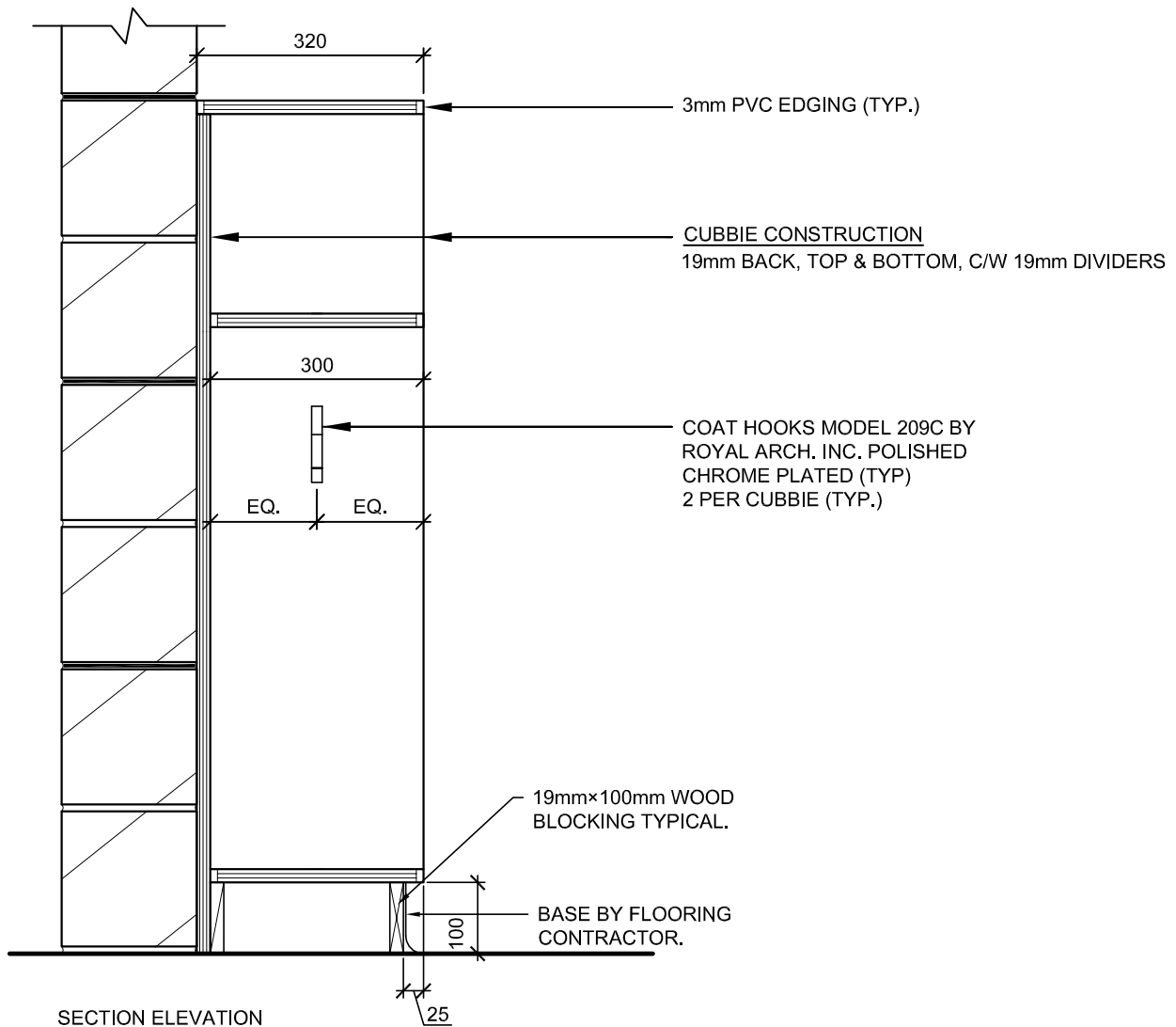
PARTIAL ELEVATION  
SCALE: 1:20

**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE C1A**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
Web: [www.2gai.com](http://www.2gai.com)

**AD**  
**615**

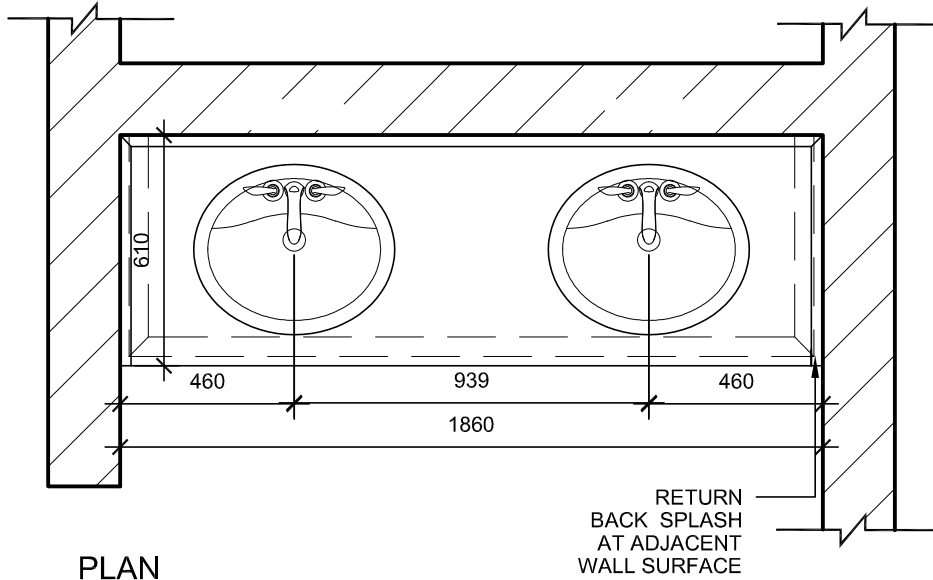


**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE C1A (SECTION A)**  
(REFERENCE: AD 615)

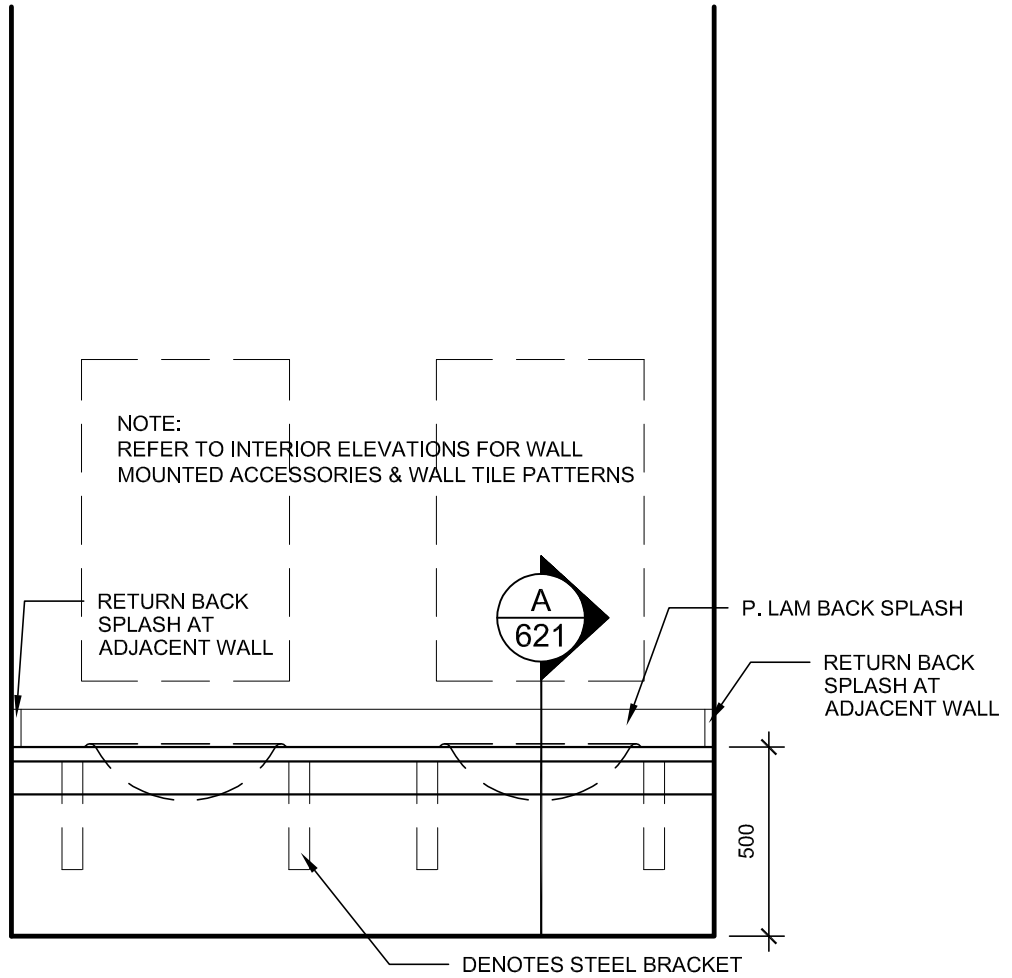
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
616**



**PLAN**  
SCALE 1:20



**ELEVATION**  
SCALE 1:20

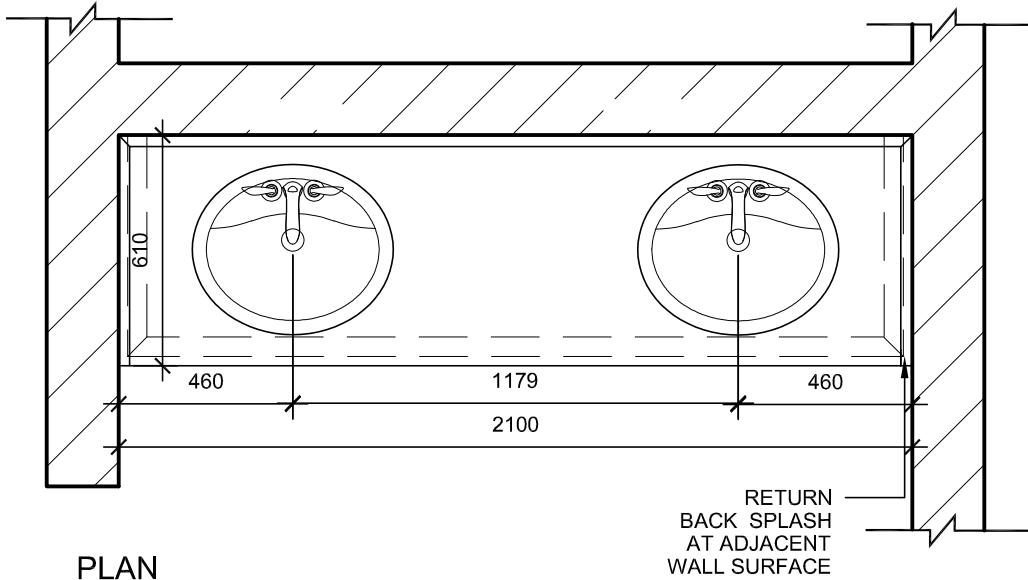
**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE S1**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

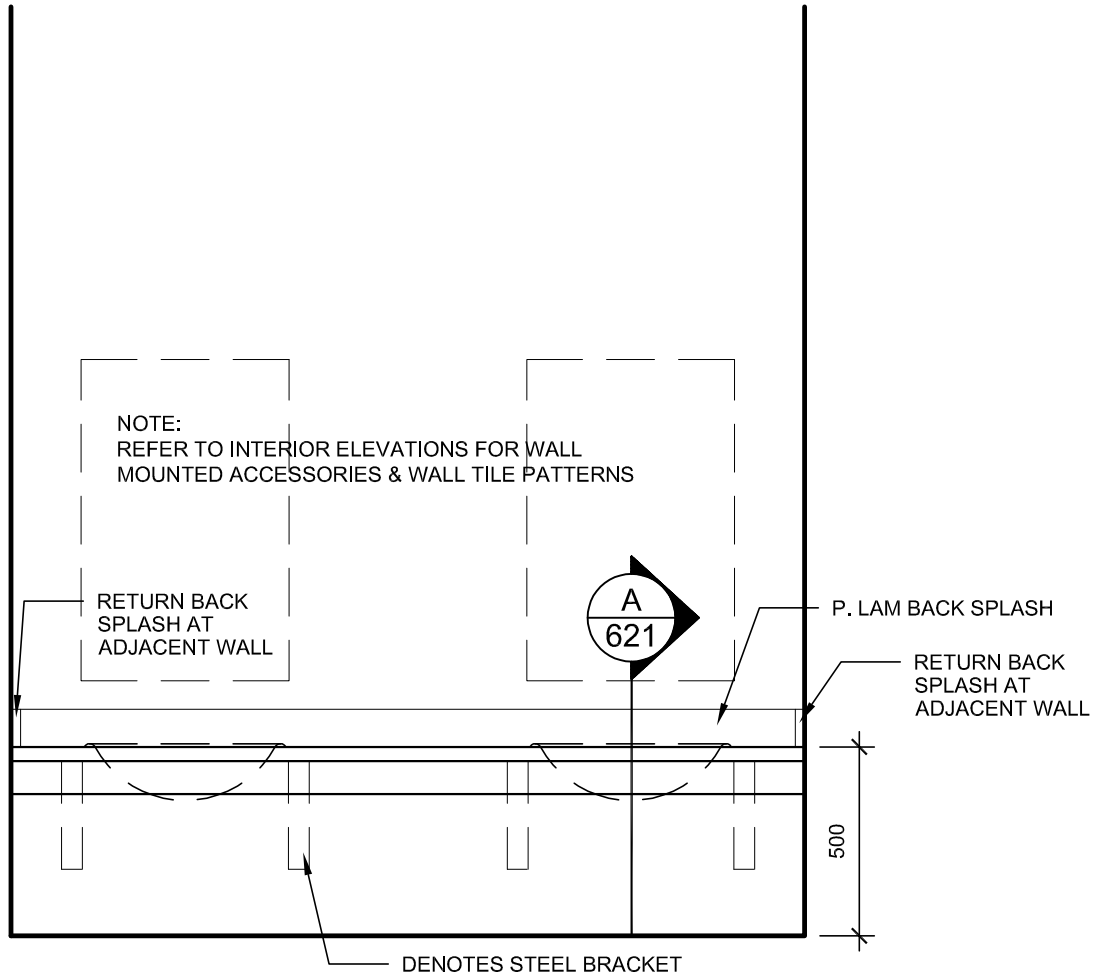
**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
617**





**PLAN**  
SCALE 1:20



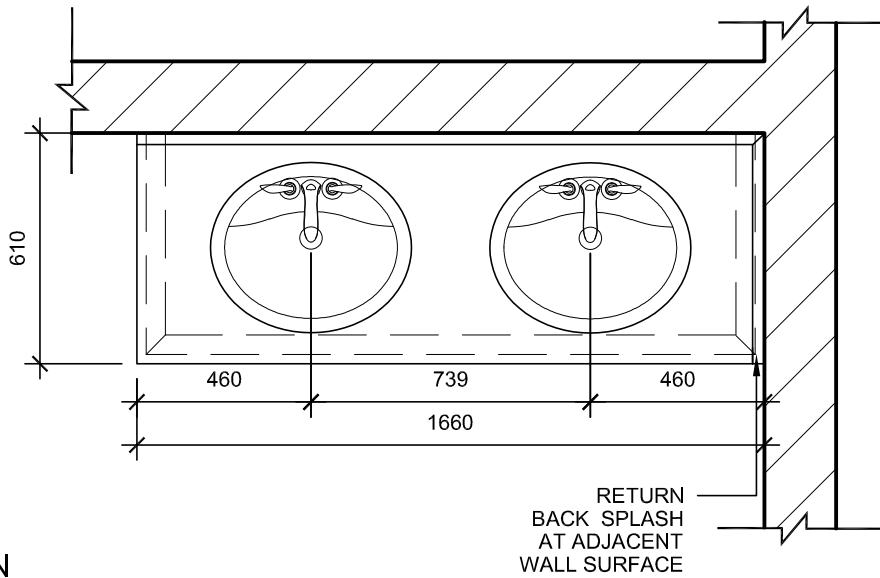
**ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE S2**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

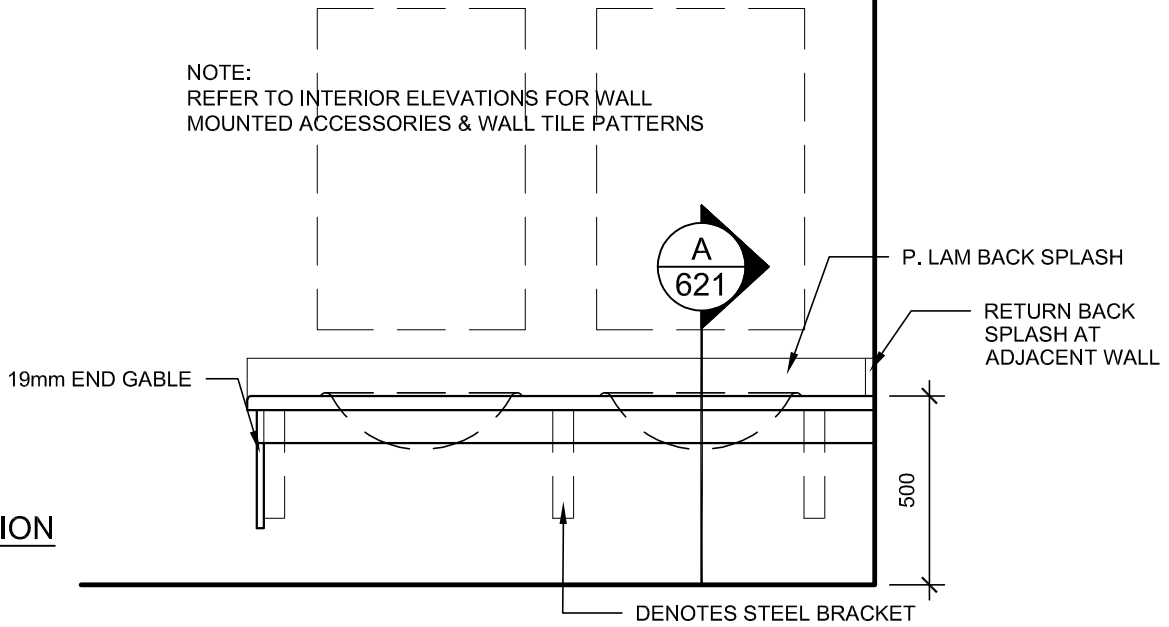
**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
618**



**PLAN**  
SCALE 1:20

NOTE:  
REFER TO INTERIOR ELEVATIONS FOR WALL  
MOUNTED ACCESSORIES & WALL TILE PATTERNS



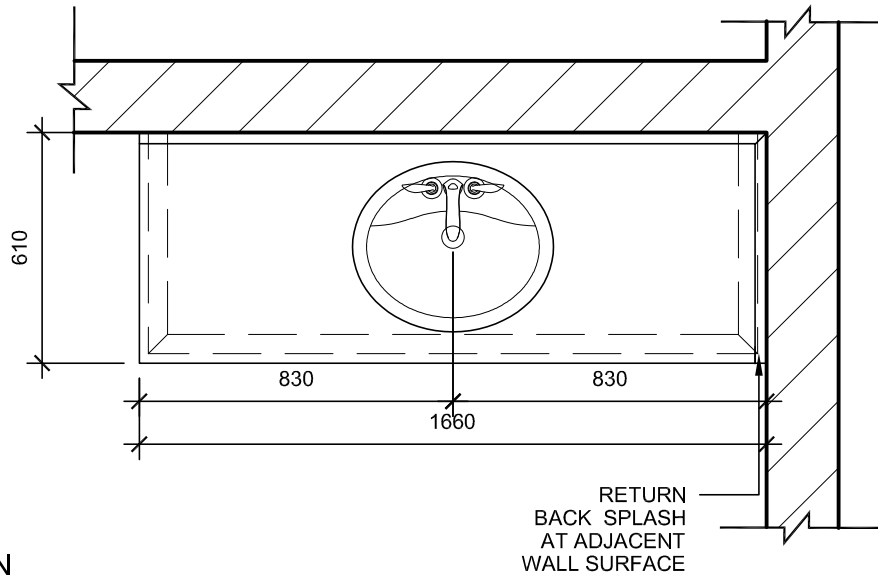
**ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE S3**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

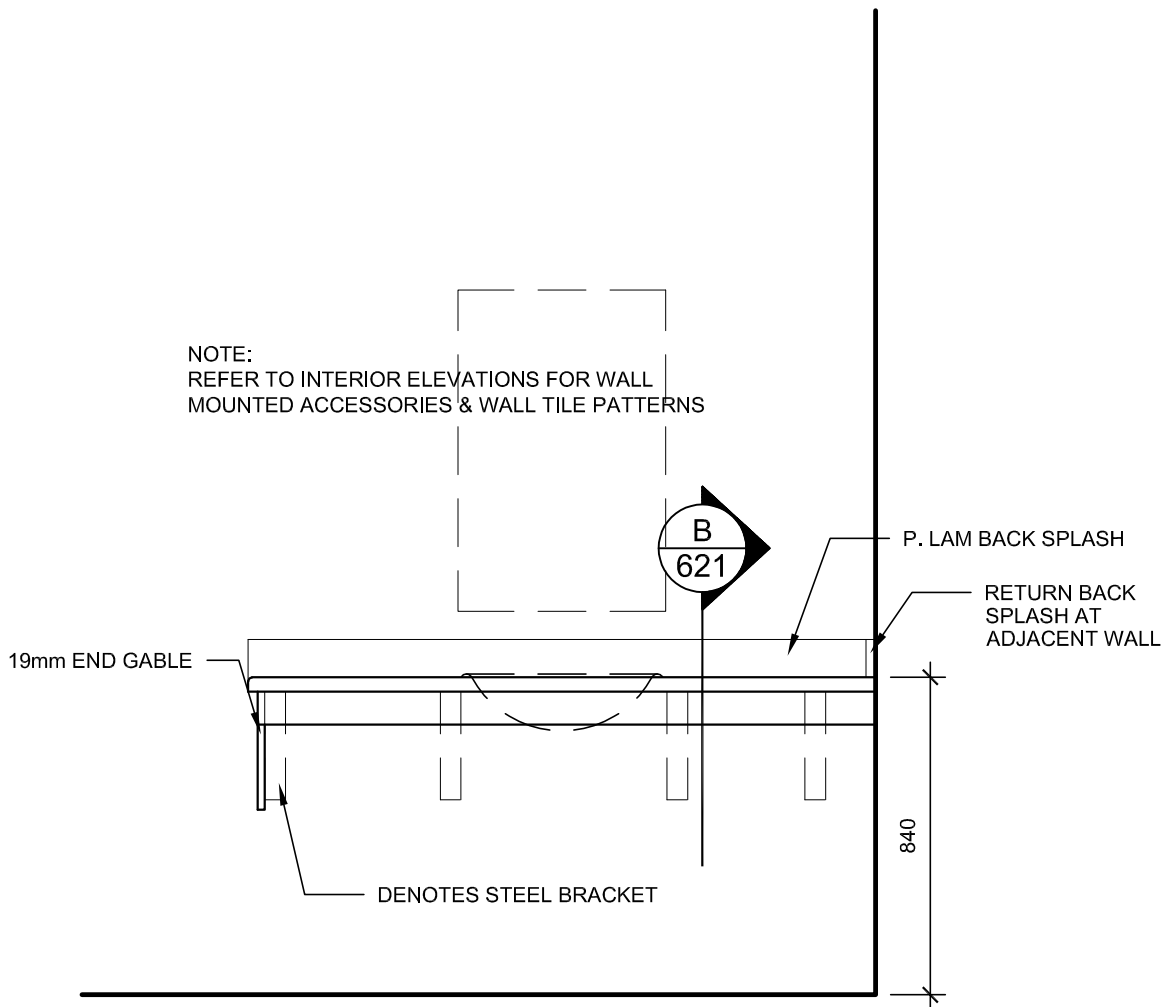
**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
619**



**PLAN**  
SCALE 1:20

NOTE:  
REFER TO INTERIOR ELEVATIONS FOR WALL  
MOUNTED ACCESSORIES & WALL TILE PATTERNS



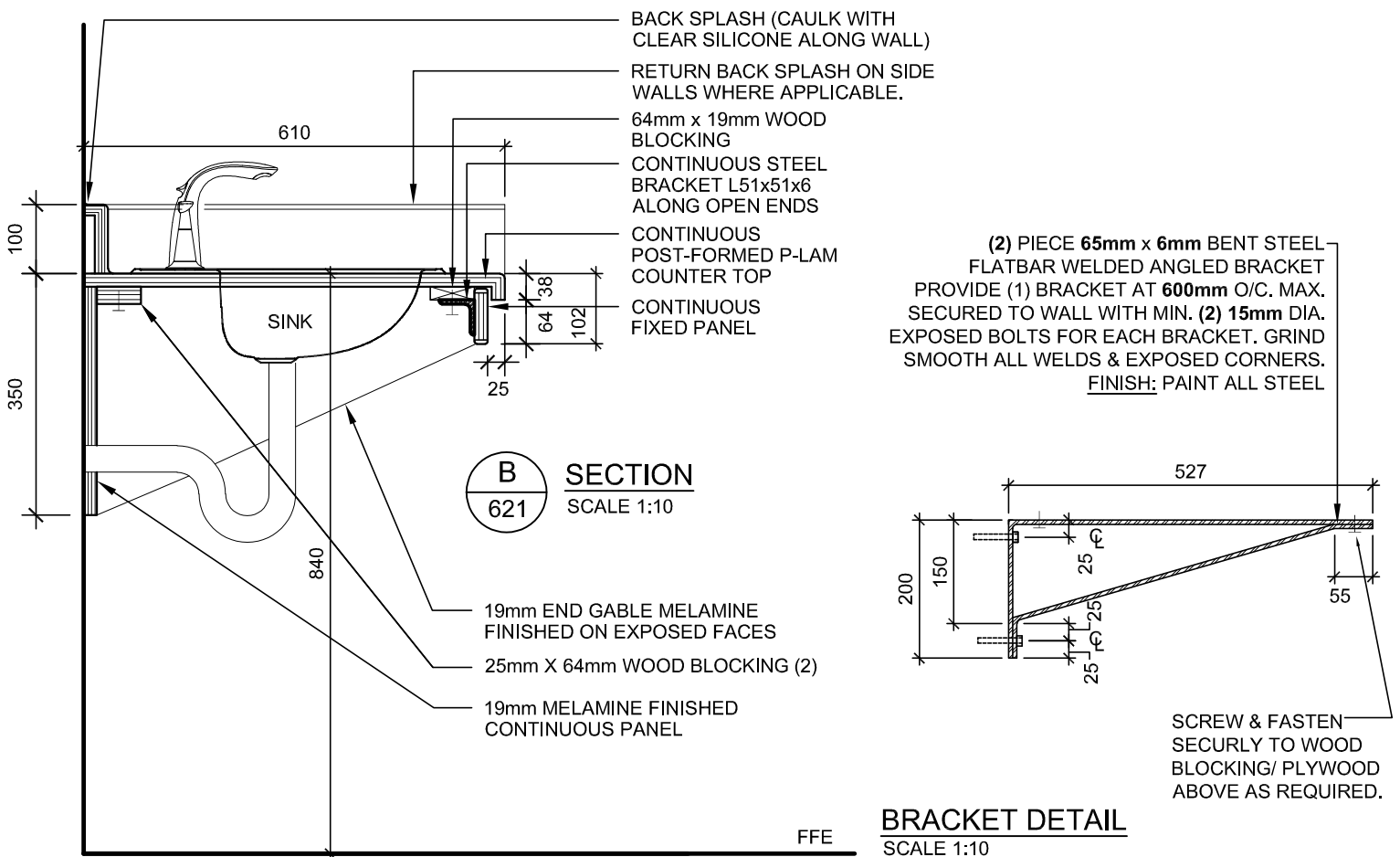
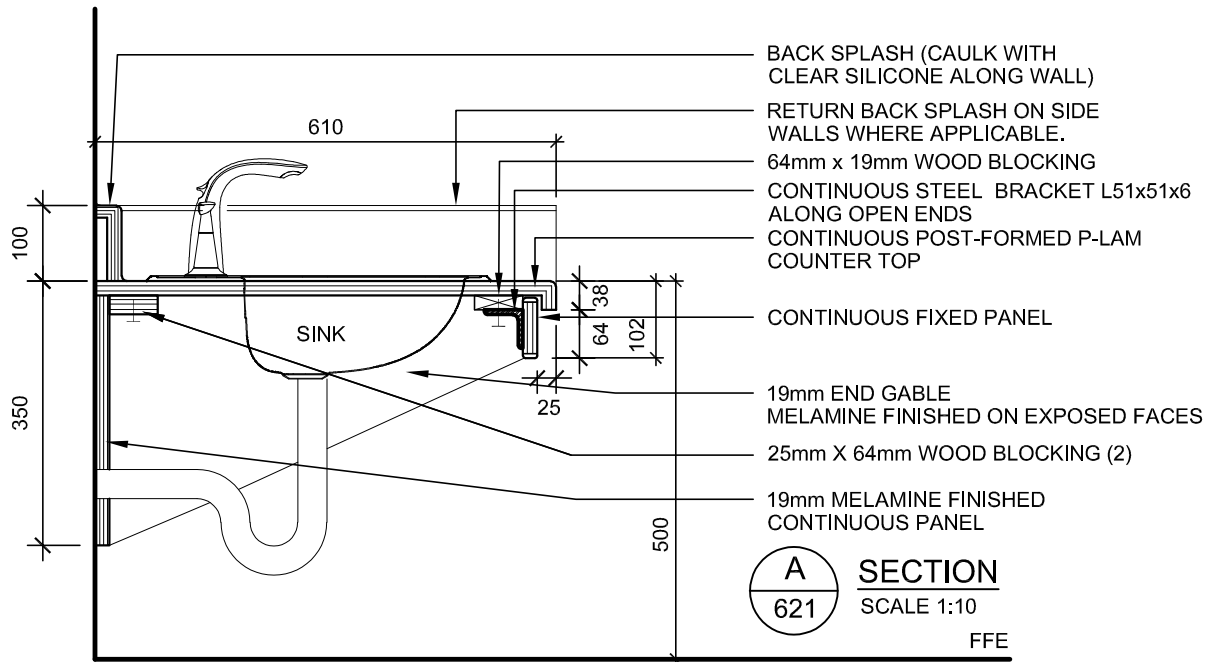
**ELEVATION**  
SCALE 1:20

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE S4**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
620**

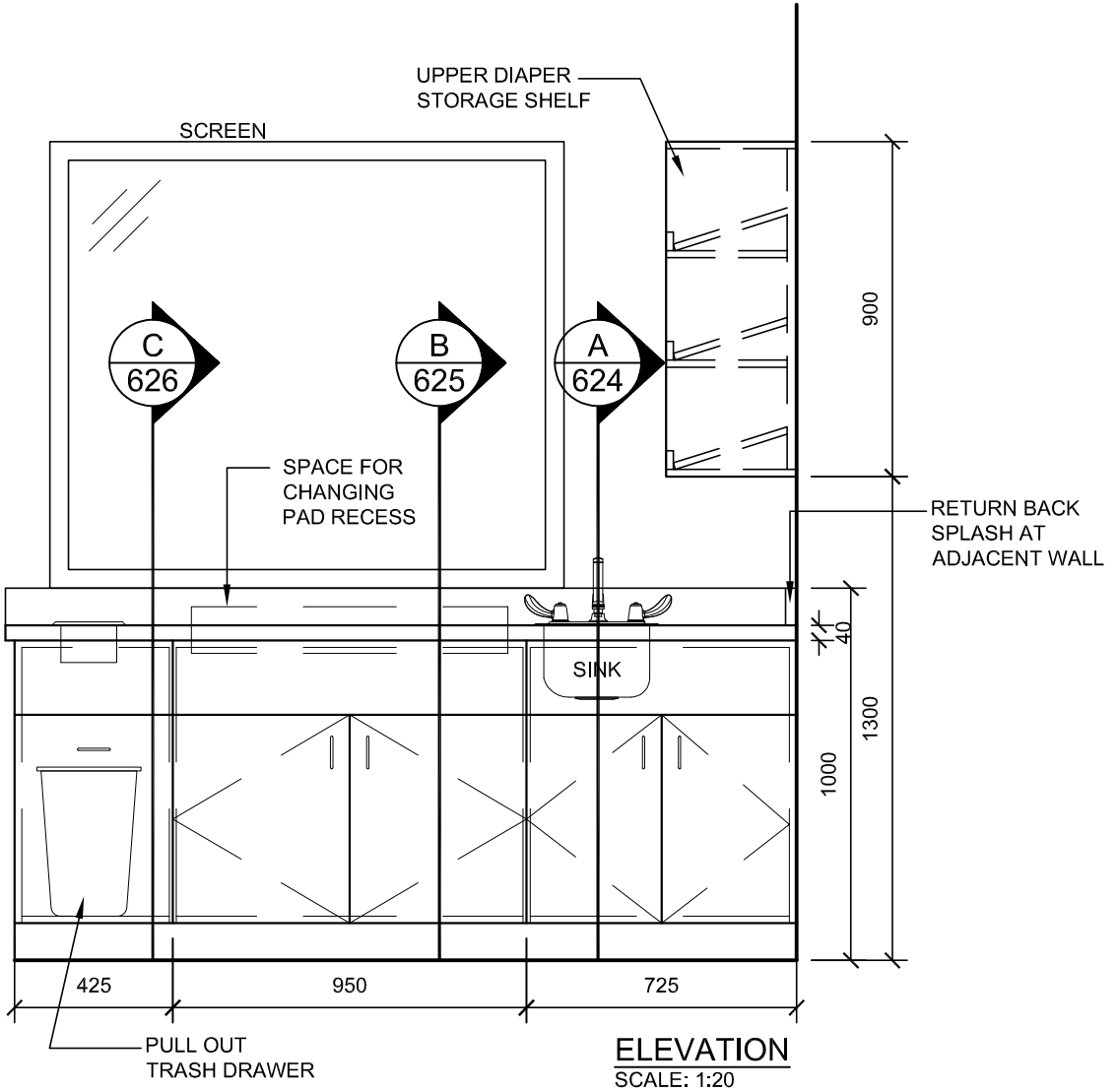
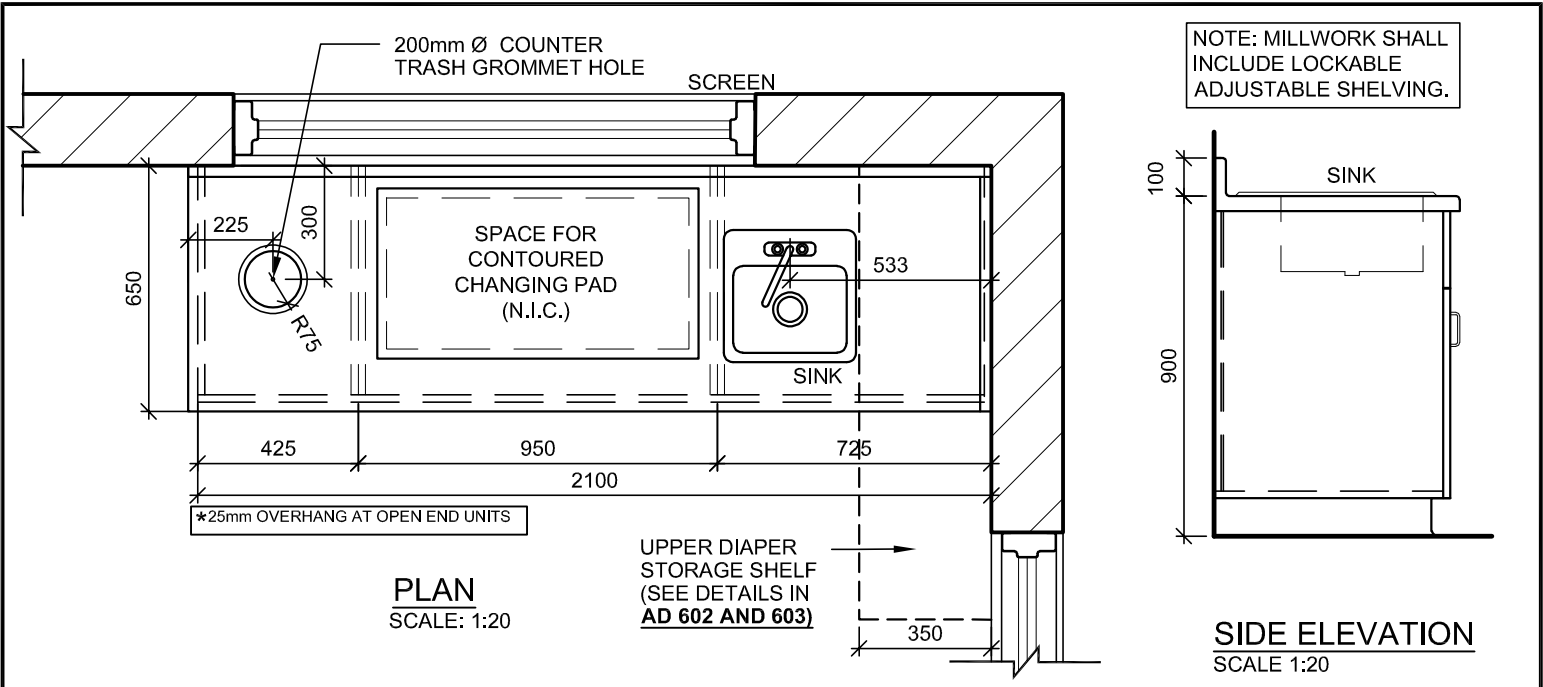


**BANBURY ELEMENTARY SCHOOL  
 CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK SECTION DETAIL**  
 (REFERENCE: AD 617, 618, 619 & 620)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC  
 ARCHITECTS  
 INCORPORATED**  
 Web: www.2gai.com

**AD  
 621**

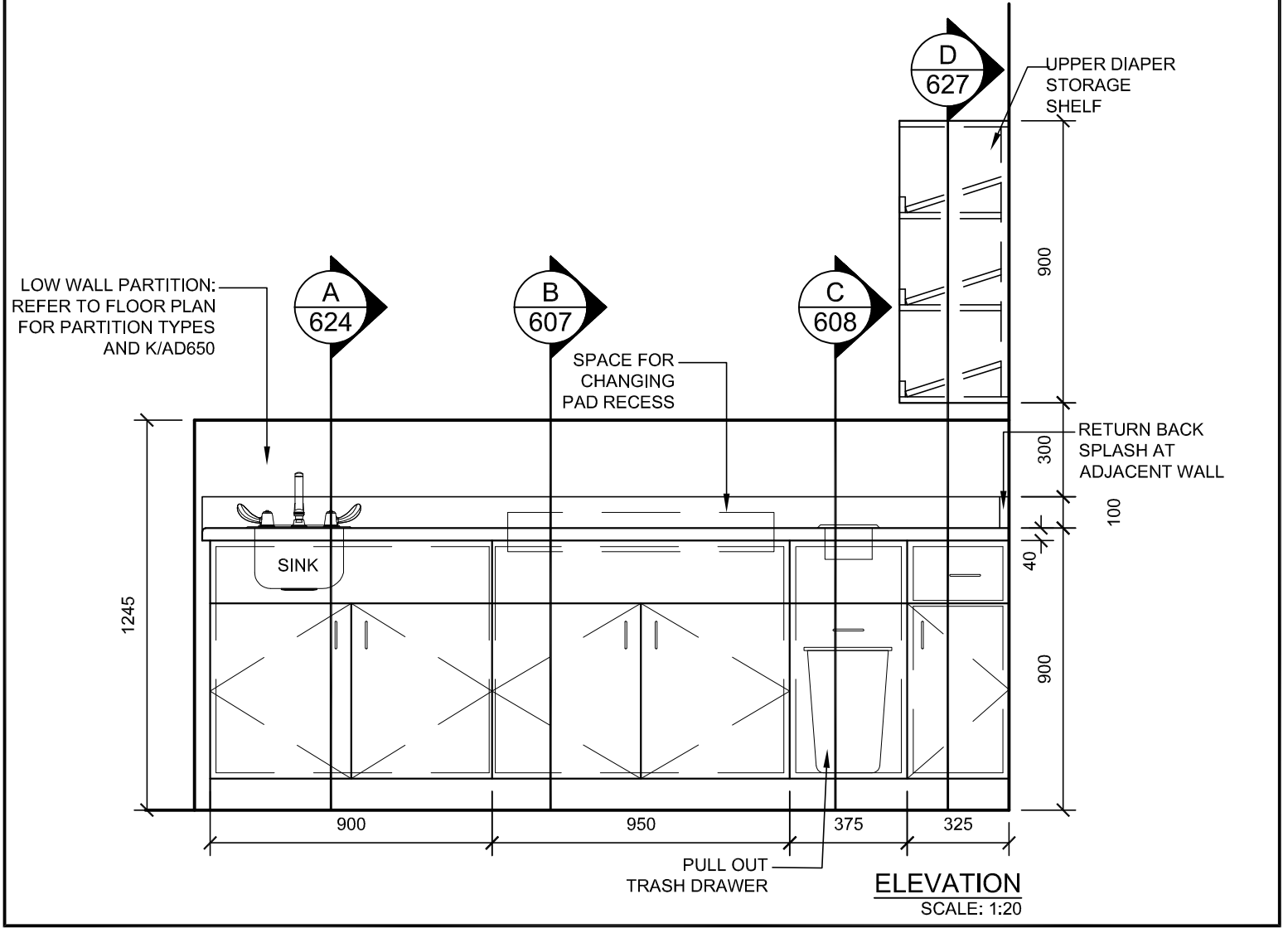
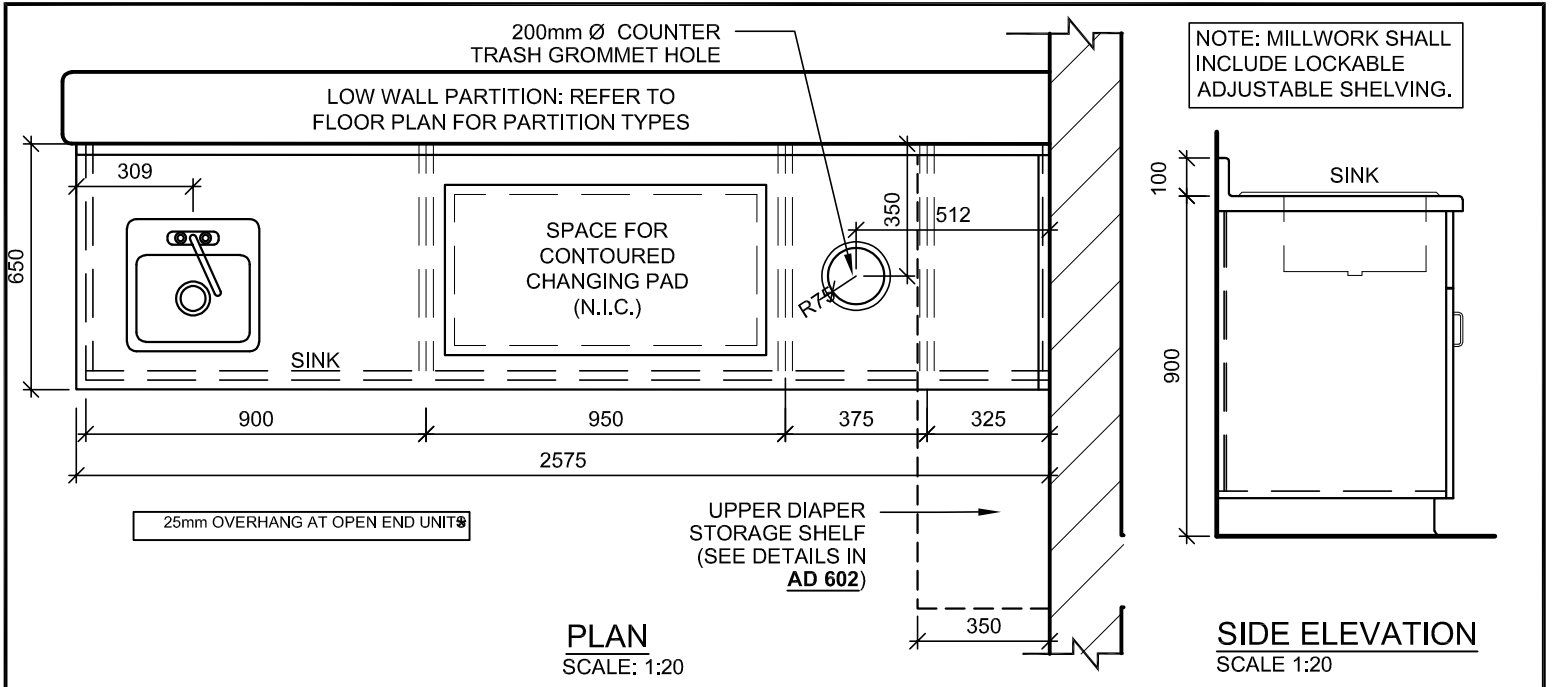


**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE CH1**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
622**



**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE CH2**  
 (REFERENCE: A2.20)

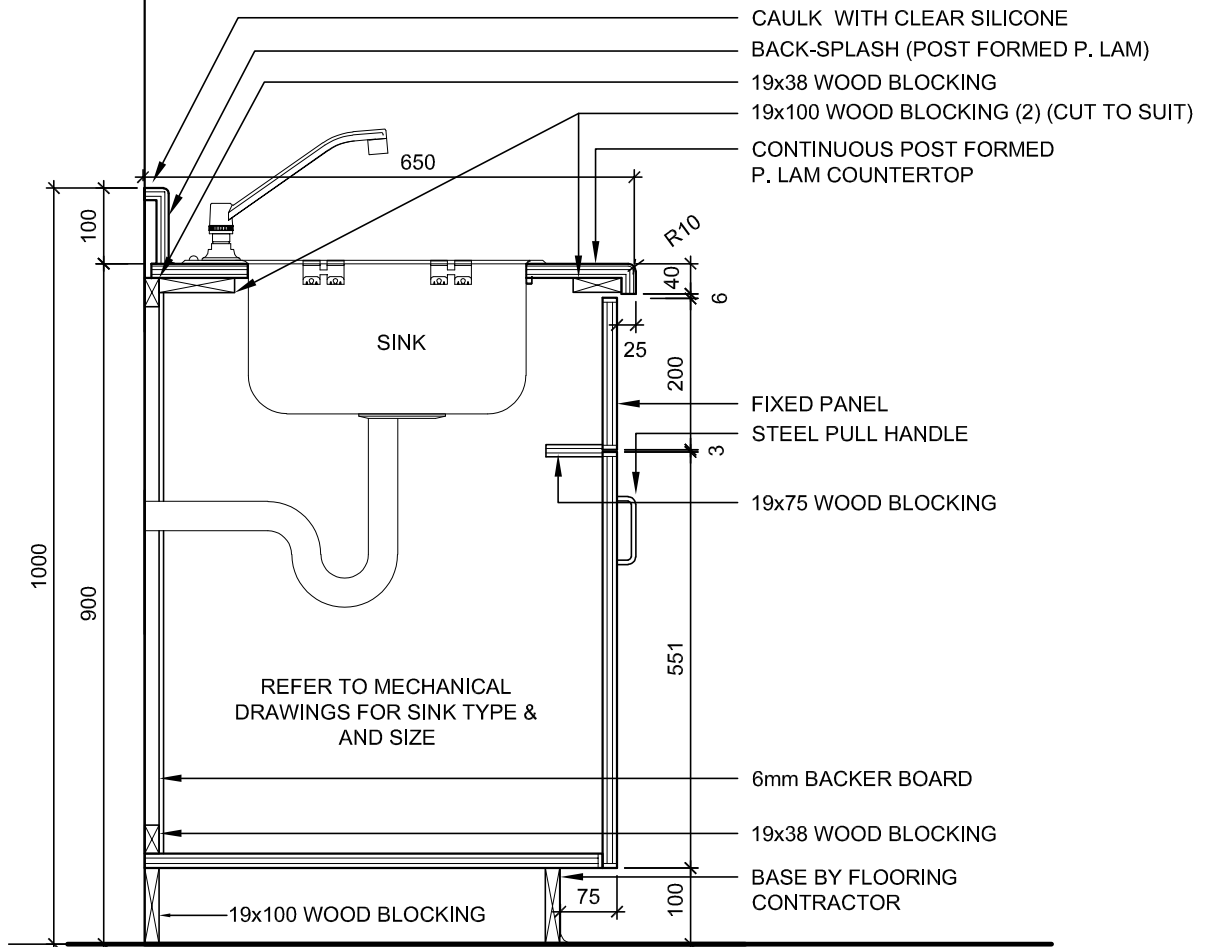
PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
 Web: www.2gai.com

**AD**  
**623**

A  
624
 

**SECTION**  
SCALE 1:10



**BANBURY ELEMENTARY SCHOOL  
 CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE CH1 & CH2 (SECTION A)**  
 (REFERENCE: AD 622 & 623)

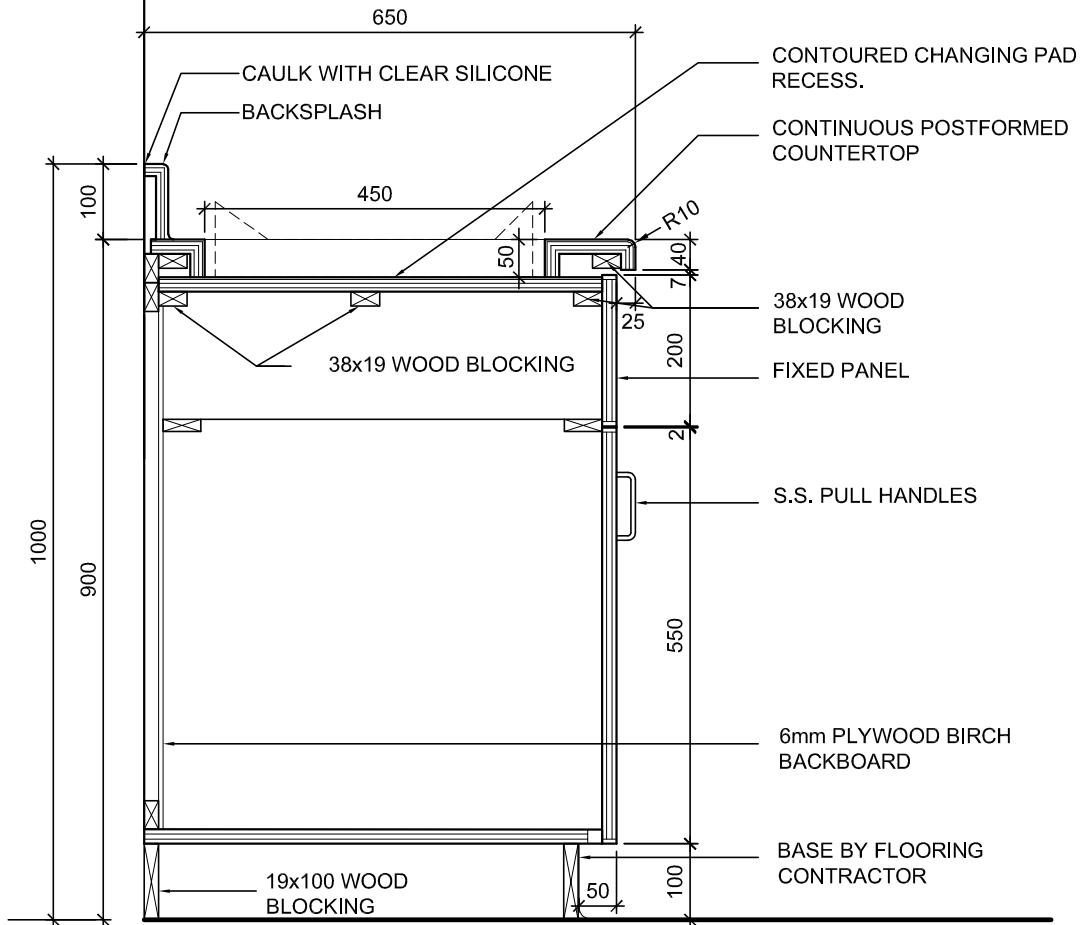
PROJ:	2022-08
SCALE:	AS NOTED
DRAWN:	DW
DATE:	2024-04-22

**GRGURIC  
 ARCHITECTS  
 INCORPORATED**  
 Web: www.2gai.com

AD  
624

**B**  
 625
 

**SECTION**  
 SCALE 1:10



**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE CH1 & CH2 (SECTION B)**  
 (REFERENCE: AD 622 & 623)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

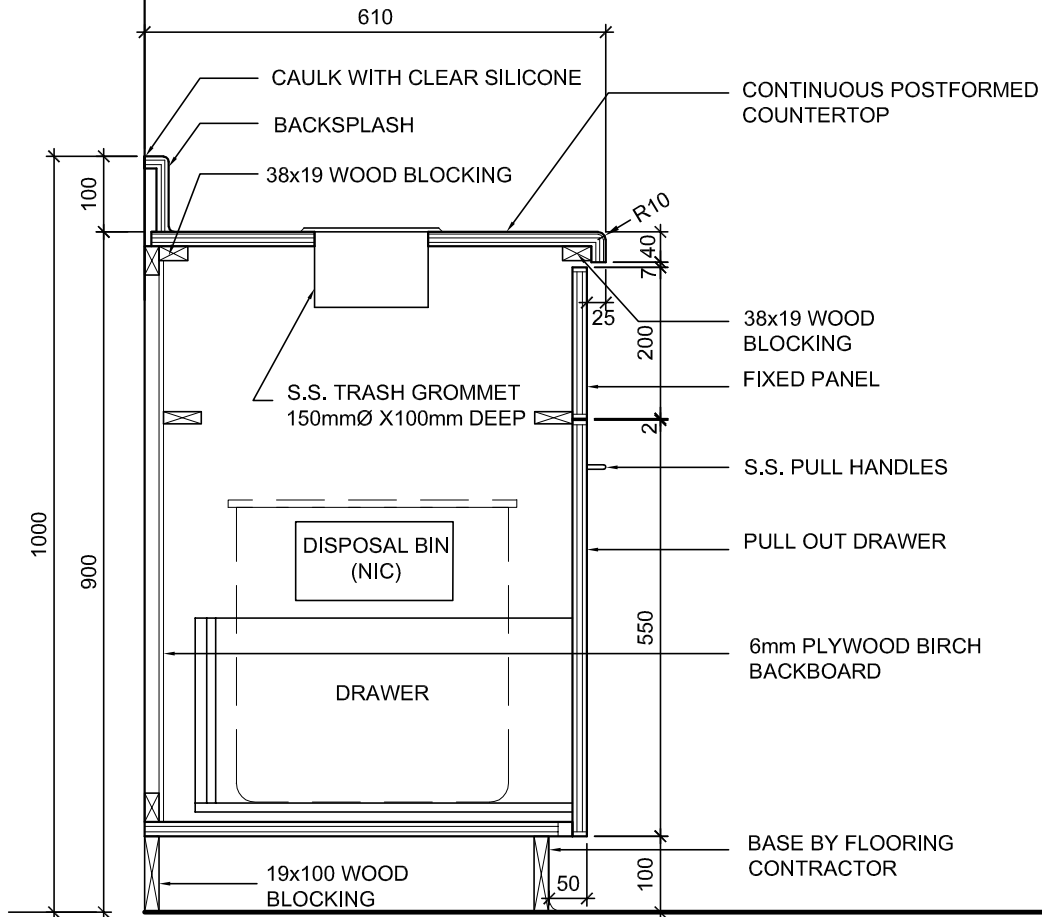
**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
 Web: www.2gai.com

**AD**  
**625**



C  
626

SECTION  
SCALE 1:10



**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**

141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3

**MILLWORK TYPE CH1 & CH2 (SECTION C)**

(REFERENCE: AD 622 & 623)

PROJ: 2022-08

SCALE: AS NOTED

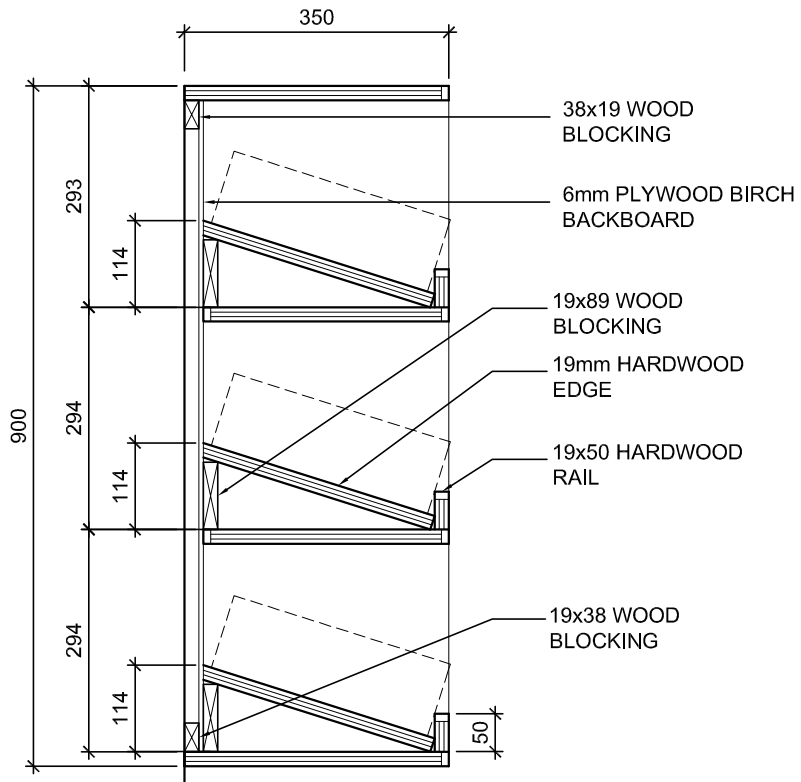
DRAWN: DW

DATE: 2024-04-22

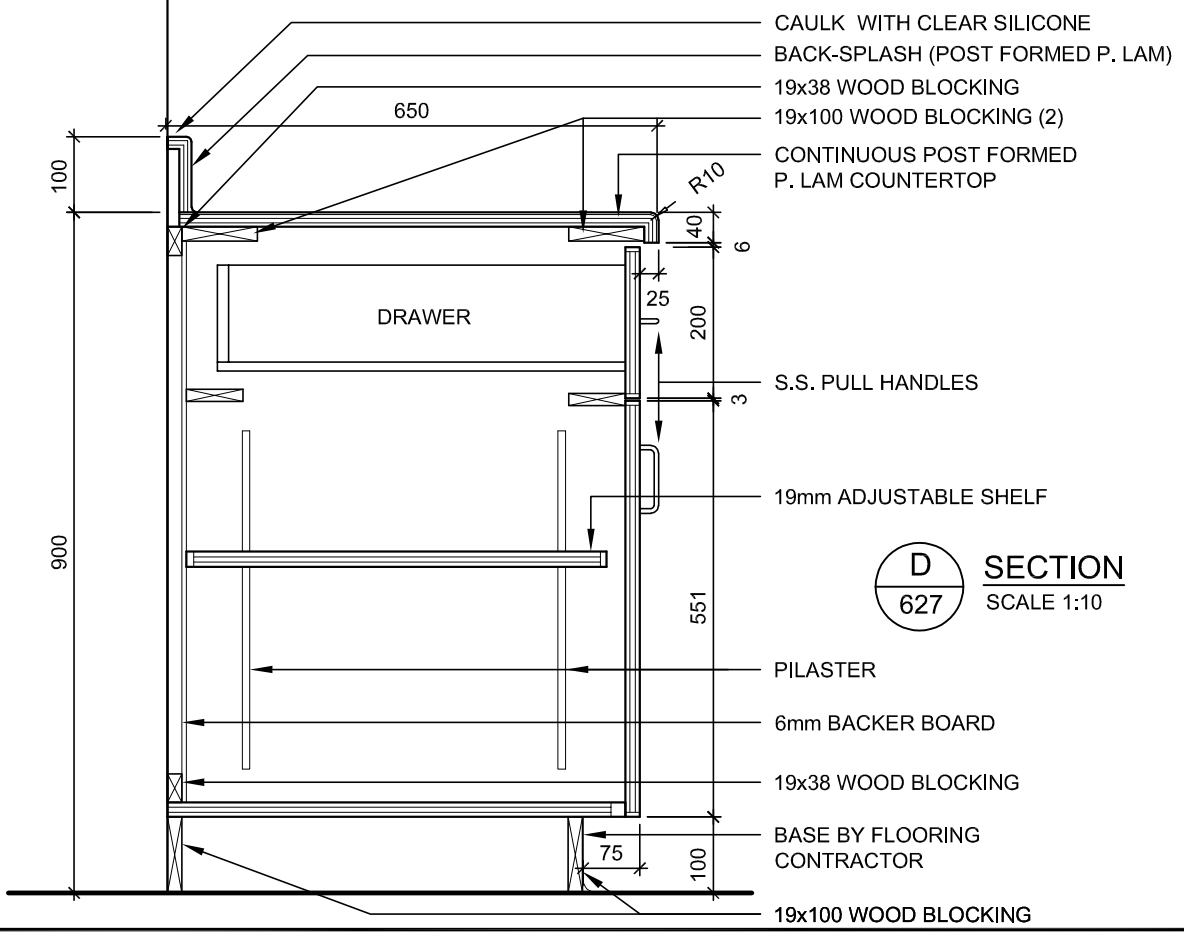
**GRGURIC  
ARCHITECTS  
INCORPORATED**

Web: [www.2gai.com](http://www.2gai.com)

**AD  
626**



**E** SECTION  
627 SCALE 1:10



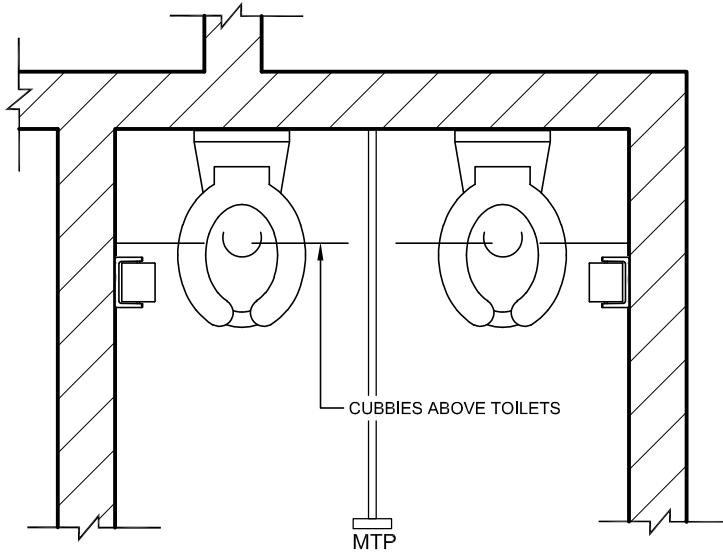
**D** SECTION  
627 SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE CH1 & CH2 (SECTION D & E)**  
(REFERENCE: AD 602, 603, & 623)

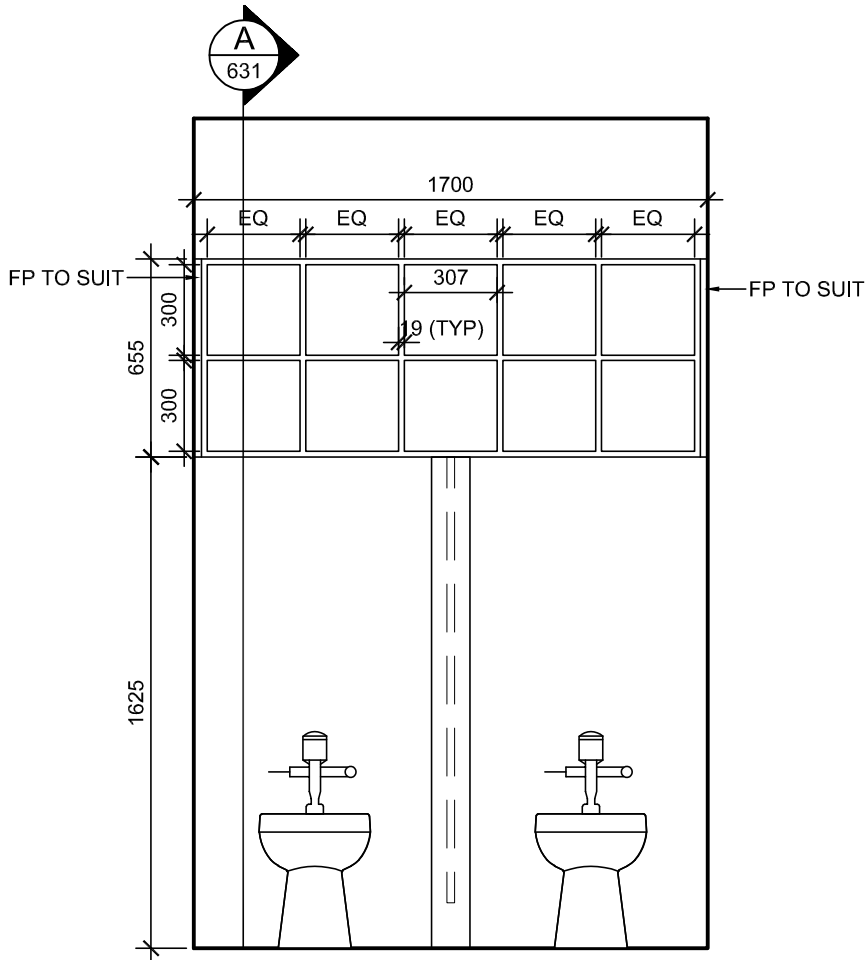
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
627**



PLAN  
SCALE 1:25



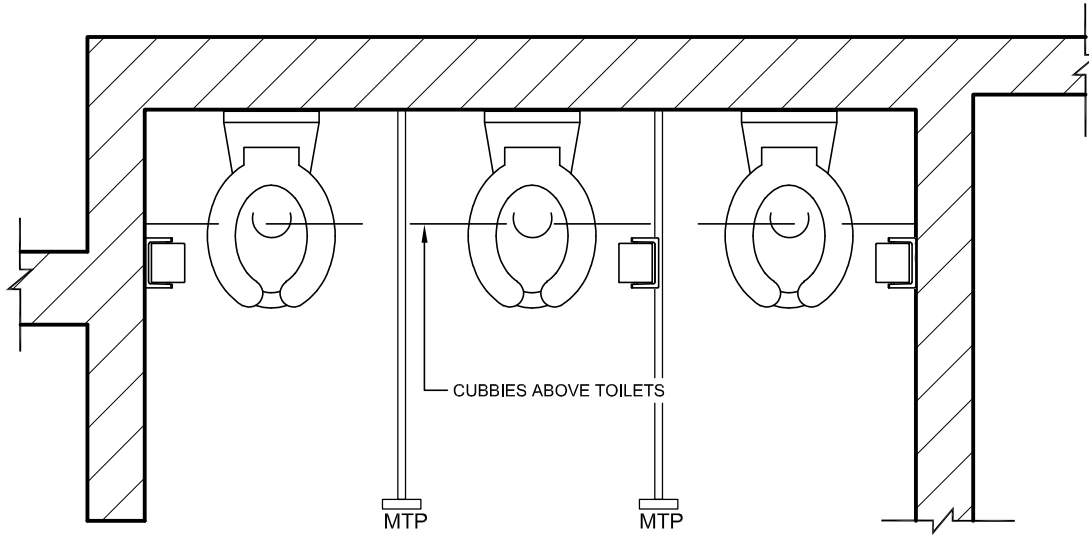
ELEVATION  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM1**  
(REFERENCE: A2.20)

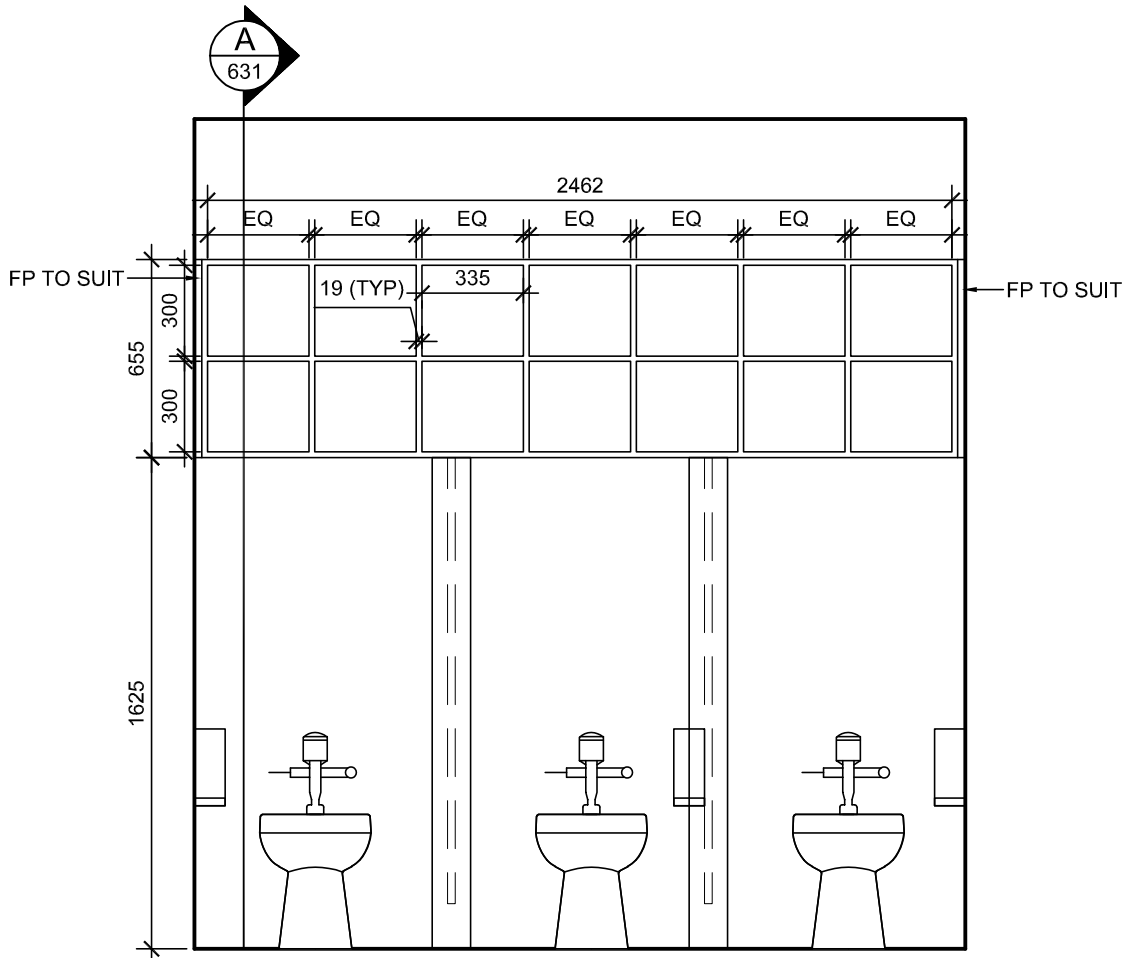
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
628**



PLAN  
SCALE 1:25



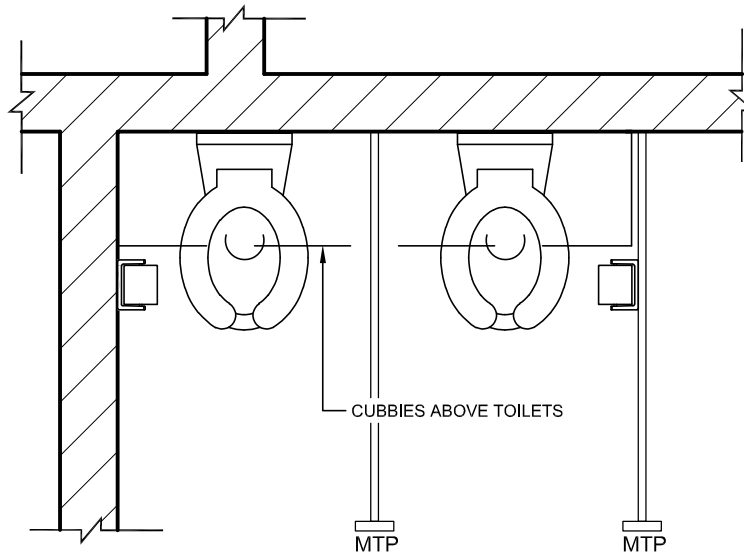
ELEVATION  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM2**  
(REFERENCE: A2.20)

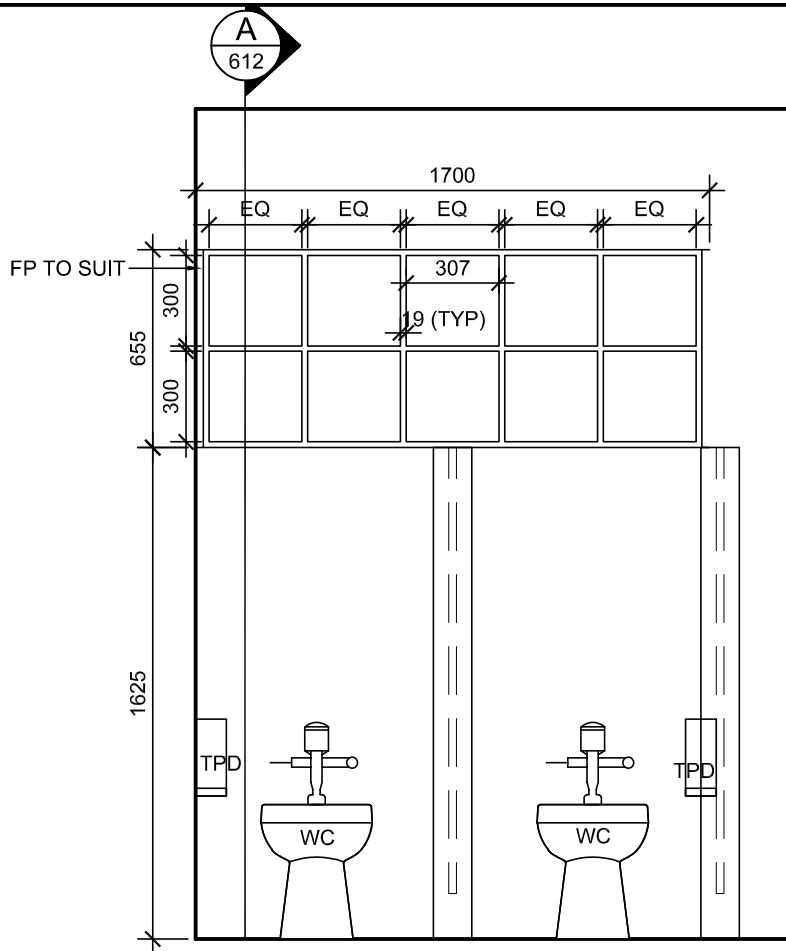
PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
629**



PLAN  
SCALE 1:25



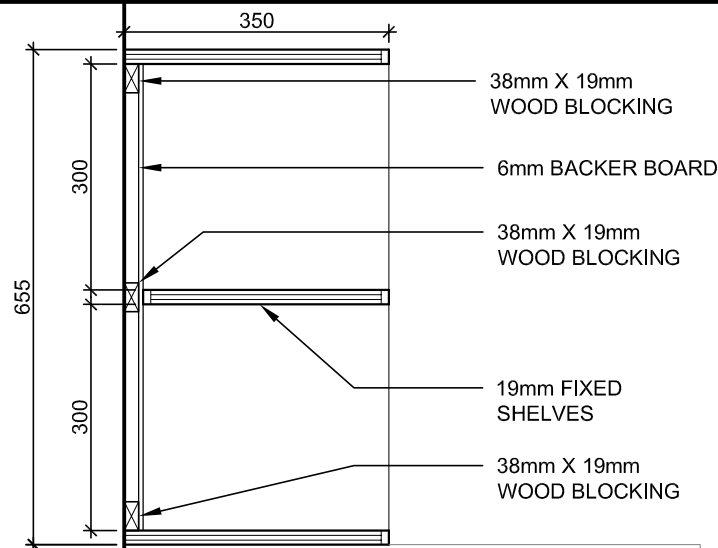
ELEVATION  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM3**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

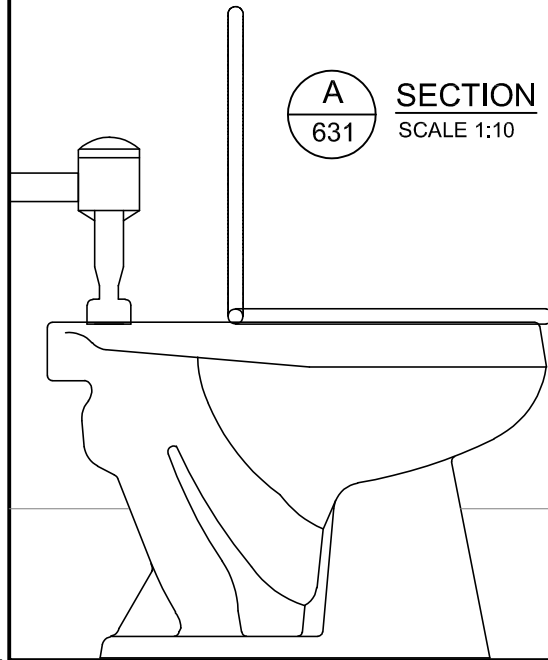
**AD  
630**



TOILET PARTITION BEYOND →

1625

A  
631 SECTION  
SCALE 1:10



**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**

141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3

**MILLWORK SECTION DETAIL**

(REFERENCE: AD 628, 629, & 630)

PROJ: 2022-08

SCALE: AS NOTED

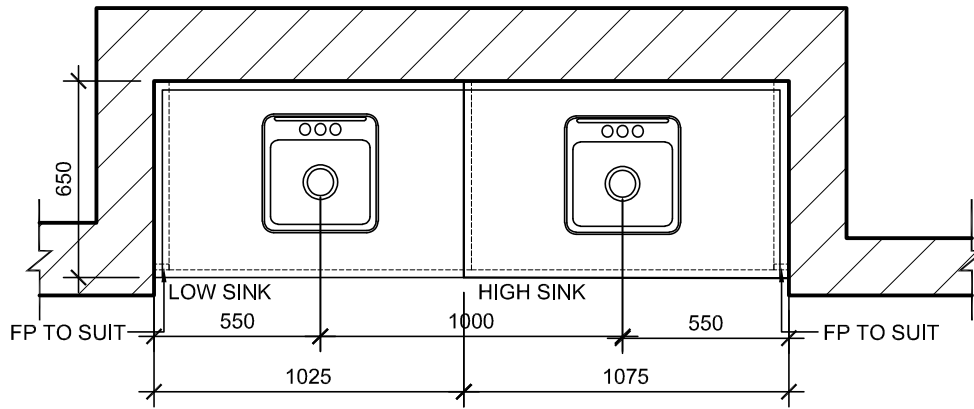
DRAWN: DW

DATE: 2024-04-22

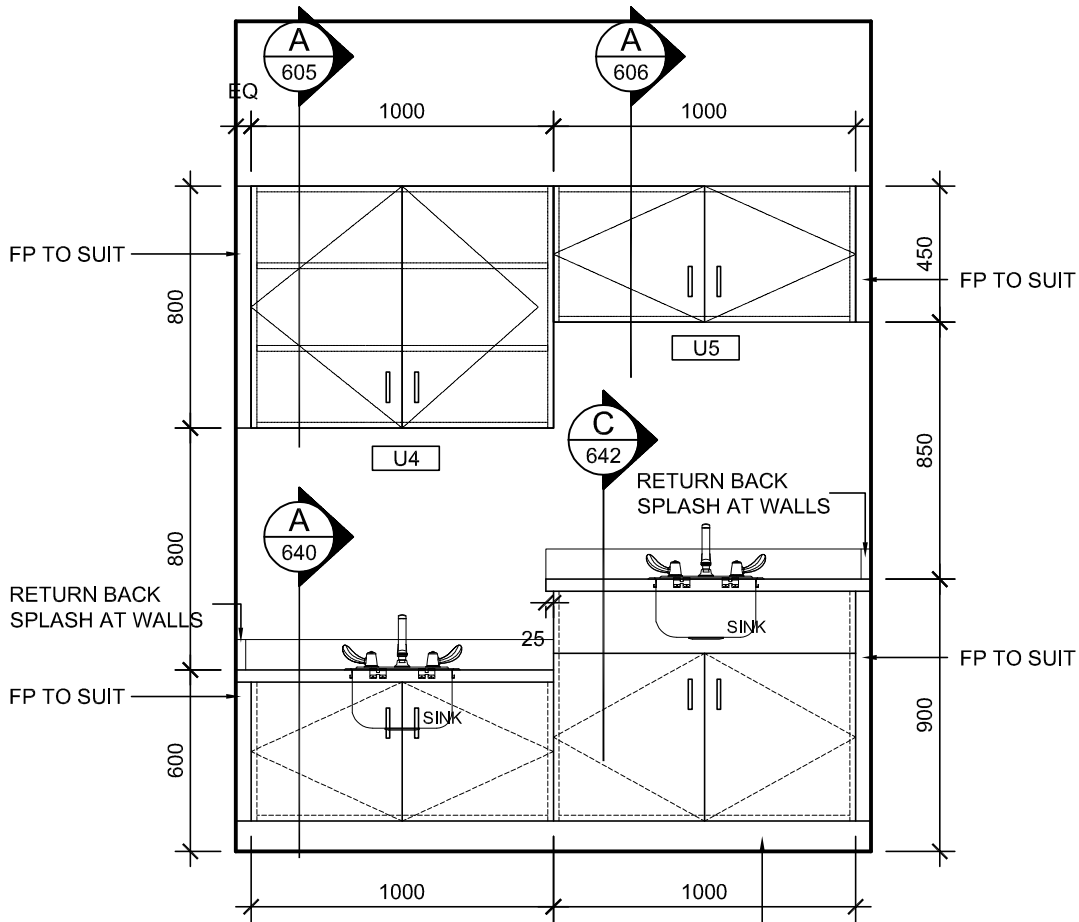
**GRGURIC  
ARCHITECTS  
INCORPORATED**

Web: [www.2gai.com](http://www.2gai.com)

**AD  
631**



PLAN  
SCALE 1:25



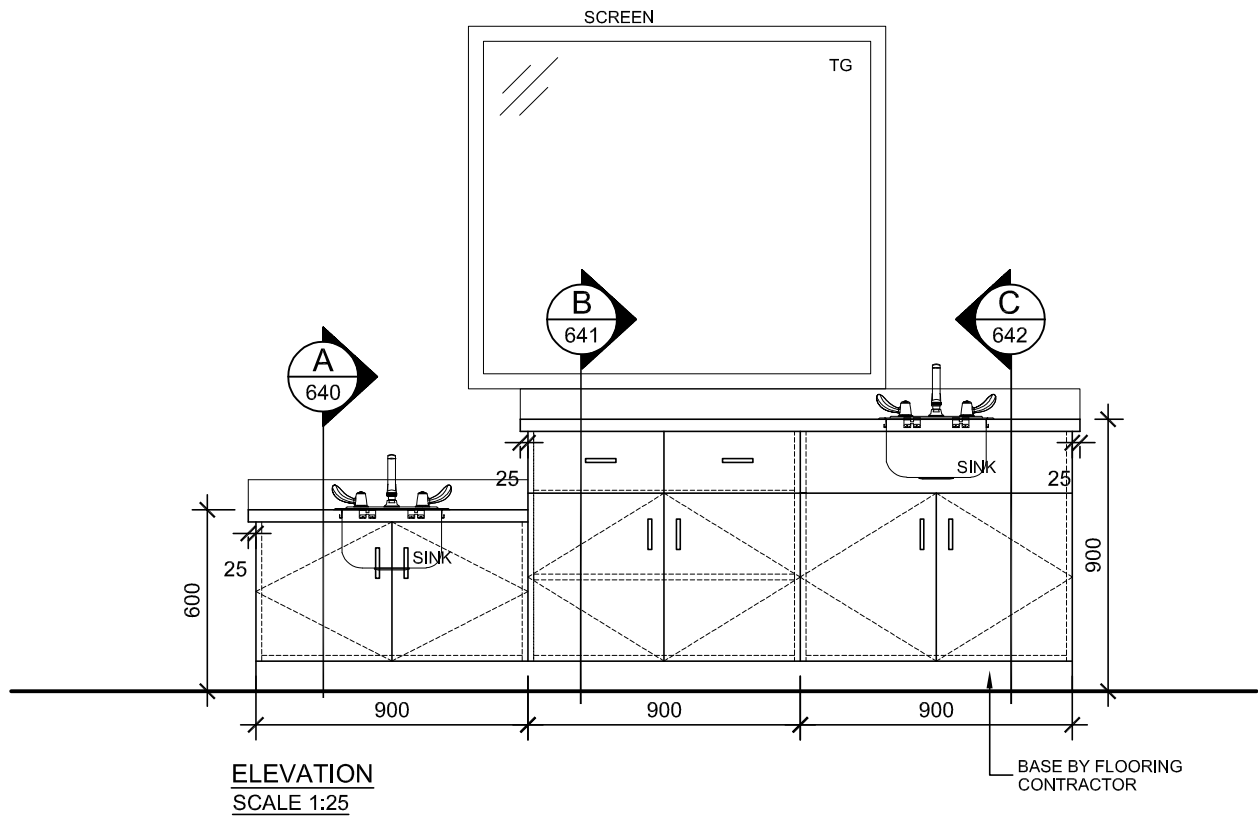
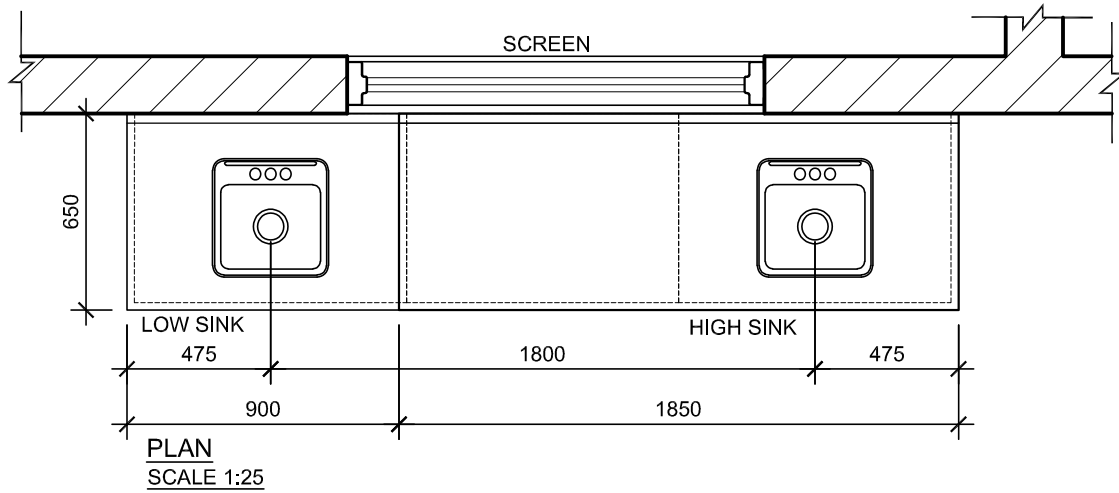
ELEVATION  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM4**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
632**



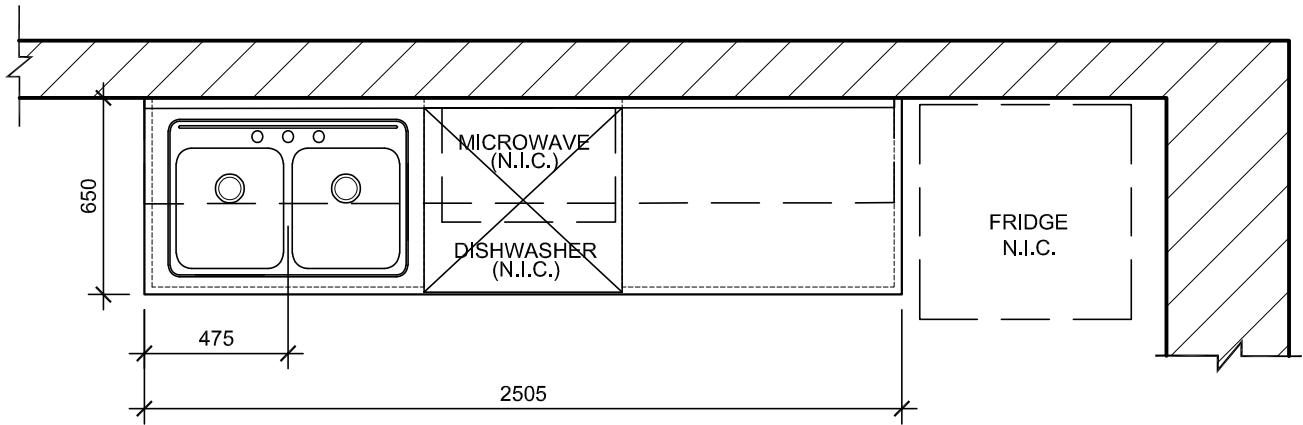
**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM5**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

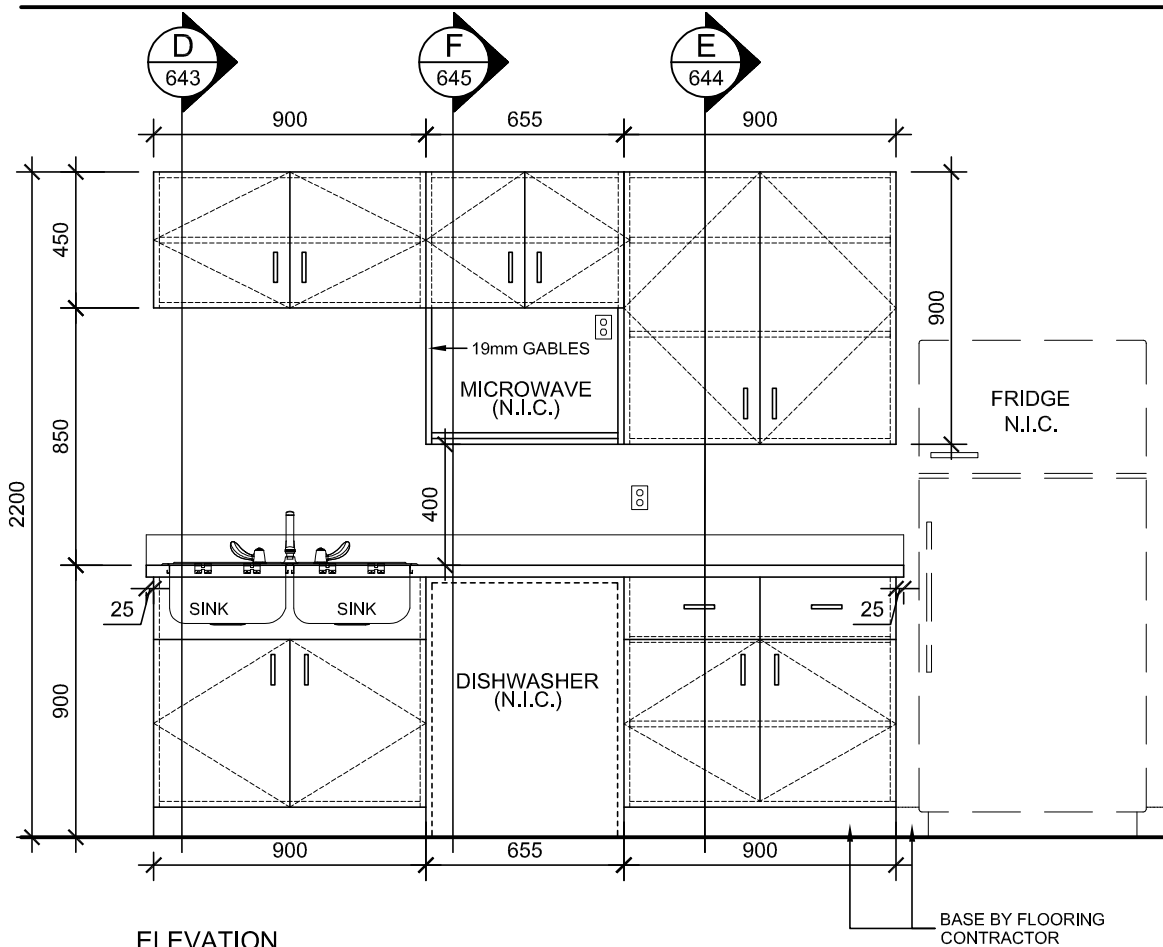
**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
633**





**PLAN**  
SCALE 1:25



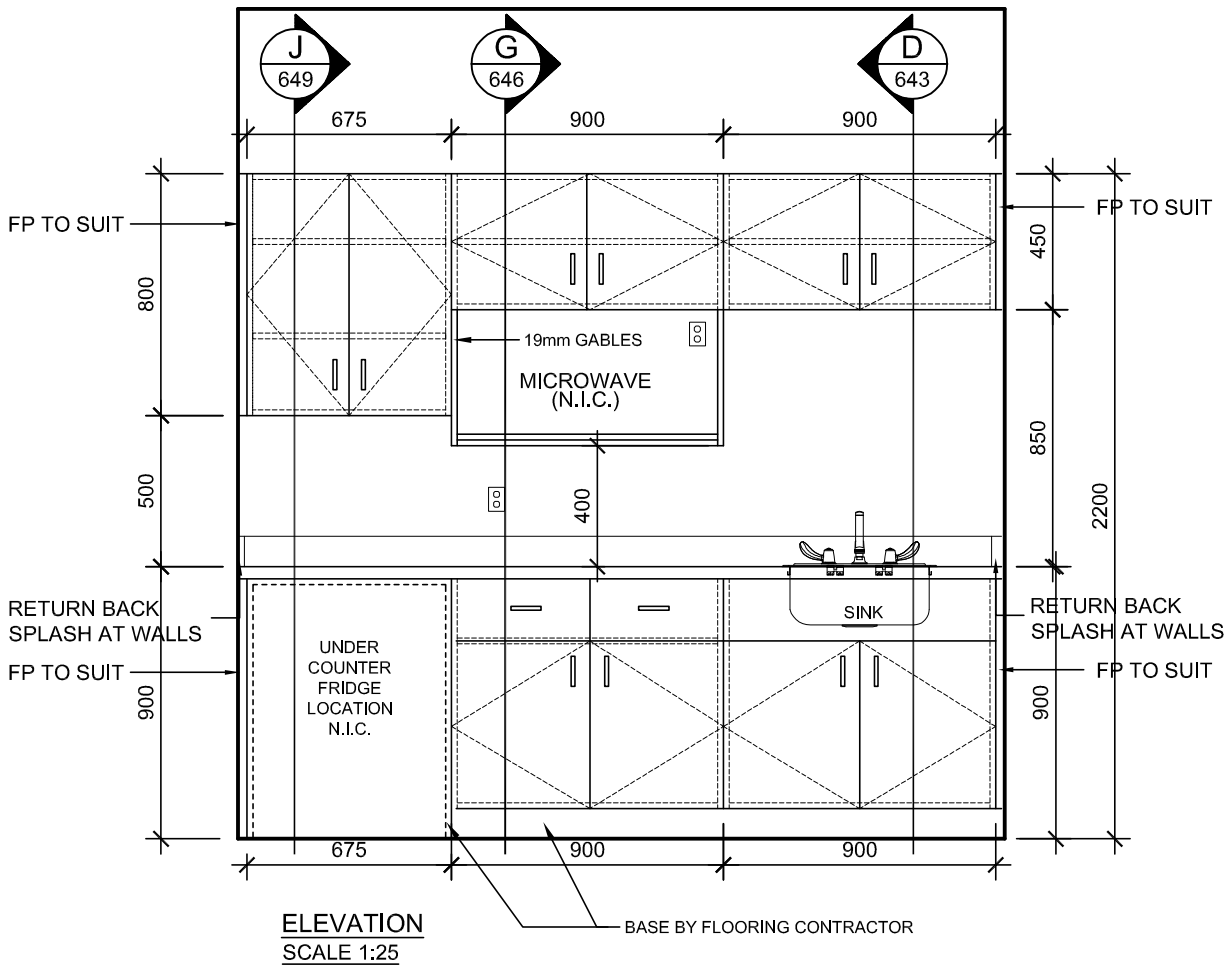
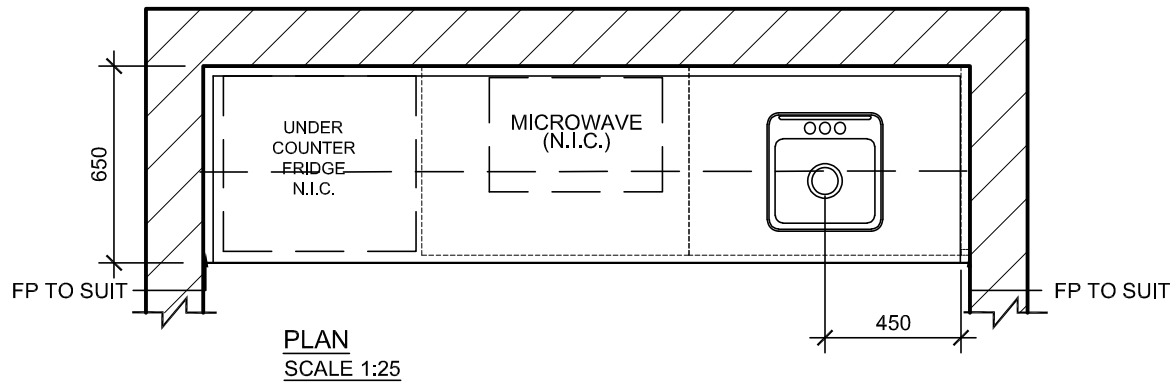
**ELEVATION**  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM6**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
634**



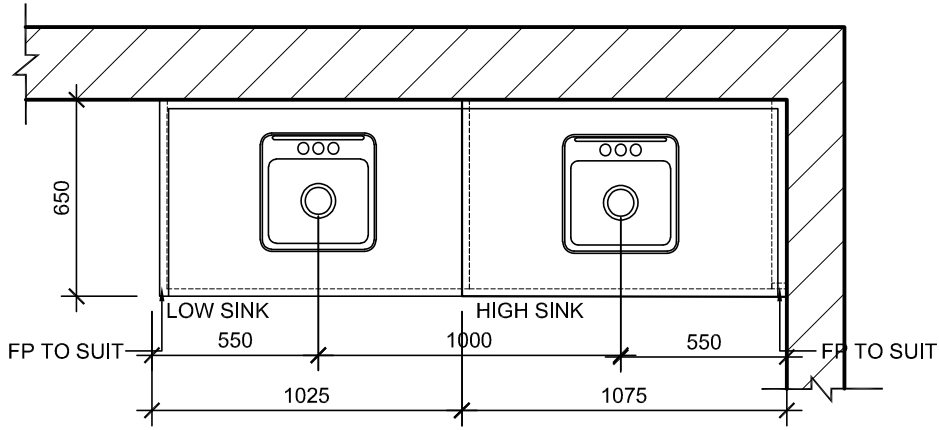
**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM7**  
 (REFERENCE: A2.20)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

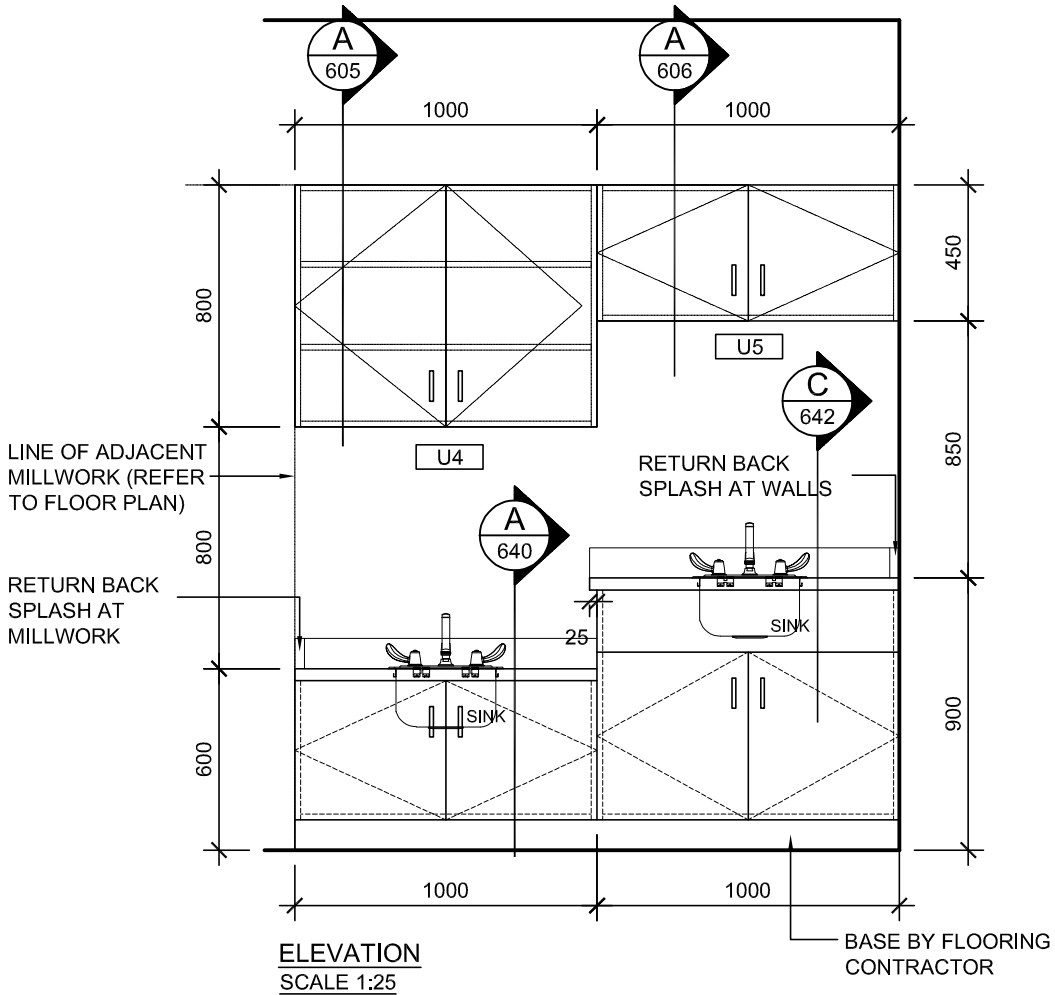
**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
 Web: www.2gai.com

**AD**  
**635**





PLAN  
SCALE 1:25



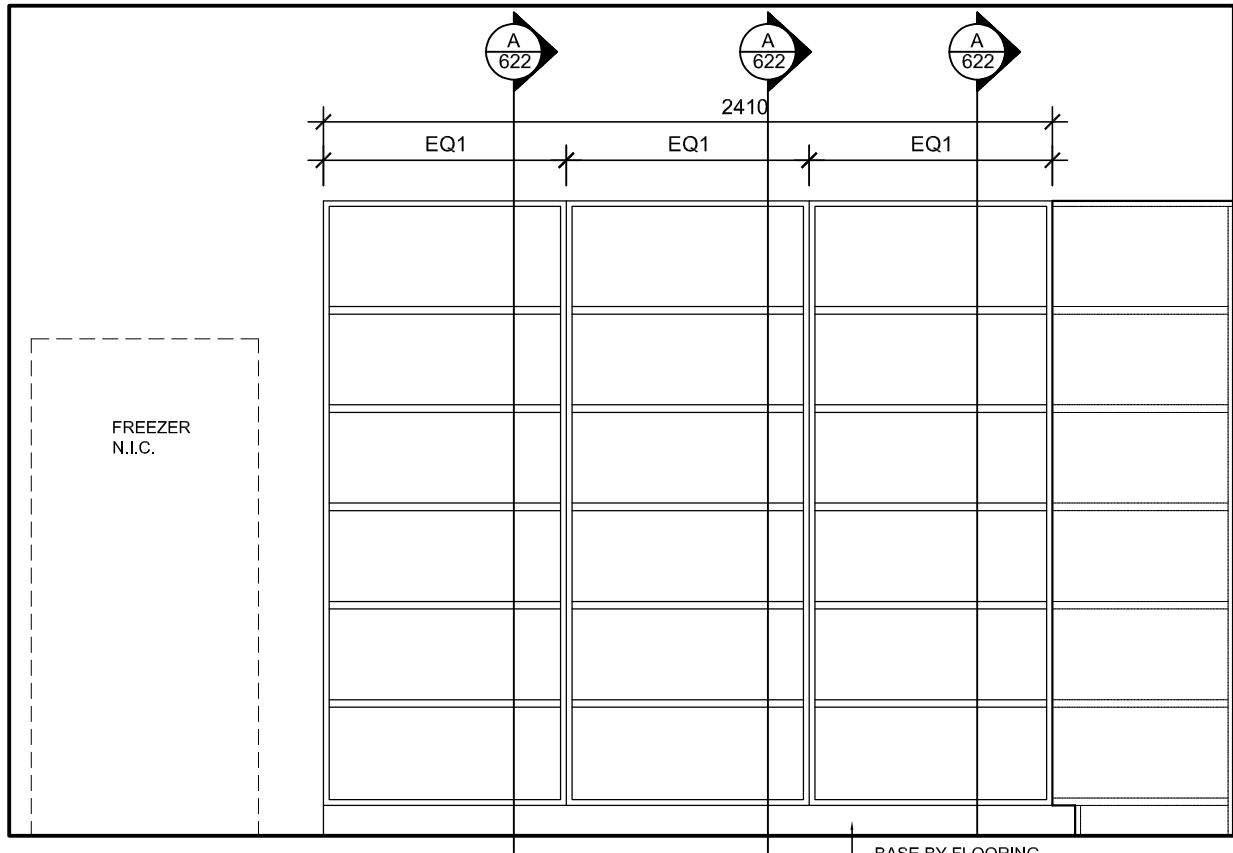
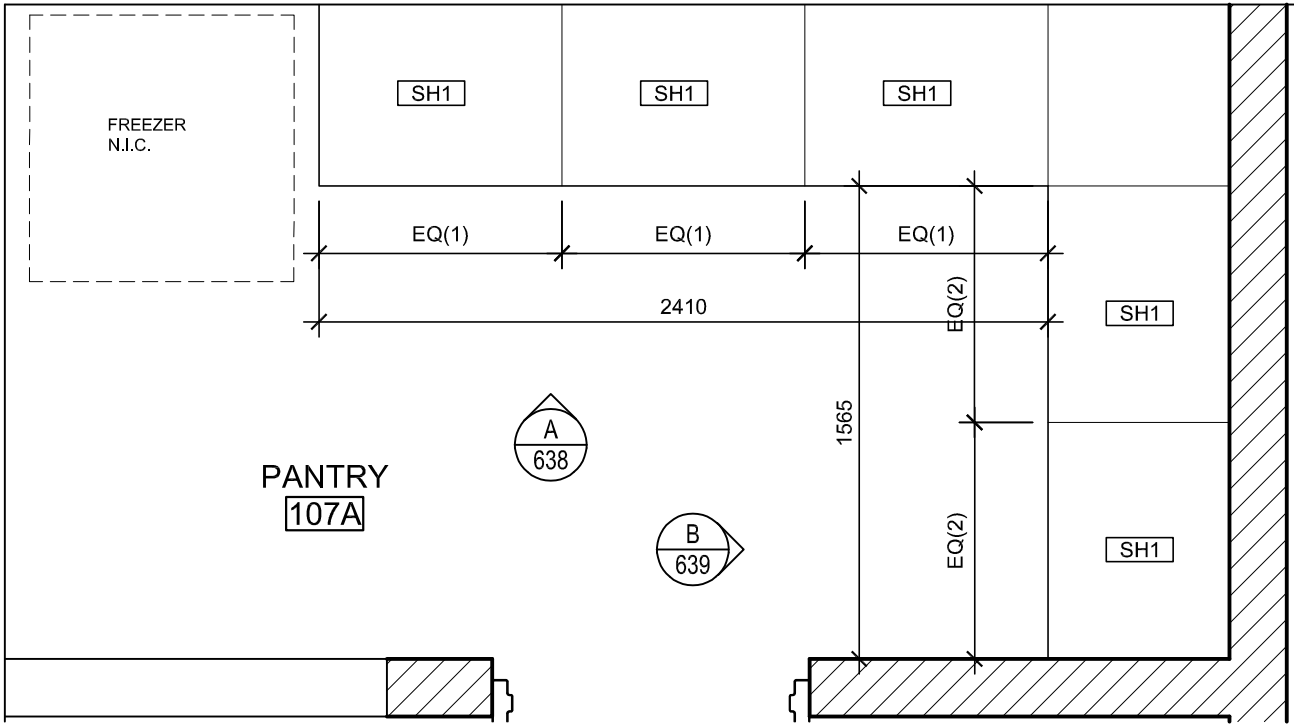
ELEVATION  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM9**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
637**



ELEVATION A  
SCALE 1:25

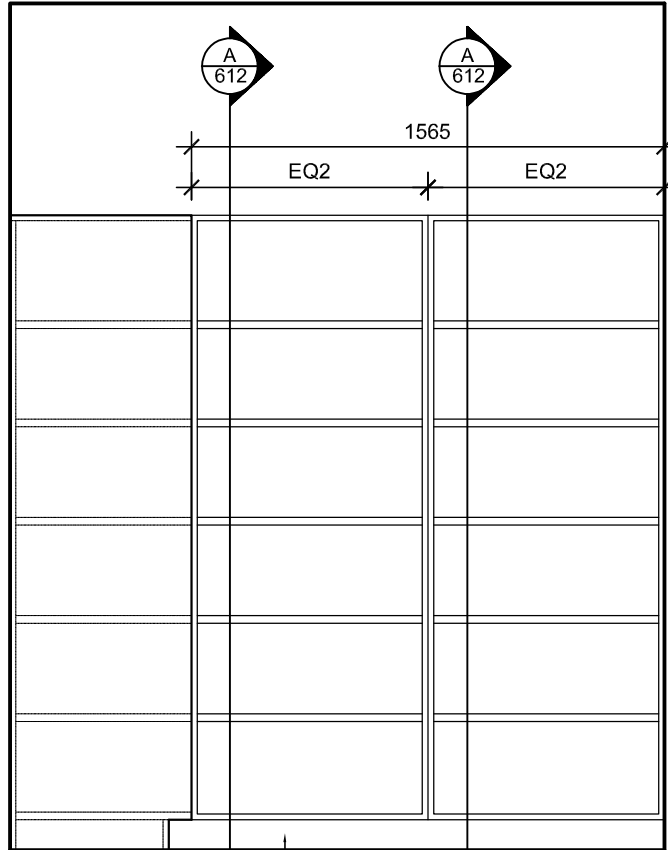
BASE BY FLOORING  
CONTRACTOR

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK TYPE MM10**  
(REFERENCE: A2.20)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
638**



BASE BY FLOORING  
CONTRACTOR

**ELEVATION B**  
SCALE 1:25

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**

141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3

**MILLWORK TYPE MM10 (ELEVATION B)**

(REFERENCE: AD 638)

PROJ: 2022-08

SCALE: AS NOTED

DRAWN: DW

DATE: 2024-04-22

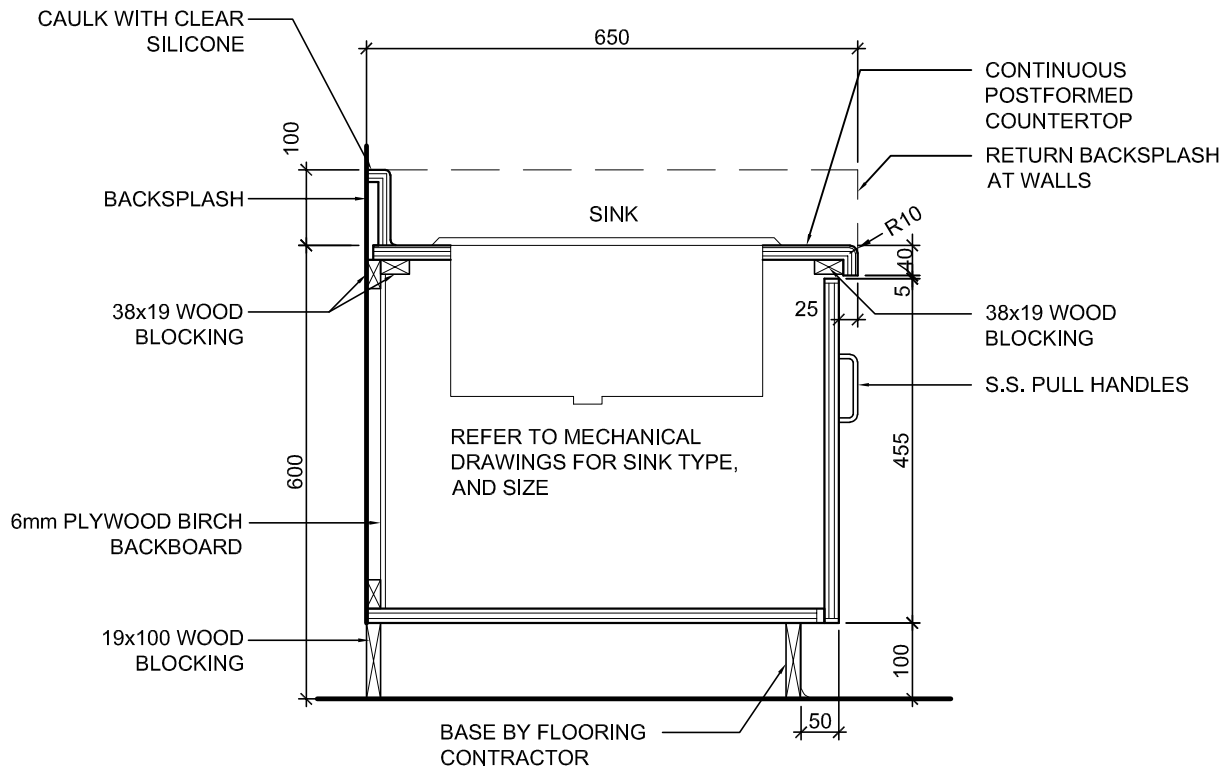
**GRGURIC  
ARCHITECTS  
INCORPORATED**

Web: [www.2gai.com](http://www.2gai.com)

**AD  
639**

A  
 640
 

**SECTION**  
 SCALE 1:10



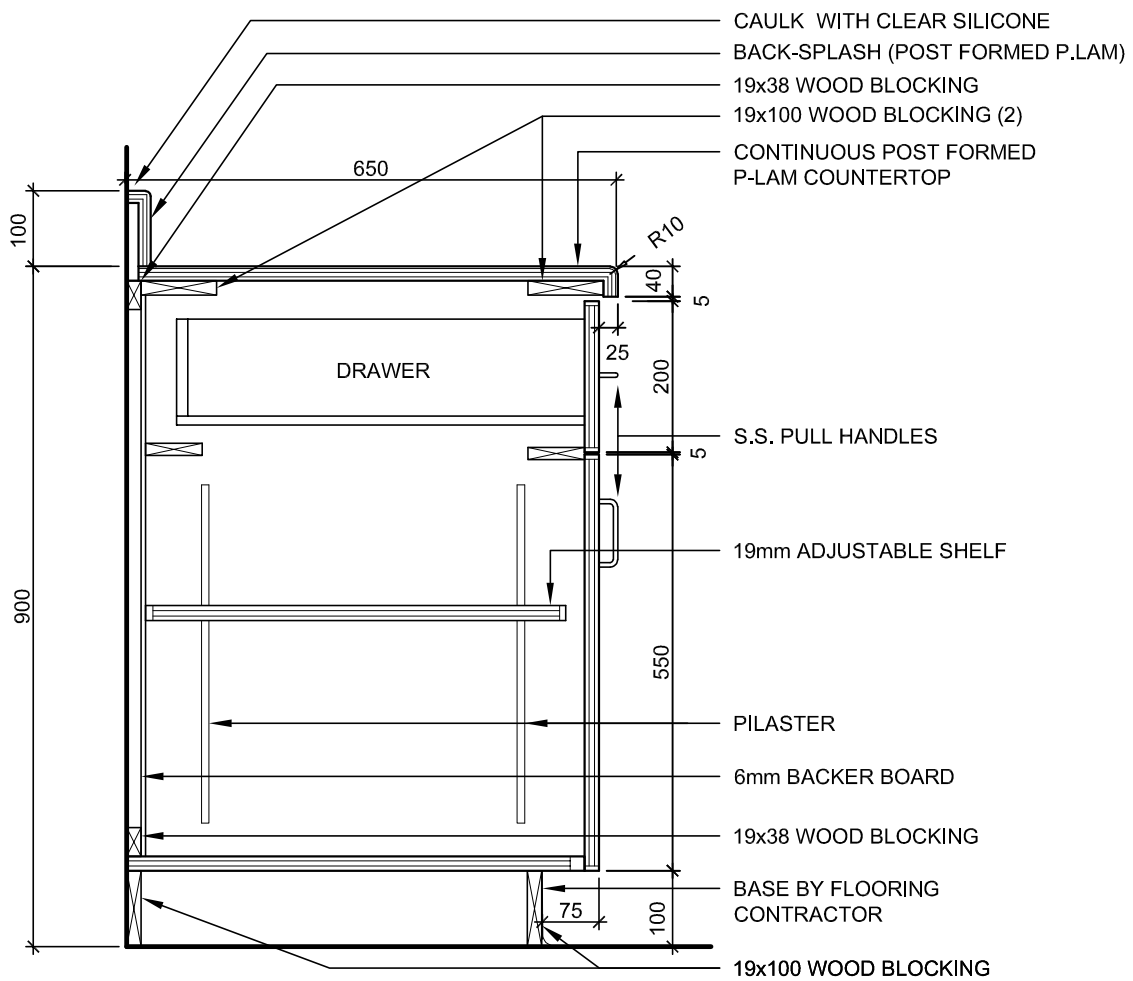
**BANBURY ELEMENTARY SCHOOL**  
**CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION A**  
 (REFERENCE: AD 632, 633, & 637)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC**  
**ARCHITECTS**  
**INCORPORATED**  
 Web: www.2gai.com

AD  
 640

**B** SECTION  
641 SCALE 1:10



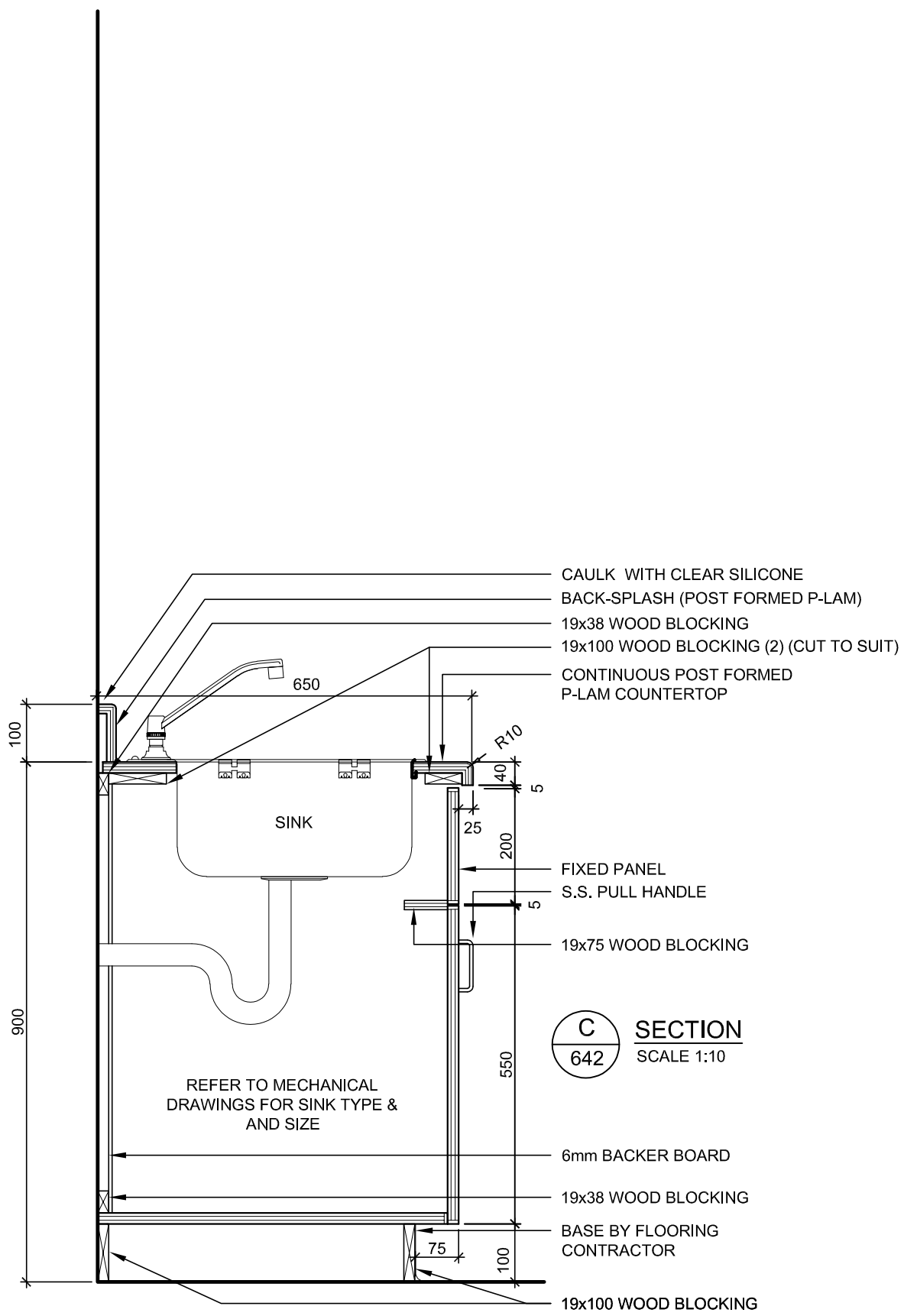
**BANBURY ELEMENTARY SCHOOL  
 CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION B**  
 (REFERENCE: AD 633)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC  
 ARCHITECTS  
 INCORPORATED**  
 Web: www.2gai.com

**AD  
 641**





**C**  
642 SECTION  
SCALE 1:10

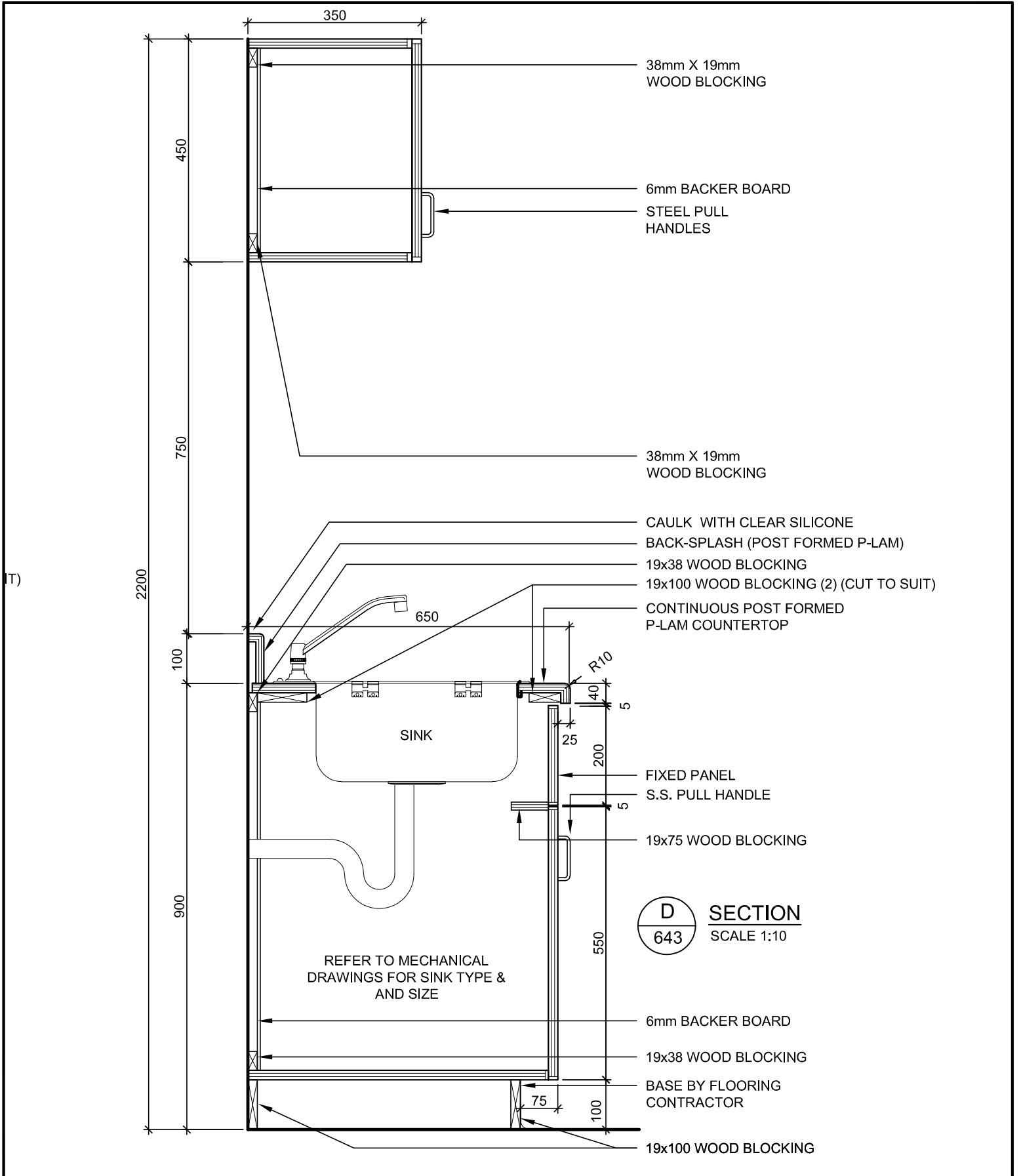
REFER TO MECHANICAL  
DRAWINGS FOR SINK TYPE &  
AND SIZE

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION C**  
(REFERENCE: AD 632, 633, & 637 )

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
642**



**BANBURY ELEMENTARY SCHOOL  
CHILD CARE ADDITION**

141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3

**MILLWORK - SECTION D**

(REFERENCE: AD 634, 635, & 636)

PROJ: 2022-08

SCALE: AS NOTED

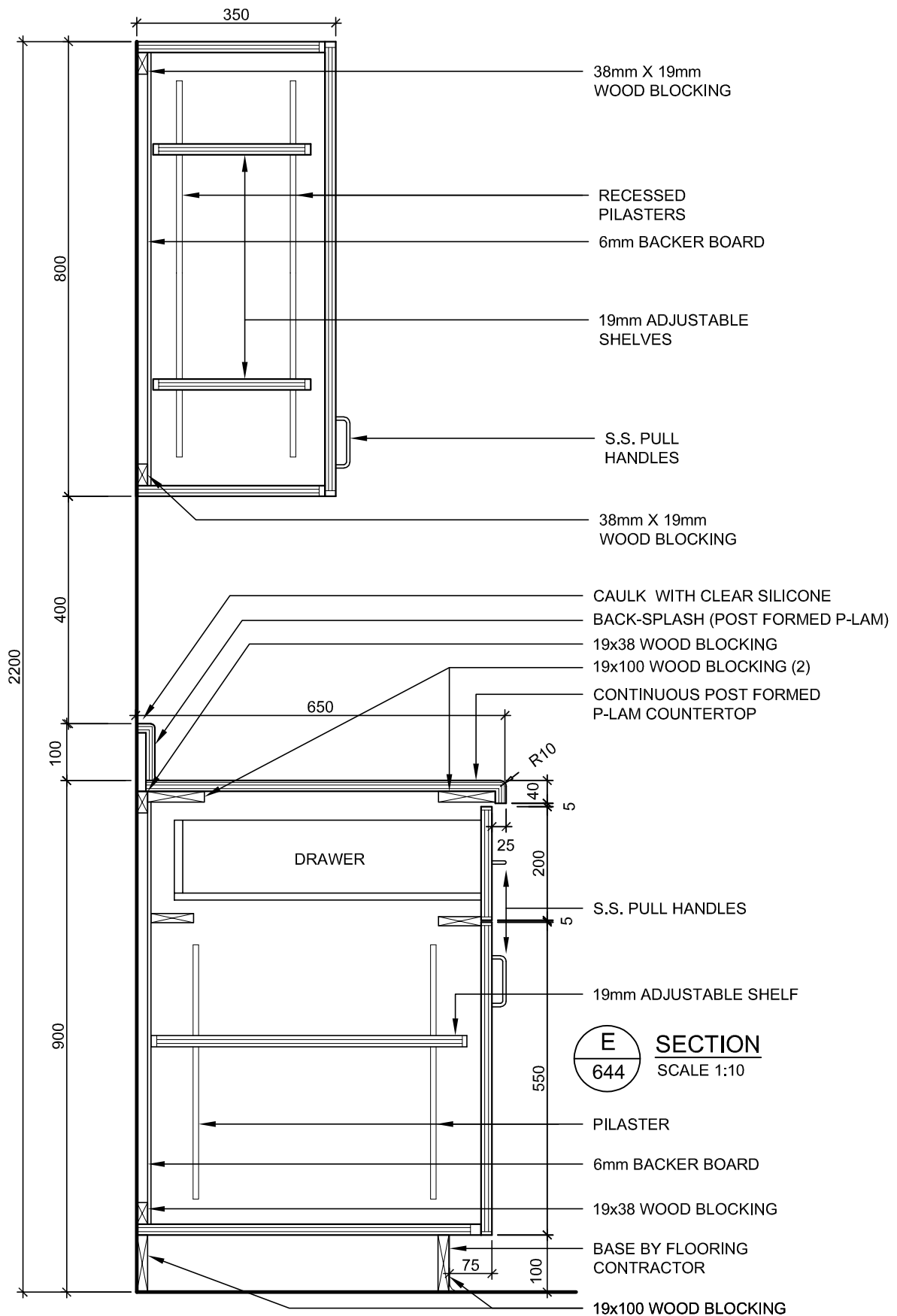
DRAWN: DW

DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**

Web: www.2gai.com

**AD  
643**

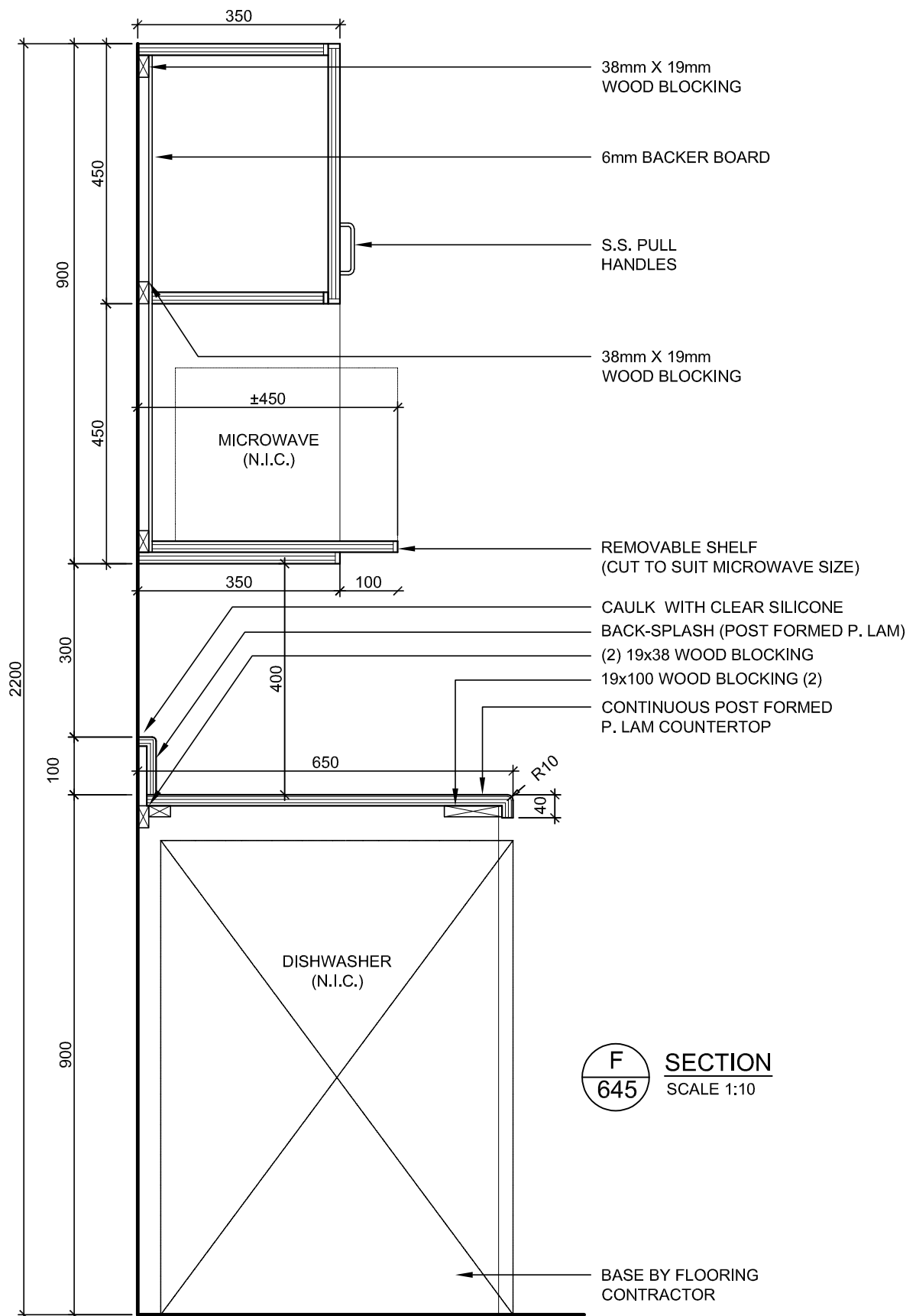


**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION E**  
(REFERENCE: AD 634 & 636)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
644**



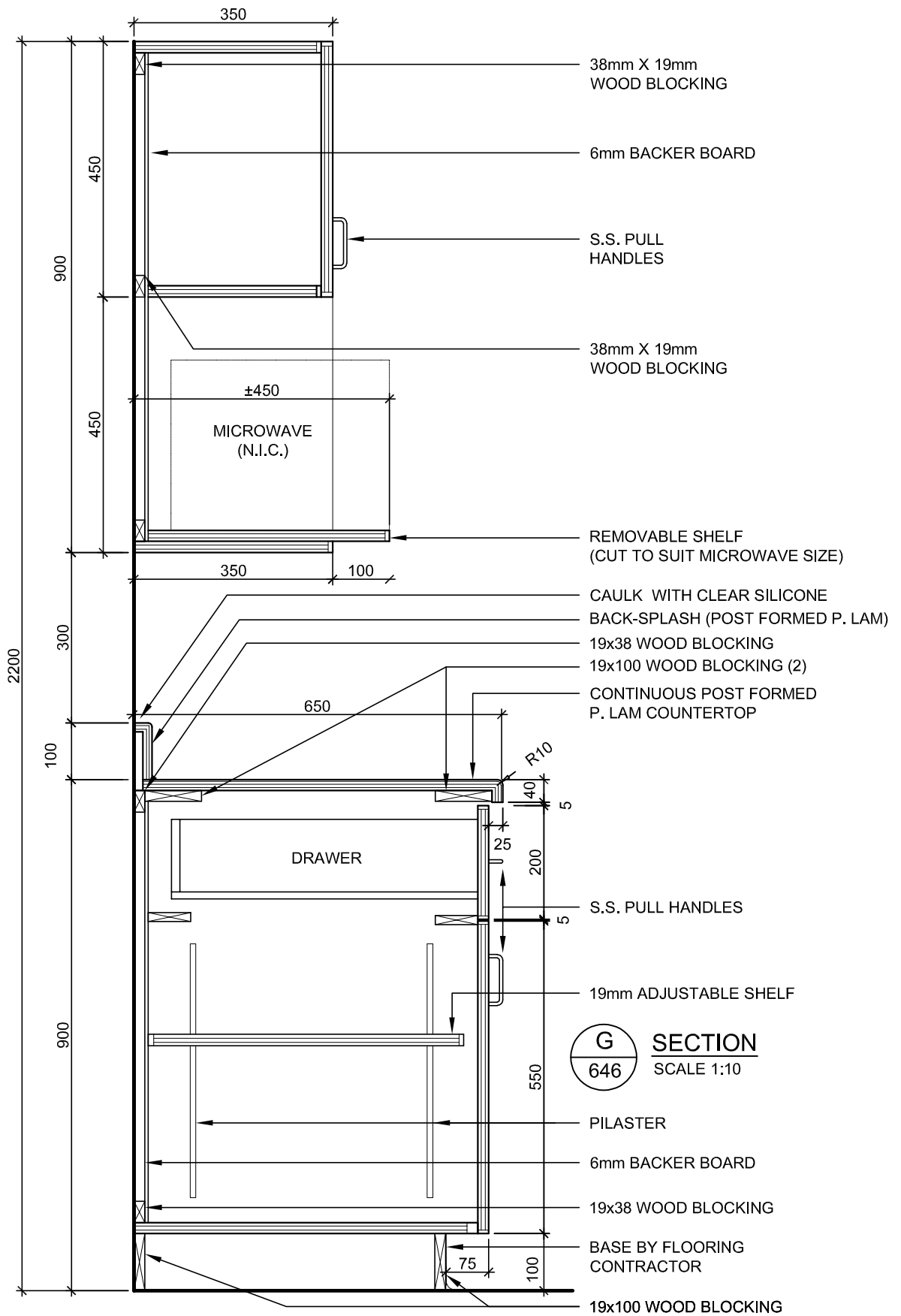
**F** SECTION  
645 SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION F**  
(REFERENCE: AD 634)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
645**

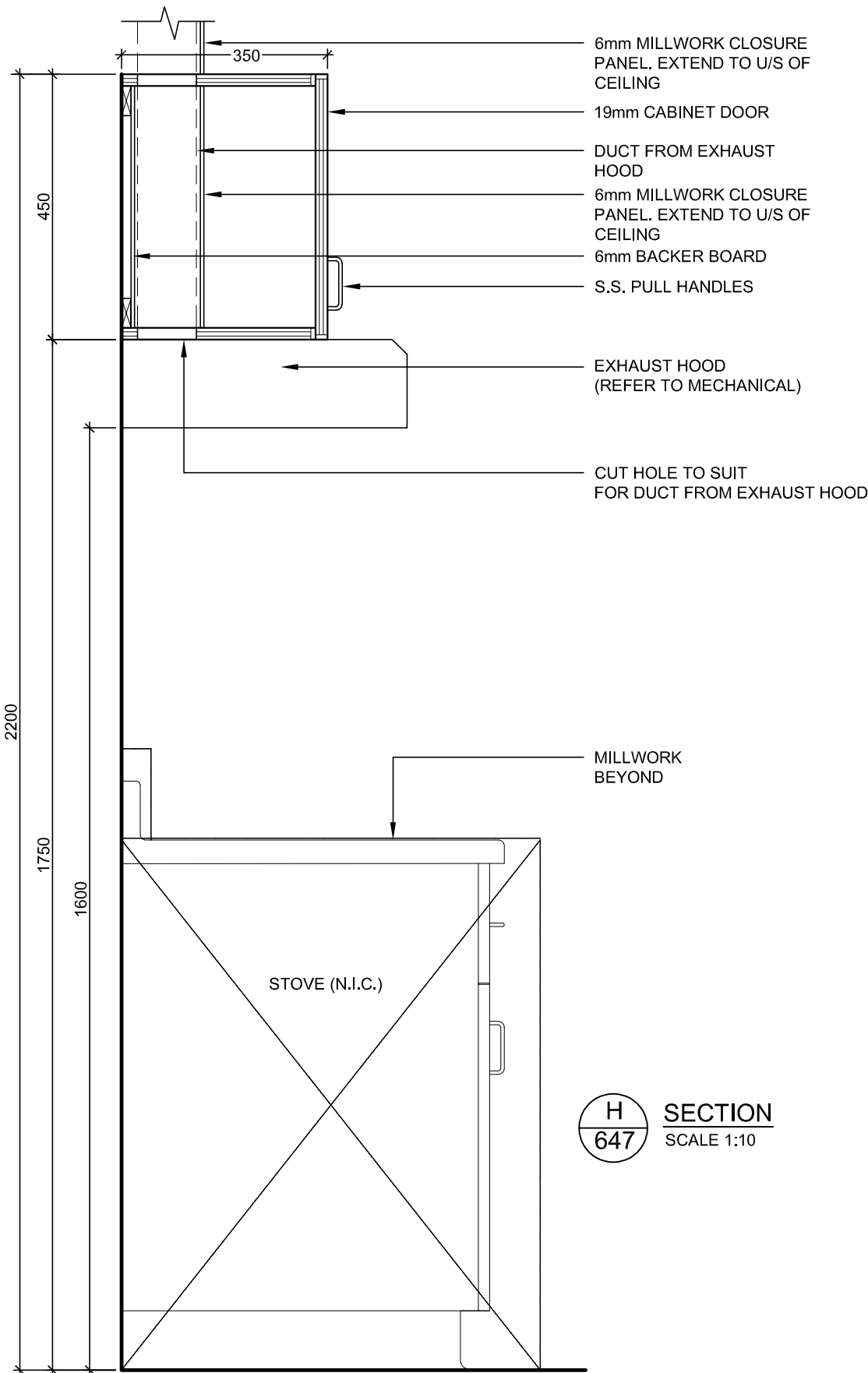


**BANBURY ELEMENTARY SCHOOL  
 CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION G**  
 (REFERENCE: AD 635)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC  
 ARCHITECTS  
 INCORPORATED**  
 Web: www.2gai.com

**AD  
 646**



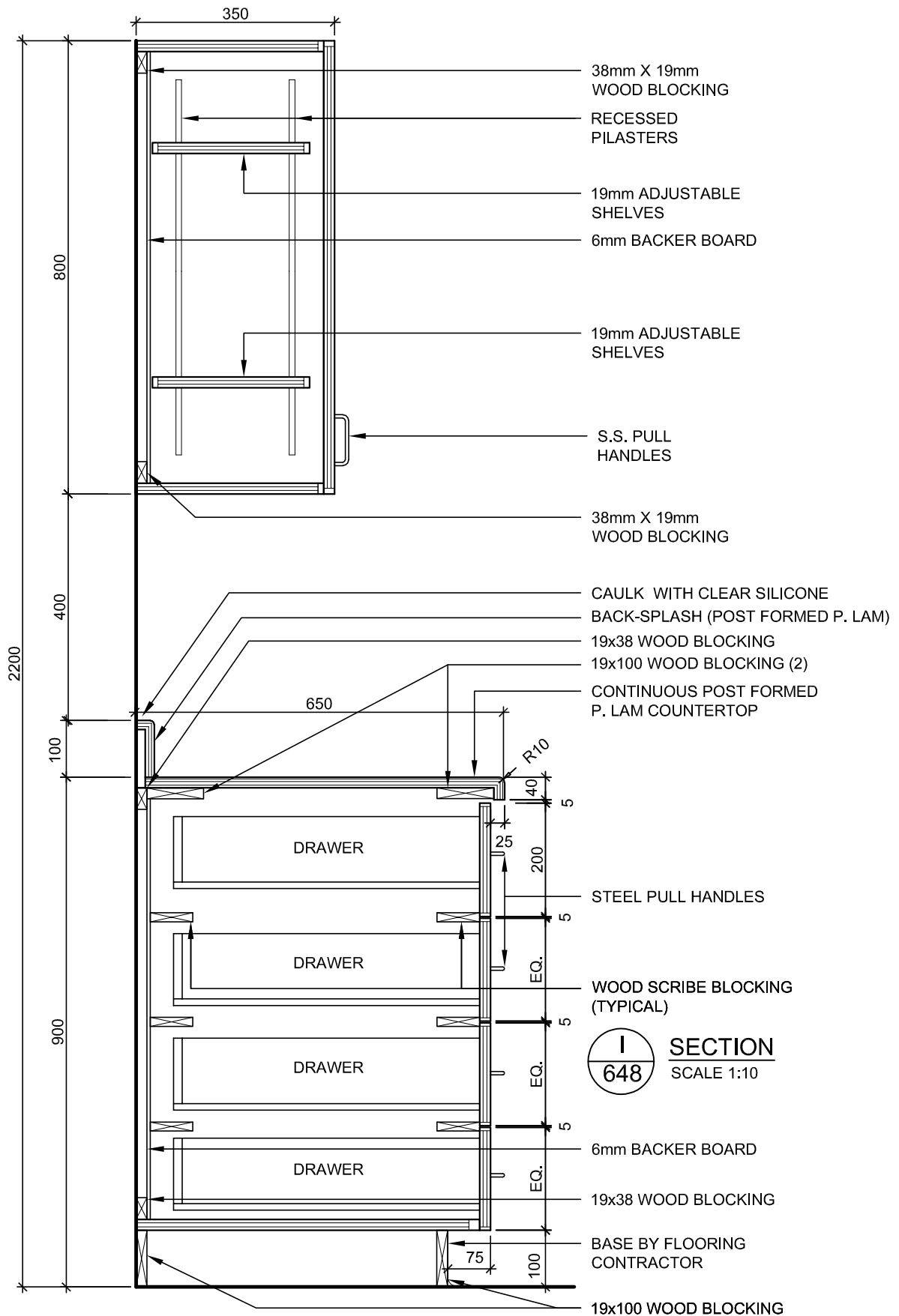
**H**  
647 SECTION  
SCALE 1:10

**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION H**  
(REFERENCE: AD 636)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
647**

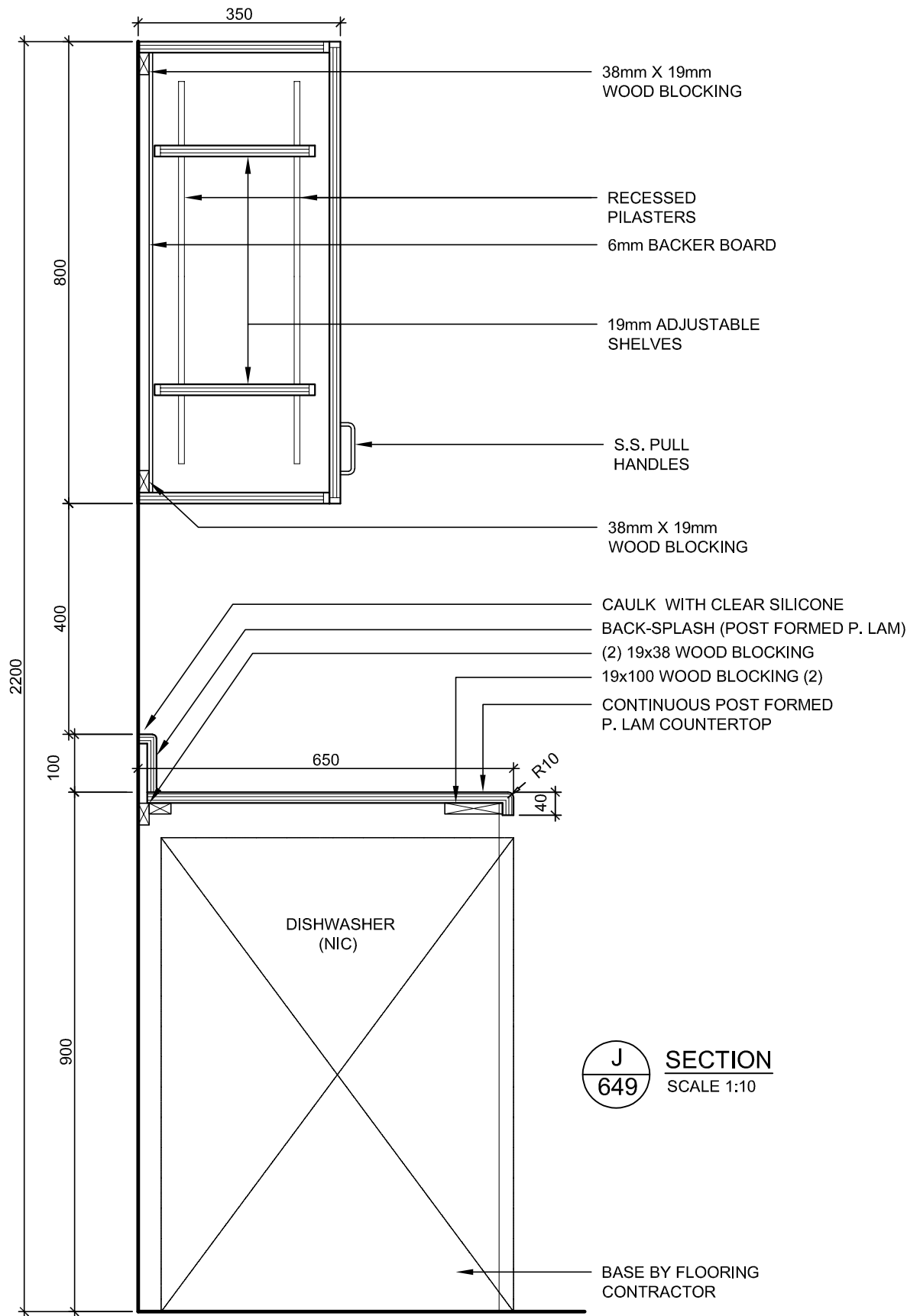


**BANBURY ELEMENTARY SCHOOL  
CHILDCARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION I**  
(REFERENCE: AD 636)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
ARCHITECTS  
INCORPORATED**  
Web: www.2gai.com

**AD  
648**



**BANBURY ELEMENTARY SCHOOL  
CHILD CARE ADDITION**  
141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION J**  
(REFERENCE: AD 635 & 636)

PROJ: 2022-08  
SCALE: AS NOTED  
DRAWN: DW  
DATE: 2024-04-22

**GRGURIC  
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INCORPORATED**  
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## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 Applicable NFPA standards.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire protection system, equipment and accessories. Include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit drawings stamped and signed by Professional Engineer licensed in Province of Ontario, Canada. Drawings shall be prepared to scale in AutoCAD (DWG) format. Drawings prepared by consultant indicate general intent of the design and proposed locations for reference. Contractor's Fire Protection Engineer shall complete detailed design, calculations, systems layouts, schematics, and riser diagrams in accordance with NFPA 13, 14, 20 or other applicable NFPA standards.
- .4 Submittals shall include system schematics, riser diagrams, detailed hydraulic calculations, design criteria and list of assumptions. Provide floor plans indicating zoning, location of all equipment and services, including piping sizes and equipment tags.
- .5 Samples:
  - .1 Submit the following samples:
    - .1 Firehose nozzles.
    - .2 Section of hose.
    - .3 Each type of sprinkler head.
    - .4 Signs.
- .6 Test reports:
  - .1 Submit certified test reports for standpipe and hose assembly from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .2 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.
- .8 Field Quality Control Submittals:
  - .1 Manufacturer's Field Reports: manufacturer's field reports specified.
- .9 Provide submittals for all proposed equipment, including:
  - .1 Piping system, fittings, and valves for each dry, wet and gas suppression systems.
  - .2 Water flow and pressure switches.
  - .3 Sprinkler heads.

- .4 Gas suppression system nozzles.
- .5 Pre-action, deluge and alarm valves, including panels and devices.
- .6 Wiring diagrams and interlocks.
- .7 Pressure reducing and regulating assemblies.
- .8 Backflow prevention devices.
- .9 Fire pumps, jockey pumps and controllers.
- .10 Test and drain assemblies.
- .11 Fire hose cabinets and hose assemblies.
- .12 Gas suppression system cabinets.
- .13 Fire extinguishers.
- .14 Specialized (kitchen) fire suppression system.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Owner's Representative and Consultant prior to final inspection.
  - .2 Operation data to include:
    - .1 Systems schematics, riser diagrams and controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .3 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .4 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified.
    - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .5 Manufacturer's catalogue Data, including specific model, type, and size for:
    - .1 Pipe and fittings.

- .2 Alarm valves.
- .3 Valves, including gate, check, and globe.
- .4 Water motor alarms.
- .5 Sprinkler heads.
- .6 Pipe hangers and supports.
- .7 Pressure or flow switch.
- .8 Fire department connections.
- .9 Excess pressure pump.
- .10 Mechanical couplings.
- .6 Drawings:
  - .1 Sprinkler heads and piping system layout.
    - .1 Prepare 760 mm by 1,050 mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
    - .2 Show data essential for proper installation of each system.
    - .3 Show details, plan view, elevations, and sections of systems supply and piping.
    - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
  - .2 Electrical wiring diagrams.
- .7 Design Data:
  - .1 Calculations of sprinkler system design.
  - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .8 Field Test Reports:
  - .1 Preliminary tests on piping system.
- .7 Records:
  - .1 As-built drawings of each system.
    - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes. Drawings shall be submitted in AutoCAD 2020 format (.dwg files) and PDF; adhere to Owner's CAD Guidelines whenever applicable – coordinate with Owner's representative prior to preparation of as-built drawings.
    - .2 Submit 760mm by 1,050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.
- .8 Approvals:
  - .1 Submit 3 copies of draft Operation and Maintenance Manual to Owner's Representative and Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
  - .2 Make changes as required and re-submit as directed by Owner's Representative and Consultant.
- .9 Contractor's Fire Protection Engineer Certification
  - .1 Contractor's Fire Protection Engineer shall complete periodic field reviews at

their own discretion to witness and certify installation of the systems prior to concealment.

- .2 Witness start-up, testing and commissioning of the fire protection systems.
- .3 Once Contractor's Fire Protection Engineer is satisfied with the installation, testing and performance of the fire protection systems, submit stamped letter of conformance for each system, including but not limited to:
  - .1 NFPA 13 – Sprinkler System
  - .2 NFPA 14 – Standpipe and Fire Hose
- .10 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  - .2 If grooved piping system is used, contractor shall arrange for quality assurance services of the grooved piping system factory trained personnel to review the installation of the piping system including fittings, couplings, joints. Manufacturer shall use discretion in selecting sample of piping system to be verified. If sample fails, contractor shall complete required corrections and additional inspection shall take place until satisfaction of manufacturer's representative. Provide and include final letter in the closeout manuals.
- .11 Operation and Maintenance Manuals:
  - .1 Provide detailed hydraulic calculations stamped by Engineer licenced in Ontario including summary sheet, and Contractors Material and Test Certificate for aboveground and underground piping and other documentation for incorporation into manual in accordance with NFPA 13, NFPA 14 and Authorities Having Jurisdiction..

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One glass for each gauge glass.
  - .4 Sprinkler head cabinet with each type of sprinkler head used in the system, quantity of heads shall be in accordance with NFPA and AHJ.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements] [and] [with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

**1.5 QUALITY ASSURANCE**

.1 Qualifications:

- .1 Installer: company or person specializing in standpipe and hose assembly with a minimum 5 years documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

**2 PRODUCTS**

**2.1 GENERAL**

- .1 All equipment and materials shall be certified for fire protection installation in Canada and bear all required listings including ULC.
- .2 All materials shall be supplied by single manufacturer.
- .3 Provide fully functioning fire suppression system throughout the building or in work areas denoted on the drawings including wet systems in conditioned spaces, dry system in unheated or exterior spaces, pre-action system as noted on drawings, clean agent fire suppression system, standpipe and fire hose systems, portable fire extinguishers.

**3 EXECUTION**

**3.1 GENERAL**

- .1 Grade fire suppression piping in the direction of drain fittings.
- .2 Provide indirect drain of fire protection systems to funnel floor drains.
- .3 Provide minimum schedule 10 pipe sleeves and chrome plated escutcheons for all fire protections piping for all penetrations.
- .4 All piping, systems and services thru fire rated floor and wall assemblies shall be fire stopped in accordance with CAN4-S115-M85 - Standard Method of Fire Tests of Firestop Systems.
- .5 All pipe penetrations thru underground exterior walls shall be sealed with modular link seal assembly.
- .6 Provide all required core drilling, scan or x-ray floors and walls prior to drilling to avoid damage of any encased services or rebar. Obtain permission from Structural Engineer prior to any drilling.

**3.2 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit reports.

- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 National Fire Prevention Association (NFPA)
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection.
  - .3 NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
  - .4 NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .3 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN4 S543-M984, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 In accordance with Section 21 05 00 – Common Work Results for Fire Suppression.

### 1.3 CLOSEOUT SUBMITTALS

- .1 In accordance with Section 21 05 00 – Common Work Results for Fire Suppression.

### 1.4 QUALITY ASSURANCE

- .1 In accordance with Section 21 05 00 – Common Work Results for Fire Suppression.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
  - .1 Store materials indoors, in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 DESIGN REQUIREMENTS**

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by pipe schedules for ordinary hazard occupancy.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems
- .6 Location of Sprinkler Heads:
  - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for each hazard occupancy.
  - .2 Uniformly space sprinklers on branch.
- .7 Water Distribution:
  - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
  - .2 Discharge from individual heads in hydraulically most remote area to be 100 % of specified density.
- .8 Density of Application of Water:
  - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
- .9 Sprinkler Discharge Area:
  - .1 Area: hydraulically most remote area as defined in NFPA 13

### **2.2 ABOVE GROUND PIPING SYSTEMS**

- .1 Provide fittings for changes in direction of piping and for connections.
  - .1 Making changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will not be permitted.
- .3 Conceal piping in areas with suspended ceiling or drywall ceiling, where possible.

### **2.3 PIPE, FITTINGS AND VALVES**

- .1 Pipe:
  - .1 Ferrous: to NFPA 13
- .2 Fittings and joints to NFPA 13:
  - .1 Ferrous: screwed, welded, flanged or roll grooved.
    - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.



- .2 Provide welded, threaded or grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
- .3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will [not] be permitted.
- .4 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
- .5 Fittings: ULC approved for use in wet pipe sprinkler systems
- .6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
- .7 Side outlet tees using rubber gasketed fittings are [not] permitted.
- .8 Sprinkler pipe and fittings: metal.
- .3 Valves:
  - .1 ULC listed for fire protection service
  - .2 Gate valves: open by counterclockwise rotation.
  - .3 Provide rising stem, OS & Y, wall indicator valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
  - .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.
  - .5 Provide gate valve in piping protecting elevator hoistways, machine rooms, and machinery spaces.
- .4 Pipe hangers:
  - .1 ULC listed for fire protection services in accordance with NFPA

## **2.4 SPRINKLER HEADS**

- .1 General: to NFPA 13 and ULC listed for fire services
- .2 Sprinkler Head Type:
  - .1 Type A: upright bronze.
  - .2 Type B: pendant chrome link and lever type.
  - .3 Type C: pendant chrome glass bulb type.
  - .4 Type D: recessed chrome, glass bulb type with ring and cup.
  - .5 Type E: flush chrome link and lever type.
  - .6 Type F: side wall chrome link and lever type.
  - .7 All sprinkler heads shall be quick response type unless otherwise noted on drawings.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
  - .1 Provide polished chromium-plated pendent sprinklers below suspended ceilings.
  - .2 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13
  - .3 Provide sprinkler heads to ensure full coverage of the areas in scope of work. Design drawings indicate proposed layouts for general intent and purposes. Contractor's Fire Protection Engineer shall be responsible for hydraulic calculations and detailed design including locations of sprinkler heads, sizing and layout of the distribution piping, location of supervisory and flow switches.

- .4 Deflector: not more than 75 mm below suspended ceilings.
- .5 Ceiling plates: not more than 25 mm deep.
- .6 Ceiling cups: not permitted.
- .4 Sprinkler heads shall be ULC listed for service and use in installed occupancies.
- .5 Sprinkler heads installed in locations subjected to damage or vandalism such as mechanical rooms, machinery room, loading dock, gymnasium, outside, stairs, etc shall be complete with listed guards.

## **2.5 ALARM CHECK VALVE**

- .1 Alarm check valve to NFPA 13 and ULC listed for fire service
- .2 Provide variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gauges, accessories, and appurtenances for proper operation of system.
- .3 Provide valve complete with internal components that are replaceable without removing the valve from the installed position.

## **2.6 WATER MOTOR ALARMS**

- .1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.
- .2 Mount alarms on outside of outer walls of each building at location as directed.
- .3 Provide separate drain piping directly to exterior of building.

## **2.7 SUPERVISORY SWITCHES**

- .1 General: to NFPA 13 and ULC listed for fire service
- .2 Valves:
  - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Pressure or flow switch type:
  - .1 With normally open and normally closed contacts and supervisory capability.
  - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
  - .3 Connect into building fire alarm system.
  - .4 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.
- .4 Pressure alarm switch:
  - .1 With normally open and normally closed contacts and supervisory capability.

## **2.8 WATER GONG**

- .1 To NFPA 13 and ULC listed for fire service. Location as indicated

## **2.9 FIRE DEPARTMENT CONNECTION**

- .1 Provide connections approximately 1.5 m above finish grade, location as indicated.
- .2 To NFPA 13 and ULC S543 listed, Siamese type.

- .3 Polished bronze of approved two-way type with 65mm (NPS 2 1/2) National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.
- .4 Thread specifications: compatible with local fire department.
- .5 Install a 90-degree elbow with drain connection at the low-point near each fire department connection to allow for system drainage to prevent freezing.

## **2.10 PRESSURE GAUGES**

- .1 ULC listed and to Section 23 05 19.13 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

## **2.11 PIPE SLEEVES**

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
  - .1 Firmly pack space with mineral wool insulation.
  - .2 Seal space at both ends of sleeve or core-drilled hole with mechanically adjustable segmented elastomeric seal.
  - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
  - .1 Provide hot-dip galvanized steel sleeves.
  - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
  - .1 Provide 0.61 mm thick galvanized steel sheet.

## **2.12 ESCUTCHEON PLATES**

- .1 Provide one piece metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished chromium-plated finish on copper alloy plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

## **2.13 INSPECTOR'S TEST CONNECTION**

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.

- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

## **2.14 SIGNS**

- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

## **3 EXECUTION**

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

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 DESIGN**

- .1 Design, provide, inspect and test fully functioning fire protection system to acceptance in accordance with NFPA 13, NFPA 25, Ontario Building Code, Ontario Fire Code and local bylaws.
- .2 System hydraulic calculations and detailed design shall be solely responsibility of the Contractor's Fire Protection Engineer licensed in Ontario. Submit detailed package of stamped submittals to Consultant and AHJ for review and approval.
- .3 Site hydraulic data shall be filed verified by Contractor and used by Fire Protection Engineer for hydraulic calculations.
- .4 Contractor's Engineer shall conduct field inspection of the existing conditions prior to design.
- .5 Contractor's Engineer shall conduct periodic quality assurance review of the progress installation and provide reports noting deficiencies or otherwise confirming compliance with the design intent.
- .6 Prior to substantial completion Contractor's Engineer shall provide stamped Letter of Conformance confirming installation meets design intent, NFPA 13 and local codes.

### **3.3 INSTALLATION**

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.
- .5 Sprinkler heads shall be installed on center or quarter point of long dimension of the ceiling tiles and on center point of long dimension of ceiling tile. Coordinate location of sprinkler heads with other ceiling mounted devices including smoke detectors, lights, diffusers, speakers, wifi modules, etc and install sprinkler heads in symmetry with these devices.
- .6 Sprinkler heads shall not be reused.

- .7 Do not installed damaged or defective sprinkler heads.
- .8 Installation of grooved piping systems shall be in conformance with manufacturer's requirements. Manufacturer's trained personnel shall provide training to contractor's personnel on installation methods of grooved piping systems. Manufacturer's trained personnel shall complete periodic quality assurance inspections to observe progress installation of the piping system and provide reports. A final conformance letter shall be provided certifying that installation of grooved piping system meets manufacturer's requirements.

### **3.4 ELECTRICAL CONNECTIONS**

- .1 Provide electrical work associated with this section in accordance with Division 26 requirements.
- .2 Provide fire alarm system in accordance with Division 28.
- .3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .4 Provide wiring in rigid metal conduit or intermediate metal conduit.

### **3.5 DISINFECTION**

- .1 Disinfect new piping and existing piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

### **3.6 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS**

- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
- .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.
- .3 Bolt sleeves around main piping.
- .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
- .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

### **3.7 FIELD PAINTING**

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
  - .1 Piping in Finished Areas:
    - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
    - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
    - .3 Provide piping with 50mm wide red enamel bands spaced at maximum of 6 m intervals throughout piping systems.
  - .2 Piping in Unfinished Areas:
    - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in attic spaces, [spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
    - .2 Provide piping with 50 mm wide red enamel spaced at maximum of 6 m intervals.

### **3.8 FIELD QUALITY CONTROL**

- .1 Site Test, Inspection:
  - .1 Perform test to determine compliance with specified requirements in presence of Contractor's Fire Protection Engineer. Owner's Representative or Consultant may chose to witness testing, provide minimum (5) business days' notice prior to tests.
  - .2 Test, inspect, and approve piping before covering or concealing.
  - .3 Preliminary Tests:
    - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
    - .2 Flush piping with potable water in accordance with NFPA 13
    - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
    - .4 Test alarms and other devices.
    - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13
  - .4 Formal Tests and Inspections:
    - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
    - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
    - .3 Repeat required tests as directed.
    - .4 Correct defects and make additional tests until systems comply with contract requirements.

- .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
- .6 Authority of Jurisdiction will witness formal tests and approve systems before they are accepted.

.2 Site Tests:

- .1 Field test each fire pump, driver and controllers in accordance with NFPA 20. Testing shall include:
  - .1 Verification of proper installation, system initiation, system operation, adjustment and fine tuning.
  - .2 Verification of the sequence of operations and alarm systems.
- .2 Testing to be witnessed by Contractor's Fire Protection Engineer and authority having jurisdiction.
- .3 Develop detailed instructions for O & M of this installation.

**3.9 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**



## 1 GENERAL

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for all equipment, systems and accessories; include product characteristics, performance criteria, materials, physical size, weights, finishes, listings, approvals, limitations, warranty and lead times.
- .3 Shop Drawings:
  - .1 Submit shop drawings for all plumbing systems, components and equipment, including:
    - .1 Plumbing fixtures.
    - .2 Piping system.
    - .3 Valves and fittings.
    - .4 Cleanouts.
    - .5 Floor and roof drains.
    - .6 Trap seal primers.
    - .7 Hot water heaters and storage tanks.
    - .8 Hose bibs.
    - .9 Pumps, including controls.
    - .10 Backflow preventers.
    - .11 Pressure reducing valves.
    - .12 Water hammer arrestors.
    - .13 Access panels and doors.
  - .2 Indicate on drawings:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
    - .3 List of accessories and options specific to each equipment.
  - .3 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
    - .6 Installation instructions.

### 1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.



- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Owner's Representative and Consultant before final inspection.
  - .2 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
    - .8 Testing data (backflow preventer, etc).
  - .3 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .4 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified.
    - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .5 Approvals:
    - .1 Submit 2 copies of draft Operation and Maintenance Manual to Owner's Representative and Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
    - .2 Make changes as required and re-submit as directed by Consultant.
  - .6 Additional data:
    - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- 7 Records:
  - .1 As-built drawings of each system.
  - .2 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes. Drawings shall be submitted in AutoCAD 2020 format (.dwg files) and PDF; adhere to Owner's CAD Guidelines whenever applicable – coordinate with Owner's representative prior to preparation of as-built drawings.
  - .3 Submit 760mm by 1,050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.

- .4 Use different colour waterproof ink for each service.
- .5 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings. Contractor shall be responsible for all changes, revisions and updates of the AutoCAD drawings.
  - .2 Submit to Consultant for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section [01 78 00 - Closeout Submittals].
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **2 PRODUCTS**

### **2.1 ACCESS PANELS/DOORS**

- .1 Provide access panels at all locations of concealed equipment, fittings requiring access for operation, maintenance and repair including but not limited to valves, traps, cleanouts, expansion devices, air vents, water hammer arrestors, trap seal primers, vacuum breakers, plumbing controls.
- .2 Access doors shall be located to provide complete access to concealed equipment and devices.

- .3 Construction:
  - .1 Plaster or wet wall: 16 ga steel flush with surface complete with gasket and concealed flange.
  - .2 Masonry or drywall: 16 ga steel flush with surface complete with gasket and concealed flange.
- .4 Finish:
  - .1 Tiled or marble surfaces: type 304 stainless steel, #4 satin polish.
  - .2 Other areas: prime coated steel, finished to match adjacent.
- .5 Options and accessories:
  - .1 Continuous concealed hinges.
  - .2 Adjustable anchoring straps to suit installation.
  - .3 Mineral wool insulation (for fire rated panels).
  - .4 Self latching screw driver operated slam latch.
  - .5 Automatic panel closer.
  - .6 Inside latch release.
- .6 Sizing:
  - .1 Access panels/doors shall be of adequate size to facilitate access to all components. The following are minimum recommended sizes:
    - .1 Hand access: 300x300mm (12"x12")
    - .2 Body entry access: 600x600mm (24"x24")
- .7 Fire rating
  - .1 Access doors/panels installed in fire rated floor and wall assemblies shall have similar fire rating and corresponding ULC label.

### **3 EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

**3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers.
- .2 Clean all fixtures and accessories.

**3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct tests in accordance with Section 01 45 00 - Quality Control and submit reports to Consultant.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports to Consultant.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.5 DEMONSTRATION**

- .1 Owner's Representative or Consultant may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Contractor shall record these demonstrations on video tape for future reference.

**3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**3.7 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**3.8 CORING**

- .1 Provide core drilling for installation of plumbing systems.
- .2 X-ray or scan floor and wall assemblies prior to core drilling, consult with Consultant on any noted interferences. X-ray shall only be carried out after hours, coordinate with Owner's Representative and provide minimum 10 business days' notice.
- .3 Coring and cutting of structural components shall only be completed once approved by Structural Engineer.
- .4 Repair adjacent finishes and any damages as a result of this work to satisfaction of Owner's Representative and Consultant.

- .5 Verify obstructions and interference on the other side of the floor and wall assemblies prior to coring. If any obstructions are noted, contractor shall locate alternate core locations and propose to Consultant for review and approval. Proceed with coring at alternate locations only once approved by Consultant.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
  - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
  - .1 ANSI/AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
  - .2 ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.
  - .3 ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.
- .3 CSA Group (CSA)
  - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2 CSA B79, Commercial and Residential Drains and Cleanouts.
  - .3 CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Efficiency Valuation Organization (EVO)
  - .1 International Performance Measurement and Verification Protocol (IPMVP).
    - .1 IPMVP.
- .5 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada (NPC).
- .6 Plumbing and Drainage Institute (PDI)
  - .1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
  - .2 PDI-WH201, Water Hammer Arresters Standard.
- .7 American National Standards Institute/National Sanitation Foundation (ANSI/NSF).
  - .1 ANSI/NSF 61, Drinking Water System Components.
  - .2 ANSI/NSF 372, Drinking Water System Components – Lead Content.

## 2 PRODUCTS

### 2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to CSA B79 complete with trap seal primer and venting in accordance with Ontario Building Code Part 7.
- .2 FD-1 (general duty): cast iron body round, adjustable head, nickel bronze strainer, integral seepage pan, and clamping collar.
- .3 FD-2 (heavy duty): cast iron body, heavy duty non-tilting or hinged lacquered cast iron grate, integral seepage pan and clamping collar.
- .4 FFD-1 (combination funnel floor drain): cast iron body with integral seepage pan, clamping

collar, nickel-bronze adjustable head strainer with integral funnel.'

- .5 Standard of acceptance: Zurn, J.R. Smith or Watts.

## **2.2 ROOF DRAINS**

- .1 RD-1 (standard roof drain): cast iron body with aluminum dome, under-deck clamp to suit roof construction, flashing clamp ring with integral gravel stop.
- .3 RD-2 (cornice, sill or canopy drain): cast iron body with cast aluminum dome, strainer and flashing clamp ring.
- .4 RD-3 (parapet or scupper drain): cast iron body with aluminum strainer/grate and flashing clamp.
- .5 RD-4 (inverted roofing system): cast iron body with aluminum dome, under-deck clamp and sump receiver to suit roof construction, with integral gravel stop and stainless steel drainage grid.
- .6 RD-4 (controlled flow): aluminum body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, flow control weir assembly, aluminum dome.
- .7 Standard of acceptance: Zurn, J.R. Smith or Watts.

## **2.3 CLEANOUTS**

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
- .1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
- .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
- .1 Plugs: bolted bronze with neoprene gasket.
- .2 Cover for Unfinished Concrete Floors: cast iron or nickel bronze round square, gasket, vandal-proof screws.
- .3 Cover for Terrazzo Finish: polished nickel bronze or brass with recessed cover for filling with terrazzo, vandal-proof locking screws.
- .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
- .5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
- .3 Standard of acceptance: Zurn, J.R. Smith or Watts.

## **2.4 NON-FREEZE WALL HYDRANTS**

- .1 Surface mount with integral vacuum breaker, 20mm (NPS 3/4) hose outlet, removable operating key, polished bronze finish.
- .2 Standard of acceptance: Zurn, J.R. Smith or Watts.

## **2.5 NON-FREEZE GROUND HYDRANT**

- .1 Deck type with polished bronze] box with hinged cover, removable operating key, bronze

casing for 2,150 mm ground cover, all-bronze valve body and working parts, 20mm (NPS 3/4) inlet and outlet, anchor flange, membrane clamp.

- .2 Standard of acceptance: Zurn, J.R. Smith or Watts.

## **2.6 WATER HAMMER ARRESTORS**

- .1 Copper construction, piston type: to PDI-WH201.
- .2 Lead free construction.
- .3 Standard of acceptance: Zurn or Watts.

## **2.7 BACKFLOW PREVENTERS**

- .1 Provide backflow preventers on main incoming water service, interface between potable and non-potable systems and where indicated on drawings in accordance with CAN CSA B64.
- .2 Reduced Pressure Principle Assembly (RPZ) – 65mm (NPS 2 1/2) to 250mm (NPS 10)
  - .1 Construction: lead free construction, 304L stainless steel main body and access covers, EPDM seal ring, Buna Nitrile O-rings and stainless steel sensing line, stainless steel stem (ASTM A 276), EPDM seat disc.
  - .2 Maximum working pressure and temperature: 1,200 kPa (175 psi) and 60°C (140°F).
  - .3 Class 150 flanged end connections to ASME B16.42.
  - .4 Flanged end OS&Y gate valves.
  - .5 Checks and the relief valve shall be accessible for maintenance without removing the device from the line.
  - .6 Listings and certifications:
    - .1 ASSE Listed 1013
    - .2 AWWA Compliant C511 (with gates only), and C550
    - .3 FM Approved
    - .4 UL Classified
    - .5 cUL Classified
    - .6 CSA Certified
    - .7 IAPMO Listed
    - .8 Meets the requirements of NSF/ANSI/CAN 61.
  - .7 Standard of Acceptance: Zurn or Watts
- .3 Double Check Valve Assembly (DCVA) - 65mm (NPS 2 1/2) to 250mm (NPS 10)
  - .1 Construction: lead free construction, 304L stainless steel main body and access covers, EPDM seal ring, Buna Nitrile O-rings and stainless steel sensing line, stainless steel stem (ASTM A 276), EPDM seat disc.
  - .2 Maximum working pressure and temperature: 1,200 kPa (175 psi) and 60°C (140°F).
  - .3 Class 150 flanged end connections to ASME B16.42.
  - .4 Flanged end OS&Y gate valves.
  - .5 Checks and the relief valve shall be accessible for maintenance without removing the device from the line.
  - .6 Listings and certifications:



- .1 ASSE Listed 1015
- .2 AWWA Compliant C510 (with gates only), and C550
- .3 FM Approved
- .4 UL Classified
- .5 cUL Classified
- .6 CSA Certified
- .7 IAPMO Listed
- .7 Standard of Acceptance: Zurn or Watts

## **2.8 VACUUM BREAKERS**

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

## **2.9 PRESSURE REGULATORS**

- .1 Capacity: as indicated.
  - .1 Inlet pressure: 1,034 kPa (150 psi).
  - .2 Outlet pressure: 413 kPa (60 psi) or as indicated on drawings.
- .2 Up to 40mm (NPS 1-1/2): bronze bodies, screwed: to ASTM B62
- .3 50mm (NPS 2) and over: semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

## **2.10 BACKWATER VALVES (BWV)**

- .1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover.
- .2 Access:
  - .1 Surface access.
  - .2 Access pipe with cover: maximum 300 mm depth.
  - .3 Steel housing with gasketed steel cover.
  - .4 Concrete access pit with cover, as indicated.

## **2.11 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

## **2.12 WATER MAKE-UP ASSEMBLY**

- .1 Complete with reduced pressure principle backflow preventer, common pressure gauge on inlet and outlet with isolation valves, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet

## **2.13 WATER METERS**

- .1 Water meter shall be supplied by municipal water services, size as indicated on drawings. Meter shall be complete with remote readouts and pulse output for integration into Building Automation System (BAS).
- .2 Contractor shall be responsible for all costs of obtaining meter including cost of the meter,

transportation, applications.

- .3 Meter shall be complete with bypass, drain fittings in accordance with installation details and authorities having jurisdiction.

#### **2.14 TRAP SEAL PRIMERS (TSP)**

- .1 Single Drain Primer Station
  - .1 Constructed of C693 Lead Free brass, EPDM E70 O-rings, Dow #7 Silicone, #60 stainless steel mesh screen, stainless steel adjustment screw.
  - .2 Unit shall be complete with adjusting screw to allow for adjustment for static line pressure.
  - .3 Operating range: 138 kPa (20 psi) to 552 kPa (80 psi).
  - .4 Provide shut off valve on inlet and union on outlet for servicing.
  - .5 Standard of acceptance: Precision Plumbing Products P1-500.
- .2 Combined Trap Seal Primer Assembly
  - .1 Provide when serving multiple drains.
  - .2 Trap seal assembly shall provide automatic water seal in floor drain traps and shall be complete with atmospheric vacuum breaker, pre-set 24-hour adjustable timer, manual override switch, 120V solenoid valve, 20mm (NPS 3/4) connection, calibrated manifold for equal water distribution, fire rated access door prime coated.
  - .3 Operating range: 138 kPa (20 psi) to 1,034 kPa (150 psi).
  - .4 Standard of acceptance: Precision Plumbing Products PT series, model number from PT-4 to PT-12 to suit number of served traps at each location.

#### **2.15 STRAINERS**

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 50mm (NPS 2) and under: bronze body, screwed ends, with brass cap.
- .3 65mm (NPS 2 1/2) and over: cast iron body, flanged ends, with bolted cap.

#### **2.16 DIELECTRIC UNIONS**

- .1 Provide on connections between dissimilar metals.
- .2 50mm (NPS 2) and under: provide insulating unions.
- .3 65mm (NPS 2 1/2) and over: provide insulating flanges.
- .4 Isolation shall be provided where piping may come in contact with dissimilar metals including hangers, supports, joists and studs.

### **3 EXECUTION**

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

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

**3.2 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada (NPC), Ontario Building Code Part 7 and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

**3.3 CLEANOUTS**

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum 100mm (NPS 4).
- .4 Cleanouts installed outside shall be encased in concrete and flush with grade.
- .5 Unless otherwise noted, cleanout shall not be installed in finished areas.

**3.4 NON-FREEZE WALL HYDRANTS**

- .1 Install 600 mm above finished grade and as indicated.

**3.5 NON-FREEZE GROUND HYDRANT**

- .1 Install with top of box flush with ground and with drainage connection to discharge as indicated.

**3.6 WATER HAMMER ARRESTORS**

- .1 Install on branch supplies to fixtures or group of fixtures and where indicated.

**3.7 BACK FLOW PREVENTERS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code
- .2 Pipe discharge to terminate over nearest drain.
- .3 Ensure adequate service clearance around the backflow prevented in accordance with local codes and CSA-B64.
- .4 Flush line thoroughly prior to installation to remove all debris, chips, welding slag and other foreign materials.
- .5 Use backflow prevention devices approved for installation in horizontal and vertical installation as specified.
- .6 Do not install strainer on backflow preventers serving fire protection systems unless otherwise noted.
- .7 OS&Y gate valves of backflow preventers installed on fire protections service shall be electrically supervised and connected to fire alarm system for monitoring and alarming, coordinate installation with Division 26.

**3.8 BACKWATER VALVES**

- .1 Install in main sewer lines, at weeping tile connection in pit provided at building cleanout, at floor drain in elevator pit, at floor drains in critical spaces and where indicated.

**3.9 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

**3.10 TRAP SEAL PRIMERS**

- .1 Install for all floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.
- .3 Install soft copper tubing to floor drain.

**3.11 STRAINERS**

- .1 Install with sufficient room to remove basket for maintenance.

**3.12 GREASE INTERCEPTORS**

- .1 Install with sufficient space, as indicated, for maintenance.

**3.13 WATER METERS**

- .1 Install water meter provided by local water authority.
- .2 Install water meter as indicated.

**3.14 WATER MAKE-UP ASSEMBLY**

- .1 Install on connections to closed loop heating, cooling systems and open loop condenser water systems.
- .2 Pipe discharge from relief valve to nearest floor drain.

**3.15 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

**3.16 TESTING AND ADJUSTING**

- .1 General:
  - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.

- .3 Application tolerances:
  - .1 Pressure at fixtures: +/- 70 kPa.
  - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
  - .1 Verify that flow rate and pressure meet design criteria.
  - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, removability of strainer.
  - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O&M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
  - .4 Provide copy of test certificate to building inspector or AHJ for permit closeout.
- .7 Roof drains:
  - .1 Check location at low points in roof.
  - .2 Check security, removability of dome.
  - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
  - .4 Clean out sumps.
  - .5 Verify provisions for movement of roof systems.
- .8 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .9 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .10 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .11 Wall, ground hydrants:
  - .1 Verify complete drainage, freeze protection.
  - .2 Verify operation of vacuum breakers.
- .12 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .13 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.

- .3 Verify that cleanout plug does not leak.
- .14 Grease interceptors:
  - .1 Activate, using manufacturer's recommended procedures and materials.
- .15 Hose bibbs, sediment faucets:
  - .1 Verify that flow and pressure meet design criteria.
  - .2 Check for leaks, replace compression washer if required.
- .16 Hydronic system water Make-up Assembly:
  - .1 Verify flow, pressure, and connection.
- .17 Water meters:
  - .1 Verify location and accessibility.
  - .2 Test metre reading accuracy.

### **3.17 CLOSEOUT ACTIVITIES**

- .1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning Requirements: reports, supplemented as specified.
- .2 Training: provide training in accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.

### **3.18 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.19 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.
- .3 Protect existing floor drains when working in existing space, contractor shall be fully responsible for any damages to existing drainage systems as a result of debris accumulation or dumping of construction waste (concrete, dust, grease, etc). All costs of repairs including but not limited to complete replacement of piping, saw cutting of slab, cutting and patching, restoration work shall be solely responsibility of contractor.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
  - .1 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .5 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .6 ASME B31.9, Building Services Piping.
  - .7 ASME B36.19M, Stainless Steel Pipe.
- .2 ASTM International (ASTM)
  - .1 ASTM A182/A 182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - .2 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A312/A312M, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .5 ASTM A351/A351M, Castings, Austenitic, for Pressure Containing Parts.
  - .6 ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings.
  - .7 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .8 ASTM B32, Standard Specification for Solder Metal.
  - .9 ASTM B42, Seamless Copper Tube, Standard Sizes.
  - .10 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
  - .11 ASTM F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
  - .12 ASTM F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
  - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .2 ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast, for Water.
  - .3 AWWA C904, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.
  - .4 AWWA C651, Disinfecting Water Mains.
  - .5 AWWA C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

- .4 CSA Group (CSA)
  - .1 CSA B137.5, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
  - .2 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S101, Fire Endurance Tests of Buildings Construction and Materials.
  - .2 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
  - .3 CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.
- .6 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-02a, Butterfly Valves.
  - .2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)
  - .1 National Plumbing Code of Canada (NPC) .
- .10 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).
- .11 American National Standards Institute/National Sanitation Foundation (ANSI/NSF).
  - .1 ANSI/NSF 61, Drinking Water System Components.
  - .2 ANSI/NSF 372, Drinking Water System Components – Lead Content.

## **1.2 QUALITY ASSURNACE**

- .1 A certificate shall be submitted prior to welding of steel piping showing the Welder's certification. The certificate shall be current and no more than one year old. Welder's qualifications shall be in accordance with ASME BPVC Section IX.
- .2 All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption and shall be certified in accordance with NSF 61 or NSF 372.
- .2 All components, fittings, fixtures and devices used in potable water systems shall meet the requirements of NSF 61, Section 9.



## **2.1 UNDERGROUND WATER SERVICE**

- .1 75 mm (NPS 3) and above: Ductile iron, AWWA C151, 2,413 kPa (350 psig) pressure class, exterior bituminous coating, and cement lined. Bio-based materials shall be utilized when possible. Provide flanged and anchored connection to interior piping.
- .2 75 mm (NPS 3) and under: Copper tubing, ASTM B88, Type K, seamless, annealed. Use brazing alloys, AWS A5.8M/A5.8, Classification BCuP.
- .3 Flexible Expansion Joint: Ductile iron with ball joints rated for 1,725 kPa (250 psig) working pressure conforming to AWWA C153, capable of deflecting a minimum of 20 degrees in each direction. Flexible expansion joint size shall match the pipe size it is connected to and shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be factory tested with a 1500-volt spark test. Flexible expansion joint shall have flanged connections conforming to AWWA C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene. The flexible expansion fitting shall not expand or exert an axial thrust under internal water pressure. Provide piping joint restraints at each mechanical joint end connection and piping restraints at the penetration of the building wall. The restraints shall be provided to address the developed thrust at the change of piping direction.

## **2.2 ABOVE GROUND (INTERIOR) WATER PIPING**

- .1 Copper tube, hard drawn, type K or L to ASTM B88M.
- .2 Stainless steel piping: Type 304 or 316 to ASTM A312/A312M and ASME B36.19M.
- .3 Stainless steel tubing: Type 304 or 316 to ASTM A269 and ASME B16.19

## **2.3 FITTINGS**

- .1 Copper fittings:
  - .1 Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
  - .2 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.
  - .3 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
  - .4 50mm (NPS 2) and larger:
    - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
    - .2 PEX fittings to CSA B137.5 and F1960.
  - .5 40mm (NPS 1 1/2) and smaller:
    - .1 Wrought copper to ANSI/ASME B16.22 or cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1,380 kPa.
    - .2 PEX fittings to CSA B137.5.
  - .6 Mechanical press-connect fittings for copper pipe and tube are not accepted.
  - .7 Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.
- .2 Stainless steel fittings:
  - .1 Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.

- .3 Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.
- .4 Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

## **2.4 JOINTS**

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series
- .3 Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.
- .4 Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.
- .5 Teflon tape: for threaded joints.
- .6 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .7 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.
- .7 40mm (NPS 1 1/2) and smaller: PEX fittings to CSA B137.5
- .8 NPS 2 and larger: PEX fittings to CSA B137.5 and ASTM F1960. Elbows, adapters, couplings, plugs, tees, multi-port tees and valves

## **2.5 GATE VALVES**

- .1 50mm (NPS 2) and under, soldered:
  - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .2 65mm (NPS 2 1/2) and over, flanged:
  - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim.
  - .2 Valves 150mm (NPS 6) and above, installed at 2,440mm (8ft) above floor shall be complete chainwheel operator including sprocket rim, brackets and chain.

## **2.5 GLOBE VALVES**

- .1 50mm (NPS 2) and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.
  - .2 Lockshield handles: as indicated.
- .2 65mm (NPS 2 1/2) and over, flanged:
  - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc.
  - .2 Lockshield handles: as indicated.

## **2.6 SWING CHECK VALVES**

- .1 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.

- .2 50mm (NPS 2) and under, screwed:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.
- .3 65mm (NPS 2 1/2) and over, flanged:
  - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind seat, bronze disc, bolted cap.

## **2.7 BALL VALVES**

- .1 50mm (NPS 2) and under, screwed:
  - .1 Class 150.
  - .2 Bronze or Forged Brass body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.
- .2 50mm (NPS 2) and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors.

## **2.8 BUTTERFLY VALVES**

- .1 65mm (NPS 2 1/2) and over, wafer or lug:
  - .1 To MSS-SP-67, Class 200
  - .2 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.
  - .3 100mm (4") and under - lever operated, 150mm (NPS 6) and over - gear operated.

## **2.9 STRAINER**

- .1 Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where indicated on drawings. Strainer element shall be removable without disconnection of piping, ensure unobstructed access to strainer screen.
- .2 Basket or "Y" type with easily removable cover and brass strainer basket.
- .3 Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

## **2.10 WATER HAMMER ARRESTOR**

- .1 Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:
  - .1 All solenoid valves.
  - .2 All groups of two or more flush valves.
  - .3 All quick opening or closing valves.
  - .4 All medical washing equipment.

### **3 EXECUTION**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards
- .4 Install cold water piping below and away from heating water piping and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- .7 Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
- .8 All pipe runs shall be laid out to avoid interference with other work/trades.
- .9 Install union and shut-off valve on pressure piping at connections to equipment.
- .10 Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- .11 Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot and cold-water circulating lines with no traps. Complete field review of all invert, elevations and pipe sloping prior to beginning any work and advise Consultant of any discrepancies for further action prior to proceeding with work.
- .12 Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.
- .13 Buried tubing:
  - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding
  - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .14 Valves
  - .1 Isolate equipment, fixtures and branches with ball valves.
  - .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.
- .15 All exposed piping shall be installed parallel to walls, bulkheads, ceilings in a neat manner. Piping shall be grouped whenever practical.
- .16 Only use approved and listed piping and materials thru fire rated separations.

- .17 Provide drain valves complete with chain and cap at all low points and at all branch connections to mains to facilitate partial and complete system drainage.
- .18 Provide isolation valves at all connections to equipment.
- .19 Provide reduced pressure backflow prevention device at all interfaces between potable and non-potable water systems. Install and test all devices in accordance with B64.10, Selection and installation of backflow preventers / Maintenance and field testing of backflow preventers.

### **3.3 PIPING PENETRATIONS**

- .1 Firestopping:
  - .1 Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases.
  - .2 Completely fill and seal clearances between raceways and openings with the firestopping materials.
  - .3 Provide fire stop collars for all combustible pipe penetrations thru fire rated floor and wall assemblies.
  - .4 Firestopping systems shall be tested and listed to CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.
  - .5 Firestopping materials shall be free of water-soluble expansions materials.
  - .6 Firestopping materials shall be provided by single manufacturer. For retrofit applications, contractor shall confirm with the Owner's Representative standard supplier prior to submitting of the submittals.
- .2 Waterproofing:
  - .1 At floor penetrations, completely seal clearances around the pipe and make watertight with sealant. Bio-based materials shall be utilized when possible.
- .3 Acoustical sealant:
  - .1 Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.
- .4 Flashing:
  - .1 Provide flashing of all equipment and piping penetrations thru waterproofed walls and roof assemblies.
  - .2 Retain basebuilding roofing contractor for all modifications of roofing system to preserve warranty, contact Owner's Representative for roofing contractor's information.
  - .3 Provide flashing for all floor drains in finished areas, extend flashing 300mm (12") on all sides. Secure flashing to drain flashing flange with approved non-metallic waterproofing membrane.
- .5 Sleeves:
  - .1 Provide sleeves for piping penetrations thru floors and walls, complete with adequate reinforcing and sized to allow for movement due to expansion.
  - .2 Provide minimum 50mm (2") extended sleeves above floors prone to collection of water including but not limited to mechanical rooms, janitor closets, plenums, shafts.
  - .3 Where passing thru fire rated assemblies, seal space between sleeve and piping with

listed non-combustible insulation to meet fire rating of given assembly.

- .4 Provide tight fitting clamps on each side of the sleeve and finish with chrome plated escutcheons at penetrations in finished surfaces and millwork.
- .1 Installation:
  - .1 Install fire and waterproofing materials in accordance with manufacturer's instructions.
  - .2 Firestopping and waterproofing materials shall be installed by factory trained personnel with a proven track record of minimum 5 years history.
  - .3 Verify penetrations are properly sized and in suitable condition for application of materials.
  - .4 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - .5 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - .6 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - .7 Do not proceed until unsatisfactory conditions have been corrected.
  - .8 Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
  - .9 Materials shall be applied in adequate temperatures 4°C (40°F) and 37°C (98°F) or as per manufacturer's instructions.

### **3.4 PRESSURE TESTS**

- .1 Test system either in its entirety or in sections. Submit testing plan to Consultant within 10 working days prior to test date.
- .2 Potable water: test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1,035 kPa (150 psig) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.
- .3 All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.
- .4 The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

### **3.5 FLUSHING AND CLEANING**

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

### **3.6 STERILIZATION AND DISINFECTION**

- .1 After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- .2 Use liquid chlorine for sterilization, bleed water thru outlets to ensure thorough distribution.

- .3 Allow disinfectant in system for 24 hours, ensure outlets are not operated during disinfection period.
- .4 Test for chlorine residual at minimum 20% of outlets; ensure disinfectant residual is less than 25mg/L or as per local codes and regulations. Repeat treatment if results are unsatisfactory.
- .5 Complete flushing of disinfectant until residual is equal to that of the municipal water supply or 1mg/L, whichever is less.
- .6 Obtain samples at least 24 hours following flushing procedures at water entrance and 20% of outlets, complete laboratory analysis in accordance with AWWA C651.
- .4 Upon completion, provide laboratory test reports on water quality for Consultant's approval.

### **3.7 PRE-START-UP INSPECTIONS**

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

### **3.8 START-UP**

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Sterilization procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Commission water conditioning systems, where applicable.
  - .4 Bring HWS storage tank up to design temperature slowly.
  - .5 Monitor piping systems for freedom of movement, pipe expansion as designed.
  - .6 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

### **3.9 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing

for HVAC.

- .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
  - .4 Sterilize water systems for Legionella control.
  - .5 Verify performance of temperature controls.
  - .6 Verify compliance with safety and health requirements.
  - .7 Check for proper operation of water hammer arrestors. Run 20% of outlets for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
  - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

### **3.10 OPERATION REQUIREMENTS**

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
- .2 Operational requirements in accordance with Section 01 47 19 - Sustainable Requirements: Operation, include:
  - .1 Cleaning materials and schedules.
  - .2 Repair and maintenance materials and instructions.

### **3.11 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**





## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
  - .1 ASTM B32, Standard Specification for Solder Metal.
  - .2 ASTM B306, Standard Specification for Copper Drainage Tube (DWV).
  - .3 ASTM C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  - .5 ASTM D2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .6 ASTM D2564, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 CSA Group (CSA)
  - .1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  - .2 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .3 CAN/CSA-B125.3, Plumbing Fittings.
  - .4 CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36-[00], Commercial Adhesives.
- .4 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada(NPC).
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .6 Canada Green Building Council (CaGBC)
  - .1 LEED Canada-NC Version 1.0, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
  - .2 LEED Canada-CI Version 1.0, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

## 2 PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, storm and vent Type DWV to: ASTM B306
  - .1 Fittings.
    - .1 Cast brass: to CAN/CSA-B125.3.
    - .2 Wrought copper: to CAN/CSA-B125.3.
  - .2 Solder: lead free to ASTM B32.



## 2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried (inside building) sanitary, storm and vent minimum 80mm (NPS 3) to: CAN/CSA-B70, with one layer of protective coating.
  - .1 Mechanical joints:
    - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70 or ASTM C564.
    - .2 Stainless steel clamps.
  - .2 Hub and spigot:
    - .1 Caulking lead: to CSA B67
    - .2 Cold caulking compounds.
- .2 Above ground sanitary, storm, and vent: to CAN/CSA-B70
  - .1 Hub and spigot:
    - .1 Caulking lead: to CSA B67
  - .2 Mechanical joints:
    - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

## 2.3 ABS PIPING AND FITTINGS

- .1 Buried (inside building) sanitary and storm piping to CAN/CSA-B1800 and CAN/ULC-S102.2, flame spread rating 15.
  - .1 Fittings: to CAN/CSA-B1800 and CAN/ULC-S102.2, flame spread rating 25.
  - .2 Joints: to ASTM D2564 solvent cement and primer.

## 2.4 PVC PIPING AND FITTINGS

- .1 Buried (inside building) sanitary and storm piping to CAN/CSA-B1800 gasketed sewer pipe SDR 35.
  - .1 Fittings: schedule 40 ABS socket type to ASTM D2468 or schedule 80 ABS threaded type to ASTM D2465.
  - .2 Joints: to ASTM D2564 solvent cement and primer.
- .2 Above ground sanitary and storm piping to CAN/CSA-B1800 and CAN/ULC-S102.2 flame spread rating 15.
  - .1 Fittings: CAN/CSA-B1800, socket type and CAN/ULC-S102.2 flame spread rating 25.
  - .2 Joints: to ASTM D2564 solvent cement and primer.

## 3 EXECUTION

### 3.1 APPLICATION

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



### 3.2 INSTALLATION

- .1 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.
- .2 Install in accordance with National Plumbing Code, Ontario Building Code Part 7 and local authority having jurisdiction.
- .3 Pitch soil and waste piping no less 1/4 inch per foot.
- .4 Group piping whenever practical.
- .5 Install equipment including backflow preventer, pressure reducing stations and water meters in accordance with manufacturer's instruction, local codes and standards. Provide adequate support, independent of adjacent piping.
- .6 Pipe relief valves to nearest floor drain and provide support of discharge line.
- .7 Provide sleeves on pipe penetrations thru floors and walls.
- .8 Provide pipe hangers and supports in accordance with ASME B13.9 and ASTM F708.
- .9 Provide heat tracing of all exterior piping, unless otherwise indicated.
- .10 Provide unions and isolation valves at connections to equipment.
- .11 Provide spring loaded check valves at discharge of pumps.
- .12 Coordinate connections to municipal storm and sanitary piping with Site Servicing contractor. Contractor shall field verify all inverts, pipe routing and sloping prior to any work.
- .13 Piping penetrations through exterior walls below grade shall be leak tight and complete with modular link seal assembly.

### 3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

### 3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

### 3.05 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with



Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**



## 1 GENERAL

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for all equipment, systems, accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
  - .2 Indicate on drawings:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .3 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
    - .6 Equipment lead times.
    - .7 List of spare parts.
    - .8 Flow diagrams, controls schematic, wiring diagrams.
    - .9 Part load (0-100% in 10% increments) and full load efficiencies.
    - .10 Performance/capacity.
    - .11 Construction of equipment.
    - .12 Product warranty.
  - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .4 Coordination Shop Drawings:
  - .1 Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
  - .2 The coordination/shop drawings shall include plan views, elevations and sections of all systems in AutoCAD format and shall be on a scale of not less than 1:50. Clearly identify and dimension the proposed locations of the equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance.
  - .3 Provide detailed coordination/shop drawings of all piping and duct systems.
  - .4 Do not install equipment foundations, equipment or piping until coordination/shop

drawings have been approved.

- .5 Rigging Plan:
  - .1 Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The plan shall include the path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.
  - .2 Confirm equipment staging areas and crane locations with the Owner's Representative prior to preparation of the plan.
  - .3 Indicate extents of the fencing, signage, barrier and temporary provisions on the plans.
  - .4 Include necessary permitting (road closure, traffic control, etc) for all required rigging and craning of the equipment.

## **1.2 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all equipment for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Owner's Representative and Consultant before final inspection.
  - .2 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .3 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .4 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified.
    - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .5 Approvals:
    - .1 Submit 2 copies of draft Operation and Maintenance Manual Owner's Representative and Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.

- .2 Make changes as required and re-submit as directed by Consultant.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Consultant will provide 1 set of reproducible mechanical drawings – “Issued for Construction” in AutoCAD 2020 format. Contractor shall be responsible for all revisions, modifications and additions to AutoCAD drawing as required to accurately reflect as-built conditions.
  - .2 Transfer information weekly to reproducible, revising reproducible to show work as actually installed.
  - .3 Adhere to Owner’s CAD Guidelines, obtain copy of the guidelines from Owner’s Representative.
  - .4 Make drawings available to Owner’s Representative and Consultant for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings in AutoCAD 2020 format.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - “AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED” (Signature of Contractor) (Date).
  - .3 Submit to Owner’s Representative and Consultant for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
  - .6 As-built drawings shall be prepared in accordance with Owner’s CAD Guidelines, obtain copy of the guidelines from Owner’s Representative.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One glass for each gauge glass.
  - .5 One filter cartridge for hydronic system and one set of filter media for each filter bank for air systems in addition to final operating set.\
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers including but not limited to boiler burner cleaning kit, chiller tube cleaning kit, etc.

- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

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

#### **1.5 CODES, REGULATIONS AND STANDARDS**

- .1 All mechanical work shall be in compliance with the latest editions of the applicable codes, regulations and bylaws, including:
  - .1 Ontario Building Code
  - .2 Ontario Fire Code
  - .3 Canadian Standards Association
  - .4 Canadian Gas Association
  - .5 ASHRAE
  - .6 ASME
  - .7 NFPA
  - .8 SMACNA
  - .9 NECB
  - .10 Local Municipal Bylaws and Regulations
  - .11 Owner Specific Standards and Guidelines
- .2 Refer to Section 01 41 00 – Regulatory Requirements for complete list.
- .3 Where discrepancies between contract documents and references codes/standards are identified, Contractor shall request clarification from Consultant prior to proceeding with work.
- .4 Referenced codes, standards, regulations and guidelines are noted as a minimum requirement and shall not be used to alter, reduce or modify requirements of the contract documents.

#### **1.6 PERMITS AND APPROVALS**

- .1 Contractor shall be responsible for all costs associated with permitting and approvals by Authorities Having Jurisdiction (AHJ), including but not limited to:
  - .1 Application and obtaining of permits
  - .2 Permit fees
  - .3 Inspection fees



- .4 Demonstration
- .2 Contractor shall be responsible for coordinating and scheduling progress inspection prior to work concealment and final acceptance.
- .3 Provide sufficient notice for inspections, provide qualified and licensed technicians to demonstrate work to inspectors.
- .4 Complete all repairs and adjustments to satisfaction of AHJ and schedule for follow-up inspection as required to complete the project.
- .5 Collect and submit all inspection certificates and permit closeout letters for all disciplines, include in closeout manuals.

### **1.7 TEST REPORTS**

- .1 Contractor shall complete all required testing as specified in the contract documents.
- .2 Provide sufficient notice (minimum 10 working days) to Owner's Representative, Consultant, Commissioning Authority, inspectors and Authorities Having Jurisdiction (AHJ). Tests may be witnessed in their entirety or partially at discretion of these parties.
- .3 Make repairs, adjustments and troubleshoot issues when test results are not acceptable.
- .4 Submit all test reports for review and approval to the Consultant, including but not limited to:
  - .1 Pressure testing of piping systems and equipment (boilers, heat exchangers, etc)
  - .2 Piping flushing, cleaning and chemical treatment
  - .3 Water and Air Systems Balancing (TAB)
  - .4 Ductwork and equipment leakage test reports
  - .5 Equipment start-up reports
  - .6 Sprinkler system certificates and Contractor's Fire Protection Engineer's NFPA 13 compliance letter
  - .7 Standpipe system certificates and Contractor's Fire Protection Engineer's NFPA 14 compliance letter
  - .8 Controls point to point verification report and sensor calibration report
  - .9 Manufacturer's troubleshooting and service reports documenting encountered issues and corrective steps taken
  - .10 Approvals by AHJ (TSSA, ESA, etc)

### **1.8 QUALITY ASSURANCE**

- .1 All systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. All construction personnel shall be experienced and qualified specialists in industrial and institutional HVAC.
- .2 Products Criteria:
  - .1 The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. All controllers and software shall be of the latest version with the latest version of the firmware. Refer other specification sections for any exceptions and/or additional requirements.
  - .2 All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall

assembly.

- .3 The products and execution of work specified shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply.
- 5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
- 6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
- 7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- 8. Use of asbestos products or equipment or materials containing asbestos is prohibited.
- .3 Systems Welding:
  - .1 All welding shall be completed in accordance with Section 23 05 17 – Pipe Welding.
  - .2 Submit required certificates, procedures, and credentials prior to any work.
- .4 Testing, Adjusting and Balancing:
  - .1 All systems shall be tested, adjusted and balanced in accordance with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
  - .2 Work shall be completed by certified agencies, submit certificates and credentials for all personnel.
  - .3 Submit test instrumentation information and calibration certificates prior to any work.
- .5 Systems Commissioning
  - .1 Carry out commissioning of all installed systems and existing systems where new systems are integrated in accordance with Section 01 91 13 – General Commissioning Requirements.

## 1.9 ALTERNATE EQUIPMENT

- .1 The design has been prepared based on the “basis of the design” equipment specified in schedules and specifications. If Contractor substitutes the basis of the design equipment with the approved alternates, the Contractor shall incur all costs associated with the re-design and all aspects of the installation of alternate equipment including, but no limited to delivery of equipment to the proposed location, disassembly/reassembly of equipment, removal or relocation of the existing services, additional electrical, structural, architectural or building envelope work as required to accommodate alternate equipment.

## 2.1 GENERAL

- .1 All materials shall be new in accordance with the specifications of contract documents.
- .2 All products shall be listed and approved by relevant authorities.
- .3 All equipment and materials shall be transported, stored, craned, rigged and moved in

accordance with manufacturer's instructions; any damages to equipment and/or parts of equipment shall be replaced by Contractor at no cost to Owner.

## **2.2 ACCESS PANELS/DOORS**

- .1 Provide access panels at all locations of concealed equipment, fittings requiring access for operation, maintenance and repair including but not limited to balancing dampers, fire dampers, smoke dampers, fire/smoke dampers, motorized dampers, sensors, filters and other components and devices requiring maintenance/service access.
- .2 Access doors shall be located to provide complete access to concealed equipment and devices.
- .3 Construction:
  - .1 Plaster or wet wall: 16 ga steel flush with surface complete with gasket and concealed flange.
  - .2 Masonry or drywall: 16 ga steel flush with surface complete with gasket and concealed flange.
- .4 Finish:
  - .1 Tiled or marble surfaces: type 304 stainless steel, #4 satin polish.
  - .2 Other areas: prime coated steel, finished to match adjacent.
- .5 Options and accessories:
  - .1 Continuous concealed hinges.
  - .2 Adjustable anchoring straps to suit installation.
  - .3 Mineral wool insulation (for fire rated panels).
  - .4 Self latching screw driver operated slam latch.
  - .5 Automatic panel closer.
  - .6 Inside latch release.
- .6 Sizing:
  - .1 Access panels/doors shall be of adequate size to facilitate access to all components. The following are minimum recommended sizes:
    - .1 Hand access: 300x300mm (12"x12")
    - .2 Body entry access: 600x600mm (24"x24")
- .7 Fire rating
  - .1 Access doors/panels installed in fire rated floor and wall assemblies shall have similar fire rating and corresponding ULC label.

## **3 EXECUTION**

### **3.1 EXAMINATION**

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

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- .2 Carry out field inspections of the proposed work and existing conditions affecting work prior to tender submission. Additional inspections may be arranged thru Owner's Representative. No additional costs will be considered for additional work where these conditions would have been discovered by such inspections. Report any potential challenges and issues which may impact proposed work to the Consultant for clarification within Q&A period, during Tender phase.

### **3.2 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
- .2 Refer to Section 01 74 00 – Cleaning.

### **3.4 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer, codes and bylaws.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer, codes and bylaws without interrupting operation of other system, equipment, components.
- .3 Contractor shall coordinate installation of each equipment components with all trades prior to any work to avoid service obstruction to equipment. Any infractions of service clearances be responsibility of the contractor and must be corrected prior to substantial completion.

### **3.5 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.
- .4 Drain valves: 20mm (NPS 3/4) gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.6 AIR VENTS**

- .1 Install automatic air vents at all high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### **3.7 DIELECTRIC COUPLINGS**

- .1 Provide on connections between dissimilar metals.
- .2 50mm (NPS 2) and under: provide insulating unions.
- .3 65mm (NPS 2 1/2) and over: provide insulating flanges.
- .4 Isolation shall be provided where piping may come in contact with dissimilar metals including hangers, supports, joists and studs.

### **3.8 PIPEWORK INSTALLATION**

- .1 Install pipework to relevant codes and regulations.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards
- .6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible [and as indicated].
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use gate valves at branch take-offs for isolating purposes except where specified.
  - .7 Install butterfly valves on chilled water and related condenser water systems only.
  - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .9 Install plug cocks or ball valves for glycol service.
  - .10 Use chain operators on valves 65mm (NPS 2 1/2) and larger where installed more than 2,400 mm above floor in Mechanical Rooms.
  - .11 Provide extended valve stems to clear insulation and allow for uncompromised valve operation without damaging insulation.

- .16 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.9 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Provide minimum 50mm (2") extended sleeves above floors prone to collection of water including but not limited to mechanical rooms, janitor closets, plenums, shafts.
- .6 Where passing thru fire rated assemblies, seal space between sleeve and piping with listed non-combustible insulation to meet fire rating of given assembly.
- .7 Provide tight fitting clamps on each side of the sleeve and finish with chrome plated escutcheons at penetrations in finished surfaces and millwork.
- .8 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for fire stopping.
    - .2 Maintain the fire-resistance rating integrity of the fire separation.
  - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.10 ESCUTCHEONS**

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
  - .1 Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.11 PREPARATION FOR FIRE STOPPING**

- .1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.
- .3 Insulated pipes: ensure integrity of insulation and vapour barriers.

**3.12 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 - Cleaning supplemented as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- .4 Provide minimum 50mm (NPS 2) bypass piping complete with ball valve at the end of each loop or circuit to facilitate complete flushing of piping network. Coordinate locations of the bypasses with the chemical treatment vendor.
- .5 Repeat flushing and cleaning of piping systems as required to achieve adequate water quality.

**3.13 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Consultant minimum 5 working days prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Consultant.
- .6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests Consultant.

**3.14 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Departmental Representative. Provide detailed Methods of Procedures (MOP) for all connections to the existing systems.
- .2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.
- .3 Unless otherwise noted, connections to the existing live piping systems shall be completed via hot tapping means to minimize system shut downs. Pipe freezing shall also be used when isolation valve is not available to prevent disruption of the piping network.
- .4 Be responsible for damage to existing plant by this work.

**3.15 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit reports.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
  - .2 Provide manufacturer's field services consisting of product use recommendations and

periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.15 MECHANICAL AND ELECTRICAL COORDINATION**

- .1 All motor control centres, starters, power wiring and conduit shall be provided by Division 26.
- .2 Where packaged mechanical equipment is shipped with integrated starter, Division 26 shall provide power wiring in conduit. Refer to schedules and relevant specifications for details.
- .3 All remote disconnect switches, service receptacles shall be provided by Division 26.
- .4 All mechanical control wiring shall be provided by this division, except for life safety and fire alarm systems.
- .5 All motors for mechanical systems shall be provided by this division.
- .6 Wiring to smoke dampers, combination fire and smoke dampers, damper end switches shall be provided by Division 26.
- .7 All relays required for mechanical systems shall be provided by this division.
- .8 Electric heat tracing systems for piping systems and basin heaters for cooling tower sumps shall be provided by this division, with power provisions by Division 26.
- .9 All relays and mechanical systems shutdowns by fire alarm systems shall be provided by Division 26.
- .10 Mechanical contractor shall coordinate with Division 26 for all power requirements to mechanical control systems; Division 26 to provide power wiring and transformer where required.

### **3.16 DEMONSTRATION**

- .1 Owner's Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Contractor shall record these demonstrations on video tape for future reference.

### **3.17 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



**3.18 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**END OF SECTION**



## 1 GENERAL

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Electrical motors, drives and guards for mechanical equipment and systems.
  - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
  - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.
  - .4 Variable Frequency Drives

### 1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .4 National Energy Code for Buildings (NECB)
- .5 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA MG-1 National Electrical Manufacturers Association – Motors and Generators.
- .6 ANSI/IEEE 112 - Test Procedures for Motors / Generators.
- .7 UL 1004 - Motors, Electric.
- .8 UL 674 - Motors, Generators, Electric, for Use in Hazardous Locations: Class I, Groups C and D; Class II, Groups E, F, and G.

### 1.3 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with Canadian Environmental Protection Act (CEPA), Canadian Environmental Assessment Agency (CEAA), Transportation of Dangerous Goods Act (TDGA) and applicable Provincial regulations.
- .2 Motors shall have CSA certification and UL listing.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Motors shall be premium efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.
- .2 Motors not to exceed speeds above 1,800 RPM unless otherwise noted.
- .3 Motors shall be located to allow for replacement of bearings.
- .4 Provided extended lube lines and alemite fitting outside of fan enclosure to facilitate lubrication.
- .5 Motors used for variable speed applications shall be inverted duty rated suitable for operation at variable torque loads over wide speed range.
- .6 Motors shall be rated for 1.15 service factor in 40°C (105°F) ambient conditions.

### **2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 V or 600V, unless otherwise indicated. Confirm electric voltage, phase and starter requirements with Division 26.
- .4 Motors shall be Open Drip Proof (ODP) to totally enclosed fan cooled (TEFC) enclosure type.
- .5 Standard of Acceptance: Baldor, WEG, US Motors or US Motors.

### **2.3 TEMPORARY MOTORS**

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

### **2.4 BELT DRIVES**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 -

Closeout Submittals.

## 2.5 DRIVE GUARDS

- .1 Provide removable guards for unprotected drives and unprotected fan inlets/outlets.
- .2 Guards for belt drives;
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38 mm (1.5") dia holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.
- .7 Guards shall be powder coated and finished painted bright yellow.

## 2.5 GROUNDING

- .1 All motors used in variable speed applications shall be provided with micro fiber shaft grounding ring, AEGIS SGR or equivalent. Ensure shaft is free from debris, coating, paint prior to installation. Install in accordance with manufacturer's instructions and test for a conductive path to ground using an ohmmeter. Ensure readings are under 1 ohm.
- .2 Ground motors to common earth ground with drive with grounding strap according to applicable standards and motor/VFD installation instructions.

## 2.6 VARIABLE FREQUENCY DRIVED (VFD)

- .1 Provide complete variable frequency drives (VFD) for the fans and pumps designated on the schedules to be variable speed. Separate schedules are not issued for the variable frequency drives. Refer to the air handling unit, return fan, cooling tower and pump schedules as applicable. All standard and optional features shall be included within the VFD enclosure. VFD enclosure shall be in heavy gauge metal NEMA 1 enclosure. The entire package shall be UL and CSA approved.
- .2 The VFD shall be tested to UL 508C. The appropriate cUL label shall be applied.
- .3 The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating.

- .4 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.
- .5 The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients.
- .6 The VFD's full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.
- .7 Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.
- .8 VFD shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.
- .9 Supply all VFD with the latest version of firmware, upgrade all existing VFD's in field as required.
- .10 All VFDs to be remote mounted on either Unistrut stand or wall. VFDs mounted directly to the motor will not be accepted.
- .11 A minimum of Class 20 I2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.
- .12 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.
- .13 Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.
- .14 Drive to be seismic certified. Seismic importance factor of 1.5 rating is required. Rating certification based upon actual shake table test data as defined by ICC AC 156.
- .15 Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.
- .16 Standard Control and Monitoring Inputs and Outputs:
  - .1 Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
  - .2 Two terminals shall be programmable to act as either a digital output or additional digital inputs.
  - .3 Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status. Each relay shall have an adjustable on delay / off delay time.
  - .4 Two programmable analog inputs shall be provided that can be either direct-or-reverse acting. Each shall be independently selectable to be used with either an analog voltage or current signal.
  - .5 The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.
  - .6 A programmable low-pass filter for either or both analog inputs must be included to

compensate for noise.

- .7 The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,
- .17 One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.
- .18 Serial communications - The VFD shall include a standard communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:
  - .1 BACnet MS/TP, Johnson N2, Siemens P1 and Modbus RTU
- .19 Standard of acceptance: Danfoss, ABB.

### **3 EXECUTION**

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

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.2 INSTALLATION**

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.
- .3 Install devices in accordance with manufacturer's recommendations.
- .4 Install the drive not more than 10 metres from the motor. The length of wiring connection shall not exceed 10 metres. Provide support for the variable frequency drive in the vicinity of the motor as required. Contractor to provide a written report to the Consultant indicating the lengths of wiring installed between the drive and the driven motor for all systems connected to variable frequency drives.
- .5 VFD Start-up - The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

#### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work and provide reports.

**3.4 WARRANTY**

- .1 The complete VFD shall be warranted by the manufacturer for a period of 24 months from date of shipment. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer and not a third party. A written warranty statement shall be provided with the submittals.
- .2 The warranty shall include all parts, labour, travel time, and expenses.

**3.5 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CSA Group (CSA)
  - .1 CAN/CSA B139, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11, Environmental Standard for Paints and Coatings.
- .5 National Research Council Canada (NRC)
  - .1 National Fire Code of Canada (NFC).

### 1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## 2 PRODUCTS

### 2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181
  - .1 Primers, Paints and Coating: in accordance with manufacturer's recommendations for surface conditions.

### 2.2 ACCESS PANELS/DOORS

- .1 Provide access panels at all locations of concealed equipment, fittings requiring access for operation, maintenance and repair including but not limited to isolation valves, balancing valves, air vents, motorized valves, flow metering devices.
- .2 Access doors shall be located to provide complete access to concealed equipment and devices.
- .3 Construction:
  - .1 Plaster or wet wall: 16 ga steel flush with surface complete with gasket and concealed flange.
  - .2 Masonry or drywall: 16 ga steel flush with surface complete with gasket and concealed flange.
- .4 Finish:
  - .1 Tiled or marble surfaces: type 304 stainless steel, #4 satin polish.



- .2 Other areas: prime coated steel, finished to match adjacent.
- .5 Options and accessories:
  - .1 Continuous concealed hinges.
  - .2 Adjustable anchoring straps to suit installation.
  - .3 Mineral wool insulation (for fire rated panels).
  - .4 Self latching screw driver operated slam latch.
  - .5 Automatic panel closer.
  - .6 Inside latch release.
- .6 Sizing:
  - .1 Access panels/doors shall be of adequate size to facilitate access to all components. The following are minimum recommended sizes:
    - .1 Hand access: 300x300mm (12"x12")
    - .2 Body entry access: 600x600mm (24"x24")
- .7 Fire rating
  - .1 Access doors/panels installed in fire rated floor and wall assemblies shall have similar fire rating and corresponding ULC label.

### **3 EXECUTION**

#### **3.1 APPLICATION**

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

#### **3.2 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

#### **3.3 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada or CAN/CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer, CAN/CSA B139 or as indicated without interrupting operation of other system, equipment, components.

#### **3.4 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.
- .4 Drain valves: 20mm (NPS 3/4) gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.5 AIR VENTS**

- .1 Install automatic air vents to at all high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.
- .4 Pipe discharge from all relief valves, air vents in glycol systems back to glycol tank.

### **3.6 DIELECTRIC COUPLINGS**

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 50mm (NPS 2) and under: isolating unions or bronze valves.
- .4 Over 50mm (NPS 2): isolating flanges.

### **3.7 PIPEWORK INSTALLATION**

- .1 Install pipework to CAN/CSA B139, CAN/CSA B149 and other applicable standards.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards
- .6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.

- .3 Install with stems above horizontal position unless indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Install globe valves in bypass around control valves.
- .6 Use gate or ball valves at branch take-offs for isolating purposes except where specified.
- .7 Install butterfly valves on chilled water and related condenser water systems only.
- .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .9 Install plug cocks or ball valves for glycol service.
- .10 Use chain operators on valves 65mm (NPS 2 ½) and larger where installed more than 2,400 mm above floor in Mechanical Rooms.
- .16 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .17 Provide insulation and jacketing in accordance with Section 23 07 19 – HVAC Piping Insulation.
- .18 Provide identification of all piping systems and equipment in accordance with Section 23 05 53 – Identification for HVAC Piping and Equipment.

### **3.8 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated. Provide adequate support and reinforcement at all sleeve locations.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm (1/4 in) minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation. Size to allow for movement for expansion.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Wet floors: terminate 50mm above finished floor c/w floor plate and caulking.
  - .3 Other floors: terminate 25 mm above finished floor.
  - .4 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181
  - .5 Provide chrome plated escutcheons at all penetrations thru finished surfaces or millwork.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for fire stopping.

- .2 Maintain the fire-resistance rating integrity of the fire separation.
- .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
- .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.9 ESCUTCHEONS**

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
  - .1 Chrome or nickel plated brass or type 302 stainless steel..
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.10 PREPARATION FOR FIRE STOPPING**

- .1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.
- .3 Insulated pipes: ensure integrity of insulation and vapour barriers.

### **3.11 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.
- .2 Provide min 65mm (NPS 2 1/2) bypass piping at end of each loop complete with isolation to facilitate thorough cleaning and flushing of the entire system. Coordinate locations of the bypasses with chemical treatment vendor prior to installation.

### **3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Owner's Representative and Consultant 48 hours minimum prior to performance of pressure tests.
- .2 Piping: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Owner's Representative or Consultant.
- .6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Consultant.

### **3.13 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Owner's Representative.
- .2 Request written approval by Owner's Representative 10 working days minimum, prior to commencement of work.

- .3 Be responsible for damage to existing plant by this work.

### **3.14 CORING**

- .1 Provide core drilling for installation of plumbing systems.
- .2 X-ray or scan floor and wall assemblies prior to core drilling, consult with Consultant on any noted interferences. X-ray shall only be carried out after hours, coordinate with Owner's Representative and provide minimum 10 business days' notice.
- .3 Coring and cutting of structural components shall only be completed once approved by Structural Engineer.
- .4 Repair adjacent finishes and any damages as a result of this work to satisfaction of Owner's Representative and Consultant.
- .5 Verify obstructions and interference on the other side of the floor and wall assemblies prior to coring. If any obstructions are noted, contractor shall locate alternate core locations and propose to Consultant for review and approval. Proceed with coring at alternate locations only once approved by Consultant.

### **3.15 PIPING ARRANGEMENT**

- .1 Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination/shop drawings shall be submitted to Consultant for review.
- .2 Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, receptacles and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted to Consultant for review. Follow manufacturer's published recommendations for installation methods not otherwise specified.

### **3.16 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1, Power Piping.
- .2 ASTM International (ASTM)
  - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
  - .4 ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process
  - .5 ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel
  - .6 ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - .7 ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip Galvanized) on Iron and Steel Hardware
  - .8 ASTM D 1929 - Standard Test Method for Determining Ignition Temperature of Plastics
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada (NPC).
- .7 Underwriter's Laboratories of Canada (ULC).
- .8 NFPA
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems
- .9 Canadian Standards Association
  - .1 CSA B139, Installation code for oil-burning equipment.
  - .2 CSA B149.1, Natural gas and propane installation code.

## 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements:
  - .1 Design supports, platforms, catwalks, hangers to withstand seismic events in accordance with the requirements of the Provincial Building Code.

## **2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58. ANSI B31.1 and
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Provide dielectric insulation at all points of contact between dissimilar metals.

## **2.4 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized or painted with zinc-rich paint after manufacture.
  - .2 Use hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping 50mm (NPS 2) maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 13 mm UL listed and FM approved.
  - .2 Cold piping 65mm (NPS 2 1/2) or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed and FM approved to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping 50mm (NPS 2) maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed and FM approved to MSS SP69.
  - .2 Cold piping 65mm (NPS 2 1/2) or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed and FM approved.
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed and FM approved to MSS SP69
- .5 Hanger rods: threaded rod material to MSS SP58:

- .1 Ensure that hanger rods are subject to tensile loading only.
- .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP69 UL listed and FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.5 RISER CLAMPS**

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed and FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.6 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

## **2.7 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR)
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25



mm minimum.

- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.8 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/- 5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.9 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements. Submit detailed calculations with shop drawings stamped by licensed Engineer in Province of Ontario.

## **2.10 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.11 HOUSE-KEEPING PADS**

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 150 mm larger than equipment; chamfer pad edges.
- .2 Provide elevated pads for air handling systems where required to ensure proper p-trap construction, coordinate with sub-trades prior pad pouring.

## **2.12 OTHER EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports from structural grade steel.
- .2 Submit detailed calculations with shop drawings stamped by licensed Engineer in Province of Ontario.

## **3 EXECUTION**

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

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:

- .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
  - .1 Vertical movement of pipework is 13 mm or more,
  - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
  - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 Variation in supporting effect does not exceed 25 % of total load.

**3.03 HANGER SPACING**

- .1 Plumbing piping: to Ontario Building Code.
- .2 Fire protection: to NFPA and Ontario Fire Code.
- .3 Gas and fuel oil piping: up to 12mm (NPS 1/2): every 1.8 m.
- .4 Copper piping: up to 12mm (NPS 1/2): every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm (12in) of each elbow.

Maximum Pipe Size: NPS	Maximum Pipe Size: mm	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	32	2.4 m	1.8 m
1-1/2	40	3.0 m	2.4 m
2	50	3.0 m	2.4 m
2-1/2	65	3.7 m	3.0 m
3	75	3.7 m	3.0 m
3-1/2	-	3.7 m	3.3 m
4	100	3.7 m	3.6 m
5	-	4.3 m	-
6	150	4.3 m	-
8	200	4.3 m	-
10	250	4.9 m	-
12	300	4.9 m	-

- .7 Pipework greater than NPS 12: to MSS SP69

### **3.4 HANGER INSTALLATION**

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### **3.5 HORIZONTAL MOVEMENT**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

### **3.08 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, other products specified in this section.
- .3 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

## 2 PRODUCTS

### 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### 2.2 SYSTEM NAMEPLATES

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: use size #5.
  - .2 Equipment in Mechanical Rooms: use size # 9.
  - .3 Rooftop/outdoor equipment: use size#9.
  - .4 Equipment concealed above ceiling or inside walls: use size#2 secured to ceiling or wall.
  - .5 Equipment elsewhere: sizes as appropriate.

**2.3 EXISTING IDENTIFICATION SYSTEMS**

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Owner's Representative and Consultant.

**2.4 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Natural and propane gas: to CSA/CGA B149.1. Piping shall be painted in yellow colour with markers indicating service ("natural gas" or "propane gas") and service pressure ("XX psi" or "XX in w.c."). Paint shall encompass entire surface area of the pipe, apply paint prior to installation at roof level. All piping installed at roof level and other exterior areas shall be weatherproof.
  - .2 Sprinklers: to NFPA 13.
  - .3 Standpipe and hose systems: to NFPA 14.

**2.5 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Owner's Representative and Consultant.
  - .2 Colours for legends, arrows: to following table:

Background Colour:	Legend, Arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Raw water	Green	RAW WATER
River water	Green	RIVER WATER
Sea water	Green	SEA WATER
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Brine	Green	BRINE
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. supply	Yellow	HTHW HTG. SUPPLY
High temp HW Htg. return	Yellow	HTHW HTG. RETURN
Make-up water	Yellow	MAKE-UP WTR

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<b>Contents</b>	<b>Background colour marking</b>	<b>Legend</b>
Boiler feed water	Yellow	BLR. FEED WTR
Steam [ ]kPa	Yellow	[ ] kPa STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
Intermittent blow-off	Yellow	INT. BLOW-OFF
Continuous blow-off	Yellow	CONT. BLOW-OFF
Chilled drinking water	Green	CH. DRINK WTR
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Contaminated lab waste	Yellow	CONT. LAB WASTE
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
No. [ ] fuel oil suction	Yellow	# [ ] FUEL OIL
No. [ ] fuel oil return	Yellow	# [ ] FUEL OIL
Engine exhaust	Yellow	ENGINE EXHAUST
Lubricating oil	Yellow	LUB. OIL
Hydraulic oil	Yellow	HYDRAULIC OIL
Gasoline	Yellow	GASOLINE
Natural gas	to Codes	
Propane	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Chlorine	Yellow	CHLORINE
Nitrogen	Yellow	NITROGEN
Oxygen	Yellow	OXYGEN
Compressed air (<700kPa)	Green	COMP. AIR [ ] kPa
Compressed air (>700kPa)	Yellow	COMP. AIR [ ] kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

Contents	Background colour marking	Legend
Carbon dioxide	Red	CO2
Instrument air	Green	INSTRUMENT AIR

## **2.6 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm (2 inch) high stencilled letters and directional arrows 150 mm (6 inch) long x 50 mm (2 inch) high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.
- .3 Identification to include air flow type (supply air, exhaust air, return air, etc), airflow direction and associated system (RTU-X, AHU-X, EF-X, SF-X, RF-X, etc).

## **2.7 VALVES, CONTROLLERS**

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

## **2.8 CONTROLS COMPONENTS IDENTIFICATION**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.
- .3 Provide label on ceiling tile or access door to identify each control valves and devices.

## **2.9 CONCEALED DEVICES**

- .1 Provide 25mm (1 inch) high nameplates for all devices and equipment concealed above ceiling (plaster, t-bar, etc) and within walls or chases.
- .2 Labels shall be color coded for each system's type as follows:
  - .1 Red – fire and fire/smoke dampers
  - .2 Yellow – HVAC terminals (VAV, fan powered boxes, coils, etc), devices (fans, dampers, etc), control and isolation valves
  - .3 Green – plumbing and drainage
- .3 Confirm colours and locations with Owner's Representative prior to installation.

## **2.10 SYSTEM DIAGRAMS**

- .1 Provide one A1 size (841x594mm) laminated color control system diagram on 12mm thick backboard for each mechanical system including heating water, chilled water, condenser water, glycol, air handling.
- .2 Install system diagram inside mechanical room or control room, confirm location with Owner's representative prior to installation.

## **2.11 LANGUAGE**

- .1 Identification in English.



### 3 EXECUTION

#### 3.1 TIMING

- .1 Provide identification only after painting has been completed.

#### 3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and CSA registration plates as required by respective agency.

#### 3.3 NAMEPLATES

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
  - .1 Do not paint, insulate or cover.

#### 3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

#### 3.5 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

**3.6 CLEANING**

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 NSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM)
  - .1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .9 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .10 ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
  - .11 ASTM C1290, Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
  - .12 ASTM C1338, Test Method for Determining Fungi resistance of Insulation Materials and Facings
  - .13 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building

Materials and Assemblies.

- .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

## **1.2 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - means "not concealed" as previously defined.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.

## **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards, member of TIAC.

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

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

## **2 PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

- .1 To CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 INSULATION**

- .1 Glass fiber insulation with integrated vapour barrier, minimum thickness as scheduled in PART 3.
- .2 Thermal conductivity ("k" factor) not to exceed 0.042 W/m/°C at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52 Ma (as scheduled in PART 3 of this Section)
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52 Ma (as scheduled in PART 3 of this section)
  - .1 Mineral fibre: to ASTM C553

- .2 Jacket: to CGSB 51-GP-52 Ma
- .3 Maximum "k" factor: to ASTM C553
- .5 Insulating materials shall be free of asbestos, lead, mercury or mercury compounds.
- .6 Standard of acceptance: Johns Manville Microlite FSK, Owens Corning FRK or approved equivalent.

## **2.4 JACKETS**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921
- .2 Lagging adhesive: compatible with insulation.
  - .1 Maximum VOC limit 50 g/L
- .3 Aluminum:
  - .1 To ASTM B209 with or without moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Corrugated.
  - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.
- .4 Stainless steel:
  - .1 Type: 304 or 316 stainless steel.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Corrugated.
  - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

## **2.5 ACOUSTIC DUCT LINING**

- .1 Rigid fiber glass board meeting or exceeding ASTM C1071 Type II duct liner requirements.
- .2 Sound absorption coefficient (NRC) of minimum 0.75 for 25mm (1 in) thick lining as tested in accordance with ASTM C423 and ASTM E795.
- .3 Thermal conductance of 1.31 W/m<sup>2</sup> °C (0.23 BTU/hr ft<sup>2</sup> °F).
- .4 Adhesive to ASTM C916.
- .5 Standard of acceptance: Johns Manville Linacoustic R-300, Owens Corning QUIETR or approved equivalent.

## **2.5 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
    - .1 Maximum VOC limit 50 g/L.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449
- .4 ULC Listed Canvas Jacket:

- .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
  - .1 Maximum VOC limit 50 g/L.
- .8 Canvas adhesive: washable.
  - .1 Maximum VOC limit 50 g/L.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on both faces of insulation.
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

### **3 EXECUTION**

#### **3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Provide thermal insulation on ductwork distribution as noted on plans and as follows:
  - .1 Outdoor air intake – all ductwork shall be thermally insulated, including plenums
  - .2 Exhaust air – insulate first 3m (10 ft) from wall or roof penetration.
  - .3 Supply/return air – insulate all ductwork passing through unconditioned spaces and plenums.
  - .4 ERV – insulate entire length of outdoor and exhaust air ductwork between outside wall or roof and ERV unit.

#### **3.2 PREINSTALLATION REQUIREMENTS**

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

#### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

- .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.
- .7 Where a vapor retarder is specified, seal tears, punctures and other penetrations of the duct wrap facing using one of the above methods to provide a vapor tight system.
- .8 Upon completion of insulation work and before operation is to commence, visually inspect the work and verify that it has been correctly installed.
- .9 Check the duct system to ensure that there are no air leaks through joints.
- .10 Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means of removal of such material.
- .11 Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with duct liner damage and moisture- saturated insulation.
- .12 The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.
- .13 Duct liner shall be installed in accordance with manufacturer's instructions and NAIMA Fibrous Glass Duct Liner Installation Standard.

**3.4 DUCTWORK INSULATION SCHEDULE**

- .1 Insulation types and thicknesses: conform to following table:

	<b>TIAC Code</b>	<b>Vapour Retarder</b>	<b>Thickness (mm)</b>
Rectangular cold and dual temperature supply air ducts	C-1	Yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	No	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	Yes	25
Mixing plenums	C-1	Yes	25
Exhaust duct between dampers and louvres	C-1	No	25
Rectangular ducts outside	C-1	Yes	50
Round ducts outside	C-1	Yes	50
Acoustically lined ducts	[none]		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

- .1 Use TIAC code C-1 insulation, scored to suit diameter of duct

- .1 Finishes: conform to following table:

	<b>TIAC Code</b>	
	<b>Rectangular</b>	<b>Round</b>
Indoor, concealed	none	none

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	TIAC Code	
	Rectangular	Round
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

**3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**





## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 ASTM International (ASTM)
  - .1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6 ASTM C547, Mineral Fiber Pipe Insulation.
  - .7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .9 ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .7 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

- .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.
- .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

## **1.2 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

## **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, and have listings of the agencies and standards of this specification.
  - .2 Instructions: submit manufacturer's installation instructions.

## **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

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

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

instructions.

- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for reuse, and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility.
  - .4 Dispose of unused adhesive material at official hazardous material collections site.

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Fire and smoke rating shall be in accordance with CAN/ULC-S102 and as follows:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.
- .2 Insulating materials including coatings, adhesives and sealers shall have UV protection and waterproof construction.
- .3 Oversize insulation for all heat traced piping, valves and specialties.
- .4 Provide thermal insulation at all contacts between surfaces prone to condensation and other building materials (for example, between chilled water heat exchanger base and concrete pad) to prevent thermal bridging.

### **2.3 INSULATION**

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
  - .2 Maximum "k" factor: to CAN/ULC-S702
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52 Ma
  - .3 Maximum "k" factor: to CAN/ULC-S702 and ASTM C547.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

- .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
- .2 Jacket: to CGSB 51-GP-52 Ma
- .3 Maximum "k" factor: to CAN/ULC-S702 and ASTM C547.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52 Ma
  - .3 Maximum "k" factor at 24°C (75°F) mean temperature:
    - .1 25mm (1 in) and under: 0.0354 W/mK (0.245 BTU in/hr sq ft)
    - .2 32mm (1-1/2 in) to 50mm (2 in): 0.040 W/mK (0.28 BTU in/hr sq ft)
  - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
  - .5 Adhesive shall be supplied by manufacturer.
- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements
  - .1 Insulation: to ASTM C533.
  - .2 Maximum "k" factor: to ASTM C533.
  - .3 Design to permit periodic removal and re-installation.
  - .4 **Do not use calcium silicate on aluminum or stainless steel piping.**

## 2.4 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm (2 in) wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm (1/16 in) diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide (3/4 in), 0.5 mm (1/64 in) thick.

## 2.5 CEMENT

- .1 Thermal insulating and finishing cement:
  - .1 Air drying on mineral wool, to ASTM C449/C449M.

## 2.6 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

## 2.7 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

## 2.8 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m<sup>2</sup>.

## 2.9 JACKETS

- .1 Polyvinyl Chloride (PVC):

- .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
- .2 Colours: to match adjacent finish paint or as directed by Consultant.
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees C.
- .5 Moisture vapour transmission: 0.02 perm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
  - .1 Indoor: use PVC or canvas.
  - .2 Outdoor: use aluminum or stainless steel.
- .2 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921
  - .2 Lagging adhesive: compatible with insulation.
- .4 Aluminum:
  - .1 To ASTM B209
  - .2 Thickness: 0.50 mm (1/64 in) sheet.
  - .3 Finish: corrugated
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm (2 in) laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm (3/4 in) wide, 0.5 mm (1/64 in) thick at 300 mm (12 in) spacing.
- .5 Stainless steel:
  - .1 Type: 304 or 316.
  - .2 Thickness: 0.25 mm
  - .3 Finish: smooth.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm (2 in) laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm (3/4 in) wide, 0.5 mm thick at 300 mm (12 in) spacing.

### **3 EXECUTION**

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

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.
- .3 Ensure heat tracing system has been installed, where specified, prior to installation of insulation.

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm (3in).
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .6 Ensure installation of the insulation permits operation of all devices, including valve handles.

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: at expansion joints, valves, flow measuring elements, strainers, balancing valves, control valves, flanges, unions at equipment and other specialties requiring access.
- .2 Design: to permit movement of expansion joint and to permit periodic removal, replacement, servicing and inspection without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: PVC (indoor), aluminum or stainless steel (outdoor).

### **3.5 INSTALLATION OF ELASTOMERIC INSULATION**

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

### **3.6 PIPING INSULATION SCHEDULES**

- .1 Insulation thickness shall comply with Ashrae 90.1 requirements.
- .2 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .3 TIAC Code: A-1.
  - .1 Securements: 18 ga stainless steel wire on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .4 TIAC Code: A-3.
  - .1 Securements: Tape at 300 mm (12 in) on centre.

- .2 Seals: VR lap seal adhesive, VR lagging adhesive.
- .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: A-6.
  - .1 Securements: in accordance with manufacturer's instructions.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-CA.
- .6 TIAC Code: C-2 with vapour retarder jacket.
  - .1 Securements: 18 ga stainless steel wire on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .7 TIAC Code: A-2.
  - .1 Securements: 18 ga stainless steel wire on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-H.
- .8 Thickness of insulation as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	°C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Steam	up to 175	[A-1]	38	50	65	75	90	90
Steam, Saturated and Super heated	over 175	[A-1]	38	65	65	75	90	90
Condensate Return	60 - 94	[A-1]	25	38	38	38	38	38
Pumped Condensate return	up to 94	[A-1]	25	38	38	38	38	38
Boiler Feed Water		[A-1]	25	25	25	25	25	25
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38
Hot Water Heating	up to 59	[A-1]	25	25	25	25	38	38
Glycol Heating	60 - 94	[A-1]	25	38	38	38	38	38
Glycol Heating	up to 59	[A-1]	25	25	25	25	38	38
Domestic HWS		[A-1]	25	25	25	38	38	38
Chilled Water	4 - 13	[A-3]	25	25	25	25	25	25
Chilled Water or Glycol	below 4	[A-3]	25	25	38	38	38	38
Chilled Water Pump Casing	4 - 13	[A-3]	25	25	25	25	25	32
Condenser Water			25	25	25	25	38	38

Application	°C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Outdoors <sup>1</sup>								
Condenser Water Indoors			Not Required	Not Required	Not Required	Not Required	Not Required	Not Required
Refrigerated Drinking Water		[A-3]	25	25	25	25	25	25
Domestic CWS		[A-3]	25	25	25	25	25	25
Domestic CWS with vapour retarder		[C-2]	25	25	25	25	25	25
Refrigerant liquid	4 - 13	[A-6]	25	25	25	25	25	25
Refrigerant hot gas and suction	below 4	[A-6]	25	25	38	38	38	38
RWL and RWP		[C-2]	25	25	25	25	25	25
Cooling Coil cond. drain		[C-2]	25	25	25	25	25	25
Diesel generator exhaust system		[A-2]	38	65	65	75	90	90

1 – insulation shall be applied only if the piping system is heat traced

**.9 Finishes:**

- .1 Exposed indoors: canvas or PVC, white finish – confirm with consultant for each project.
- .2 Exposed in mechanical rooms: canvas or PVC, white finish – confirm with consultant for each project.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation
- .5 Outdoors: water-proof aluminum or stainless steel jacket. Complete insulation and jacketing following heat tracing system installation and verification (where specified). Provide “Heat Tracing – Do Not Step On Piping” for all exposed heat traced piping in addition to standard identification.
- .6 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

**3.8 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Clean any dirt, deposits or debris from all insulation jacketing due to construction prior to project handover.

**END OF SECTION**





## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .4 ASME B18.2.1, Square and Hex Bolts and Screws Inch Series.
- .2 ASTM International (ASTM)
  - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B75M, Standard Specification for Seamless Copper Tube.
  - .4 ASTM B837, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 CSA Group (CSA)
  - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .4 CSA Group (CSA)/Canadian Gas Association (CGA)
  - .1 CAN/CSA B137.4, Polyethylene (PE) Piping Systems for Gas Services.
  - .2 CAN/CSA B149.1, Natural Gas and Propane Installation Code.
  - .3 CAN/CSA B149.1HB, Natural Gas and Propane Installation Code Handbook.
  - .4 CAN/CSA B149.2, Propane Storage and Handling Code.
  - .5 CAN/CSA Z662-15, Oil and Gas Pipeline Systems.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2 Indicate on manufacturers catalogue literature following: valves.
  - .3 Submit WHMIS SDS, indicate VOC's for adhesive and solvents during application and curing.
- .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.



- .6 Instructions: submit manufacturer's installation instructions.
- .7 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### 1.3 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
    - .5 Facility services shutdowns.
    - .6 Utility provisions (meter station, etc).
    - .7 AHJ approvals and inspections.
  - .2 Qualifications:
    - .1 All work shall be completed by qualified personnel (G1 technicians), holding valid certificates. Submit credentials of all personnel prior to any work.
  - .3 Single Source Responsibility:
    - .1 Ensure primary materials provided in this Section are each obtained from a single source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.
  - .4 System Design Approval:
    - .1 Apply for, on TSSA forms, approval of the gas system design by the TSSA prior to work beginning at the site and prior to ordering any equipment. Submit the completed TSSA Form and copies of shop drawings/product data sheets as required to the TSSA and obtain an approval certificate. Pay all costs for the TSSA review and approval process. If the TSSA requires revisions to the system and the revisions result in an extra cost, a Notice of Change will be issued by the Consultant for the revision.

## 2 PRODUCTS

### 2.1 GENERAL

- .1 Provide complete natural gas system to CSA B149.1 and to Canadian Gas Association (CGA) requirements.
- .2 Apply and secure all required permits, fill out applications for new meter or capacity increase where required.
- .3 Provide pressure reducing assemblies, regulating and relief valve assemblies at the interface between appliances and building/site natural gas services. Provide relief piping in accordance with CSA B149.1 and terminate outside.
- .4 Arrange and pay the costs of all inspections by TSSA. Complete necessary repairs where infractions are discovered and schedule follow-up inspection(s) as required to rescind noted infractions.



- .5 Support, paint and label natural gas services in accordance with CSA B149.1.
- .6 Carefully review clearances of all equipment and coordinate with other sub-trades prior to laying out pipework.

## 2.2 PIPE SYSTEM – ABOVE GROUND

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
  - .1 12mm to 50mm (NPS 1/2 to 2): screwed.
  - .2 65mm (NPS 2 1/2) and over: flanged and welded.
- .2 Copper tube: to ASTM B837
- .3 Jointing Material
  - .1 Screwed fittings: pulverized lead paste.
  - .2 Welded fittings: to CSA W47.1
  - .3 Flange gaskets: nonmetallic flat.
  - .4 Brazing: to ASTM B837.
- .4 Fittings
  - .1 Steel pipe fittings, screwed, flanged or welded:
    - .1 Malleable iron: screwed, banded, Class 150.
    - .2 Steel pipe flanges and flanged fittings: to ASME B16.5
    - .3 Welding: butt-welding fittings.
    - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M
    - .5 Bolts and nuts: to ASME B18.2.1
    - .6 Nipples: schedule 40, to ASTM A53/A53M
  - .2 Copper pipe fittings, screwed, flanged or soldered:
    - .1 Cast copper fittings: to ASME B16.18
    - .2 Wrought copper fittings: to ASME B16.22
- .5 Valves
  - .1 Provincial Code approved, lubricated plug or ball type.
  - .2 Standard of acceptance: Kitz 68, Toyo 5044C or Crane F9202.

## 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### 3.2 PIPING

- .1 Install in accordance with Section 23 05 05 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.
- .2 Install drip points:



- .1 At low points in piping system.
- .2 At connections to equipment.
- .3 Use eccentric reducers at pipe size change to ensure positive drainage.
- .4 Independently support all piping in accordance with CAN/CSA B149.1.
- .5 Pressure test and purge all piping in accordance with CAN/CSA B149.1.
- .6 Provide pressure test tags on all piping.
- .7 Arrange and pay for all inspections by TSSA/AHJ.

### 3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

### 3.4 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149.1, CAN/CSA B149.2 and requirements of authorities having jurisdiction.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
  - .3 Schedule site visits to review work at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work at 25% and 60% complete.
    - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Consultant.

### 3.5 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 and CAN/CSA B149.2.
- .2 Pre-Start-Up Inspections:
  - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

### 3.6 CLEANING

- .1 Cleaning: in accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems, CAN/CSA B149.1, CAN/CSA B149.2.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.



END OF SECTION



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
  - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S110, Standard Methods of Tests for Air Ducts.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
    - .5 Thermal properties.
    - .6 Friction loss.
    - .7 Acoustical loss.
    - .8 Leakage.
    - .9 Fire rating.

### 1.3 DELIVERY, STORAGE AND HANDLING

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

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

### **2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: 75mm (3") wide, 24 gauge galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self-extinguishing, woven fiberglass, minimum 0.61mm thickness, temperature rated at minus 40°C to plus 120°C, density of 1.3 kg/m<sup>2</sup>.
  - .2 Listings: UL, NFPA 701
- .3 Standard of acceptance: Duro Dyne Durolon, Ductmate PROflex or approved equivalent.

### **2.3 ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.
  - .6 300 x 300 mm glass viewing panels.

### **2.4 TURNING VANES**

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA.

### **2.5 INSTRUMENT TEST**

- .1 1.6mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

### **2.6 SPIN-IN COLLARS**

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

### 3 EXECUTION

#### 3.1 INSTALLATION

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control and backdraft dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils (locate on both sides of coil)
    - .6 Bottom of duct risers.
    - .7 Elsewhere as indicated.
    - .8 Airflow stations (locate on both sides of device)
    - .9 Smoke and heat detectors (locate upstream of the device)
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhausters.
      - .2 Inlets and outlets of other fan systems.
      - .3 Main and sub-main ducts.
      - .4 And as indicated.
    - .2 For temperature readings:
      - .1 At outside air intakes.



- .2 In mixed air applications in locations as approved by Consultant.
  - .3 At inlet and outlet of coils.
  - .4 Downstream of junctions of two converging air streams of different temperatures.
  - .5 And as indicated.
- .4 Turning Vanes:
- .1 Install in accordance with recommendations of SMACNA.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **2 PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture to SMACNA standards

### **2.2 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.3 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA
- .3 Maximum blade height: 100mm.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: not to exceed 2% at 500Pa (2" w.c.)

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install balancing damper at all branch locations to permit for full balancing of the system. Coordinate location of all balancing damper with TAB contractor prior to ductwork installation.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments as noted by Consultant.
- .8 Provide extended shaft linkage for all installation on insulated ductwork.
- .9 Provide min 300x300mm access panel at all balancing damper locations when installed above drywall/gypsum ceilings.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3 ULC-S505, Standard for Fusible Links for Fire Protection Service.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for [fire and smoke dampers] and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Smoke dampers.
    - .3 Fire stop flaps.
    - .4 Operators.
    - .5 Fusible links.
    - .6 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide:
    - .1 6 fusible links of each type.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory

packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect fire and smoke dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **2 PRODUCTS**

### **2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type B or Type C with no part of blade or damper frame in air stream, listed and bear label of ULC, meet requirements of provincial fire authority, authorities having jurisdiction and NFPA 90A. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Fire dampers: minimum 1-1/2 hour fire rated or as required to meet rating of the fire rated assembly.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset, multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow. ULC approved fusible link assembly shall be rated at 74°C (165°F) for all supply, return and exhaust air streams.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

### **2.2 SMOKE DAMPERS**

- .1 Smoke Dampers: to be ULC and labelled
- .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signaling device actuated by an

electro thermal link] [as indicated]. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

- .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signaling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts, ULC and labelled.
- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74°C (165°F) and from external electrical impulse of low power and short duration; ULC and labelled.

### **2.3 COMBINATION FIRE AND SMOKE DAMPERS**

- .1 Damper: similar to smoke dampers specified above.
- .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

### **2.4 FIRE STOP FLAPS**

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74°C (165°F).

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper.
- .5 Coordinate installation of fire stopping with Section 07 84 00 - Fire Stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99, Standards Handbook.
  - .2 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for [roof and wall exhausters] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Include:
    - .1 Fan performance curves showing specified point of operation.
    - .2 Sound rating data.
    - .3 Weight and dimensional data.
    - .4 Electrical data and schematics.
    - .5 Accessories (dampers, speed controllers, curb, disconnect switch, etc).

## 2 PRODUCTS

### 2.1 APPROVED MANUFACTURER

- 1.Greenheck
- 2. Loren cook
- 3.Penbarry

### 2.2 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force. Provide confirmation of testing.
  - .2 Capacity: as indicated on drawing schedules.
- .2 Statically and dynamically balanced. Constructed to ANSI/AMCA Standard 99



- .3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210, unit to bear AMCA certified rating seal.
- .5 Bearings: sealed lifetime ball bearings or heavy duty grease lubricated ball or roller bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.

## **2.3 ROOF EXHAUSTERS**

- .1 Centrifugal or axial direct driven or V-belt as noted on schedules.
  - .1 Housings: spun aluminum complete with resilient mounted motor and fan.
  - .2 Impeller: aluminum non-overloading.
  - .3 Adjustable motor sheave.
  - .4 12mm mesh 2.0 mm diameter aluminum birdscreen.
  - .5 Motorized gasketed aluminum backdraft dampers.
  - .6 Disconnect switch within fan housing.
  - .7 Continuous curb gaskets, stainless steel securing bolts and screws, and special mated sound insulating 400 mm high curbs where indicated. Hinge curb plate for access to internals for maintenance.
- .2 Sound curbs: of same manufacturer as fan and built to suit model specified.

## **2.4 WALL EXHAUSTERS**

- .1 Centrifugal or axial direct driven or V-belt as noted on schedules.
  - .1 Spun aluminum housings, complete with resilient mounted motor and fan.
  - .2 12 mm mesh 2.0 mm diameter aluminum birdscreen.
  - .3 Motorized gasketed aluminum backdraft dampers.
  - .4 Disconnect switch within fan housing.
  - .5 Stainless steel securing bolts and screws.
- .2 Housings:
  - .1 Provide with rubber or neoprene grommets for wiring passages, integral attachment collar, or angle ring mounted to mating flanged wall sleeve with full gasketing.
  - .2 Discharge pattern: away from building.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide weather resistance special nameplate on each fan, indicating:
  - .1 Fan tag.
  - .2 Served area(s) or system.
  - .3 Power source.
- .3 All roofing modifications, curb flashing and seal shall be basebuilding roofing vendor.

**3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
  - .1 ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Underwriter's Laboratories (UL)
  - .1 UL 181-[2005(R2008)], Factory-Made Air Ducts and Air Connectors.

## 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

### 2.2 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

### 2.3 VARIABLE VOLUME BOXES

- .1 Pressure independent reset to air flow between zero and maximum air volume.
- .2 Sizes, capacities: as indicated.
- .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
- .4 Complete with:
  - .1 Operator and controller: provided and field installed by Division 25.
  - .2 Sound attenuator.
  - .3 Multiport outlet adapter: as indicated.
  - .4 Reheat coil: as indicated and scheduled.
- .5 Casing: constructed of 22-gauge thick galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL 181 and NFPA 90A. Mount control components inside protective metal shroud.
- .6 Reheat coils: as scheduled and include 1,2,3 or 4-row coils. Coils shall be tested and certified in accordance with AHRI 410. Contractor to provide specialties in accordance with drawing details.

**3 EXECUTION**

**3.1 I NSTALLATION**

- .1 Install in accordance with manufacturers' recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1,000 mm of rigid inlet ducting and minimum of three duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.
- .5 Provide minimum 600x600mm access panels in ceiling for servicing and maintenance.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
  - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 National Research Council Canada (NRC)
  - .1 National Building Code of Canada (NBC).
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Pressure drop.
    - .2 Face area.
    - .3 Free area.
    - .4 Construction.
    - .5 Finishes.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

## 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### 2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

- .1 Factory manufactured aluminum, hinged at curb line.
- .1 Complete with integral birdscreen of 2.7 mm diameter stainless steel wire. Use 12 mm mesh on exhaust and 19 mm mesh on intake.

- .2 Vertical or Horizontal backdraft dampers on 4 faces.
- .3 Maximum throat velocity: 3.3 m/s intake.
- .4 Maximum loss through unit: 15 Pa exhaust static pressure.
- .5 Maximum velocity through damper area: 1.5 m/s.
- .6 Shape: as indicated.

### **2.3 GOOSENECK HOODS**

- .1 Thickness: to SMACNA.
  - .1 Kitchen: to NFPA 96
  - .2 Elsewhere: to SMACNA.
- .2 Fabrication: to SMACNA.
  - .1 Kitchen: to NFPA 96
  - .2 Elsewhere: to SMACNA.
- .3 Joints: to SMACNA and proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter stainless steel wire. Use 12 mm mesh on exhaust and 19 mm mesh on intake.
- .6 Horizontal backdraft dampers on 4 faces.

### **2.4 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1,500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1,500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body
- .7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, anodized. Colour: to Consultant's approval, submit samples of available finishes within shop drawing submittals.

### **2.5 FIXED LOUVRES**

- .1 General: copper in welded steel frame, complete with anchors.
- .2 Blades:
  - .1 24 ounce cold rolled copper set at 45 degrees, Z-shaped with drip lips.
  - .2 Stormproof design for outside air intakes.

- .3 Maximum length without mullions of same material: 1,250 mm.
- .3 Frame: galvanized structural steel, welded construction. Paint welds after construction.
- .4 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .5 Finish: factory applied enamel, anodized. Colour: to Consultant's approval, submit samples of available finishes within shop drawing submittals.

## **2.6 ADJUSTABLE LOUVRES**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1,500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1,500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body
- .7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, anodized. Colour: to Consultant's approval, submit samples of available finishes within shop drawing submittals.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 American Gas Association (AGA)
- .2 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
  - .1 ANSI/AHRI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ANSI/AHRI 270, Sound Rating of Outdoor Unitary Equipment.
- .3 CSA Group (CSA)
  - .1 CSA B52, Mechanical Refrigeration Code.
  - .2 CSA C22.1, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 ANSI/ASHRAE/IESNA 90.1 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.

## **2 PRODUCTS**

### **2.1 PACKAGED ROOF TOP UNITS – VAV**

- .1 Summary
  - .1 The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
  - .2 Approved Manufacturers
    - 1. Trane
    - 2. Carrier
    - 3. Daikin
- .2 General
  - .1 Unit(s) furnished and installed shall be packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on AHRI Standard. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls.
  - .2 Unit(s) shall be 100% factory run tested and fully charged with R-410A.
  - .3 Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
  - .4 Units shall be convertible airflow design as manufactured.
  - .5 Wiring internal to the unit shall be colored and numbered for identification.



.3 Unit Casing

- .1 Cabinet: Galvanized steel with baked enamel finish. Structural members with access doors and removable panels shall be a minimum 22 gauge.
- .2 Unit's cabinet surface shall be tested 672 hours in salt spray test in compliance with ASTM B117.
- .3 Cabinet construction shall allow for all service/ maintenance from one side of the unit.
- .4 Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
- .5 Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
- .6 Unit's base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.
- .7 Provide 1/2 inch foil faced, fire retardant permanent, odorless glass fiber material. All edges must be captured so that there is no insulation exposed in the air stream.
- .8 The base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8 inch high down flow supply/return openings to provide and added water integrity precaution.
- .9 Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.
- .10 The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

.4 Air Filters

- .1 Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. Two-inch thick glass fiber disposable media filters shall be provided.
- .2 Two-inch MERV 13 pleated filters.

.5 Fans and Motors

- .1 Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
- .2 Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
- .3 Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box.
- .4 Supply fan shall have variable speed direct drive motors. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).
- .5 Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.
- .6 Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- .7 Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

.6 Gas Fired Heating Section

- .1 Completely assembled and factory installed heating system shall be integral to unit,

- UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping.
- .2 Heating section shall be factory run tested prior to shipment.
- .3 Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Provide flame rollout switches.
- .4 Induced draft blower shall have combustion air proving switches and built-in thermal overload protection on fan motor.
- .5 Heat Exchanger: Provide tubular section type constructed from aluminized steel.
- .6 Through the base gas piping- the units shall include a standard through the base gas provision. This option shall have all piping necessary including black steel, manual gas shut off valve, elbows, and union. The manual shutoff valve shall include a 1/8 NPT pressure tap.
  
- .7 Evaporator Coil & Section
  - .1 Evaporator coil shall be constructed of copper tubes, mechanically bonded to aluminum fins.
  - .2 Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 600 psig and leak tested at 465 psig.
  - .3 Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.
  - .4 Provide clogged Filter Switch. The indication will be registered with either a zone sensor with status indication lights or an integrated comfort system. This option is available for microprocessor-controlled units.
  - .5 Provide Fan Failure Switch. The indication will be registered with either a zone sensor with status indication lights or an integrated comfort system. This option is available for microprocessor-controlled units.
  - .6 Provide Discharge Air Sensing Tube
  - .7 Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of Stainless Steel
  - .8 Unit shall include a condensate overflow switch to shut the unit down in the event that a clogged condensate drain line prevents proper condensate removal from the unit.
  
- .8 Condenser Section
  - .1 Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.
  - .2 Condenser coil shall be copper tubes mechanically bonded to aluminum fins.
  - .3 Provide tool-less factory installed corrosion resistant louvered hail/vandalism guards to protect condenser coils from hail or physical damage.
  - .4 Provide corrosion protected Condenser Coil Option that shall include an all-aluminum Microchannel. Condenser coil protection shall consist of a corrosion resistant coating that shall withstand ASTM B117 Salt spray test for 6000 Hours and ASTM G85 A2 cyclic Acidified salt for test for 2,400 hours. This coating shall be added after coil construction covering all tubes, headers and fin edges, therefore providing optimum protection in more corrosive environments.
  
- .9 Refrigeration System

- .1 All units shall have direct drive hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate.
  - .2 17 Plus series shall be 2 stage scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate.
  - .3 E-flex variable speed compressor shall be capable of speed modulation from 15Hz to a maximum of 60Hz. The minimum unit capacity shall be 25% of full load. The compressor motor shall be a permanent magnet type. Each variable speed compressor shall be matched with a specially designed refrigerant cooled , variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions.
  - .4 Provide with thermostatic temperature motor winding control for protection against excessive temperatures caused by over/under voltage operation or loss of charge. Also provide high- and low-pressure switches.
  - .5 Thermal Expansion valves are standard for all models.
  - .6 Units shall have cooling capabilities down to 0-degree F as standard with microprocessor controls (40 degrees F with electromechanical controls. For field-installed low ambient accessories, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.
  - .7 Provide each unit with refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.
  - .8 For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.
  - .9 Provide high efficiency unit with 3 stages of cooling.
  - .10 Provide ultra-high efficiency with eflex variable speed technology.
- .10 Exhaust/Return Section
- .1 Provide a factory supplied field installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.
  - .2 Supply, Return and Plenum air smoke detector: If smoke is detected all unit operation will be shut down. Reset will be manual at the unit.
- .11 Outdoor Air Section
- .1 Low leak Economizer with dampers shall be provided with airfoil blades. Dampers shall have a leakage rate of 3 CFM/sq-ft a 1.0 in WC differential.
  - .2 Provide Fault Detection and Diagnostics (FDD) control.
  - .3 Motorized outside air damper 0-50%
  - .4 Provide economizer.
  - .5 Provide adjustable minimum position control located in the economizer section of the unit.
  - .6 Provide spring return motor for outside air damper closure during unit shut down or power interruption.
  - .7 Provide Remote Potentiometer for minimum position setting of the economizer.
- .12 Operating Controls
- .1 Unit shall be complete with terminal strip control for BAS control of unit's functions including DX cooling staging, gas heating modulation, supply/power exhaust fans control and damper control. Refer to control schematics and sequences of operation for more information.

.13 Roof Curb

- .1 The contractor shall provide factory supplied roof curb, 16-gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
- .2 Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

**3 EXECUTION**

**3.1 EXAMINATION**

- .1 The contractor shall verify that the roof is ready to receive work and opening dimensions are correct.
- .2 The contractor shall verify that the proper power supply is available.

**3.2 INSTALLATION**

- .1 Contractor shall install in accordance with manufacturer's instructions.
- .2 Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- .3 Coordinate installation with electrical and structural drawings.
- .4 Provide condensate trap in accordance with drawing details.
- .5 Coordinate final location of the unit on site, maintain minimum 3m clearance between all intakes and exhausts.
- .6 Provide natural gas piping in accordance with CAN CSA B149.1, provide regulator assembly, unions, isolation valves, dirt pocket. Paint entire surface of all piping included underneath. Provide adequate support of all natural gas piping.
- .7 Provide BAS integration in accordance with drawing schematics and sequencing in accordance with Division 25 specifications. Controls contractor to provide all sensors, wiring and devices to accomplish the design intent.

**END OF SECTION**



**BAS: SEQUENCES OF OPERATION:**

**1. EXHAUST FAN - WASHROOMS**

Run Conditions - Scheduled:

The fan shall run according to a user definable time schedule.

Fan:

The fan shall run when the schedule is occupied.

Fan Status:

The controller shall monitor the fan status.

Points:

Point Descriptor	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	MV	Trend	Alarm	
Occupied Schedule							x	x		x
Occupancy Override							x			x
Exhaust Fan Command				x				x		x
Exhaust Fan Status			x					x		x

**2. FORCE FLOW HEATER (ELECTRIC)**

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - 21°C (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - 18°C (adj.) heating setpoint.

Alarms shall be provided as follows:

- Low Zone Temperature: A zone shall generate an alarm when its temperature drops below 10°C (adj.) for 30 minutes.

Fan:

The fan shall run anytime the zone temperature drops below heating setpoint and the heating flag is true, unless shutdown on safeties.



Points:

Point Descriptor	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	MV	Trend	Alarm	
Zone Temperature	x							x	x	x
Occupied Schedule							x	x		x
Occupied Heating Setpoint					x					
Unoccupied Heating Setpoint					x					
Unit Heater Command				x				x		x
No Heat Alarm			x						x	x

### 3. VAV - TERMINAL UNIT

Run Conditions:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - 24°C (adj.) cooling setpoint
  - 21°C (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - 28°C (adj.) cooling setpoint.
  - 18°C (adj.) heating setpoint.

Alarms shall be provided as follows:

- Low Zone Temperature: A zone shall generate an alarm when its temperature drops below 10°C for 30 minutes.

Zone Temperature Adjust:

The occupant shall be able to adjust the heating and cooling setpoints locally by +/- 1°C.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Variable Volume Terminal Unit - Flow Control:

The unit shall maintain zone setpoints by controlling the airflow through one of the following:

Occupied:



- When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- When the zone temperature is between the cooling setpoint and the heating setpoint, the zone damper shall maintain the minimum occupied airflow (adj.).
- When zone temperature is less than its occupied heating setpoint, the controller shall enable heating to maintain the zone temperature at the setpoint. If a reheat coil is present and the heating flag is true, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied. If the heating flag is false or a reheat coil is not present, the zone damper shall modulate to maintain the minimum occupied airflow (adj.).

**Unoccupied:**

- When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow (adj.).
- When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- When zone temperature is less than its unoccupied heating setpoint, the controller shall enable heating to maintain the zone temperature at the setpoint. If a reheat coil is present and the heating flag is true, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied. If the heating flag is false or a reheat coil is not present, the zone damper shall modulate to maintain the minimum Unoccupied airflow (adj.).

**Perimeter Electric Radiant Ceiling Panel or Baseboard (where applicable):**

The controller shall measure the zone temperature and control electric radiant ceiling panel or baseboard heater on dropping temperature to maintain its heating setpoint.

**Cooling Request:**

A zone shall generate a cooling request when it's cooling PID is greater than 80% (differential 50%) and the zone temperature is greater than the cooling setpoint (differential 0.5 deg C).

**Heating Request:**

A zone shall generate a heating request when it's heating PID is greater than 80% (differential 50%).

**Air Request:**

A zone shall generate an air request when the supply damper is greater than 95% open (differential 10%).



Points:

Point Descriptor	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	MV	Trend	Alarm	
Zone Temperature	x							x	x	x
Temperature Override	x									x
Zone Temporary Occupancy						x		x		x
Occupied Schedule							x	x		x
Occupied Heating Setpoint					x					
Occupied Cooling Setpoint					x					
Unoccupied Heating Setpoint					x					
Unoccupied Cooling Setpoint					x					
Perimeter Heating Valve Output		x						x		x
Supply Air Damper Output		x						x		x
Supply Air Flow	x							x		x
Supply Air Flow Setpoint					x			x		x
Cooling Max Flow					x					x
Occupied Cooling Min Flow					x					x
Occupied Heating Min Flow					x					x
Heating Max Flow					x					
Unoccupied Cooling Min Flow					x					
Unoccupied Heating Min Flow					x					
Heating Request Source					x					
Cooling Request Source					x					
Pressure Request Source					x					
Heating Flag						x		x		
No Heat Alarm			x						x	x





#### 4. RTU-1,2

##### Terminal Strip Control

- Equipment shall be provided with built-in safety controls and terminal strip for interface with and control by BAS.
- BAS to control the following functions:
  - Control supply and exhaust fans
  - Modulate damper actuators.
  - Enable, disable and stage cooling.
  - Gas burner staging or modulation.
- Unit shall operate subject to internal safeties, which should override BAS command through terminal strip.

##### Run Conditions – Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - 24°C (adj.) cooling setpoint
  - 21°C (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - 28°C (adj.) cooling setpoint.
  - 18°C (adj.) heating setpoint.

Alarms shall be provided as follows:

- Low Zone Temperature: A zone shall generate an alarm when its temperature drops below 10°C (adj.) for 30 minutes.

##### Zone Temperature Adjust:

The occupant shall be able to adjust the heating and cooling setpoints locally by +/- 1°C.

##### Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for 60 minutes (adj.). At the expiration of this time, control of the unit shall automatically return to the schedule.

##### Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

##### Supply Fan:

The supply fan shall run anytime the unit is commanded to run. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime. Supply fan speed shall be modulated to maintain duct static pressure setpoint – setpoint shall be established by TAB contractor and programmed by BAS Contractor.



Alarms shall be provided as follows:

- Supply Fan Status: Mismatch between the fan command and the fan status for 30 minutes.

Discharge Air Temperature Control:

The discharge air temperature setpoint shall be reset using the table below:

Average Zone Temperature	Discharge Air Temperature Setpoint
21°C	18°C
24°C	12°C

Additionally, the discharge air setpoint will be reset based on a weighted sum of heating and cooling requests.

Every zone heating request shall add 0.2°C (adj.) to the discharge air setpoint and every zone cooling request shall deduct 0.1°C (adj.) from the discharge air setpoint.

The discharge air setpoint shall be limited to a maximum of 21°C (adj.) and a minimum of 11.5°C (adj.).

Discharge Air Temperature Monitoring:

The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

- Low Discharge Air Temperature: If the discharge air temperature is less than 5°C (adj.) for 5 minutes.
- High Discharge Air Temperature: If the discharge air temperature is more than 49°C (adj.) for 5 minutes.

Gas Heating Control:

Gas heating shall be enabled as required to maintain discharge air temperature setpoint.

Heating shall be enabled whenever:

- The discharge air temperature is below heating setpoint.
- AND the outdoor air temperature is less than 15°C (adj.).
- AND the supply fan status is ON.

DX Cooling Control:

DX cooling shall be enabled as required to maintain discharge air temperature setpoint.

Cooling shall be enabled whenever:

- The discharge air temperature is above cooling setpoint.
- AND the outdoor air temperature is more than 15°C (adj.)
- AND the supply fan status is ON.



Economizer:

The outside air dampers shall be controlled by the rooftop unit's onboard controls.

Points:

Point Descriptor	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	MV	Trend	Alarm	
Zone Temperature	x							x	x	x
Warmer/Cooler Adjust	x									x
Zone Temporary Occupancy						x		x		x
Discharge Air Temperature	x							x	x	x
Supply Fan Command		x						x		x
Supply Fan Status	x						x	x	x	x
Occupied Schedule							x	x		x
Occupancy Override							x			x
Occupied Heating Setpoint					x					x
Occupied Cooling Setpoint					x					x
Unoccupied Heating Setpoint					x					x
Unoccupied Cooling Setpoint					x					x
Heating Command				x				x		x
Cooling Command				x				x		x
Outdoor Air Temperature					x			x		x
Warmup/Cooldown Command							x	x		x
AHU State							x	x		x
Cooling OA-T Lockout Setpoint					x					x
Heating OA-T Lockout Setpoint					x					x
No Heat Alarm			x						x	x

**5. RADIANT/PERIMETER HEATING - TYPICAL**

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - 21°C (adj.) heating setpoint.



- Unoccupied Mode (night setback): The unit shall maintain
  - 18°C (adj.) heating setpoint.

Alarms shall be provided as follows:

- Low Zone Temperature: A zone shall generate an alarm when its temperature drops below 10°C (adj.) for 30 minutes.

Heating Valve:

The controller shall measure the zone temperature and control electric radiant ceiling panel to maintain its setpoint.

Zone Temperature Adjust:

The occupant shall be able to adjust the heating setpoint locally by +/- 1°C.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for 60 minutes (adj.). At the expiration of this time, control of the unit shall automatically return to the schedule.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up period while still achieving comfort conditions by the start of scheduled occupied period.

Heating Request:

A zone shall generate a heating request when it's heating PID is greater than 80% (differential 50%).

Points:

Point Descriptor	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	MV	Trend	Alarm	
Zone Temperature	x							x	x	x
Warmer/Cooler Adjust	x									x
Zone Temporary Occupancy						x		x		x
Occupied Schedule							x	x		x
Occupied Heating Setpoint					x					x
Unoccupied Heating Setpoint					x					x
Radiant Panel Command				x				x		x
Heating Request Source					x			x		



No Heat Alarm			x						x	x
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Note: Refer to attached Appendix for complete list of software points to be mapped and trended.



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 CSA Group
  - .1 CSA C22.1-Latest Edition, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 Amendments
  - .3 CAN/CSA-C22.3 No.1, Overhead Systems.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-Latest Edition, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

### 1.2 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit drawings stamped and signed by Certified Electrical Contractor.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit soft copy (PDF) of drawings and product data to authority having jurisdiction.
  - .6 If changes are required, notify Consultant of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction inspection authorities for special approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 -

LOAD BALANCE.

- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.
- .5 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

## **2 PRODUCTS**

### **2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

### **2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

### **2.4 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of Consultant.
- .2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

### **2.5 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### **2.6 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoid black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
  - .2 Sizes as follows:

#### **NAMEPLATE SIZES**

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**NAMEPLATE SIZES**

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

**2.7 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1
- .4 Use colour coded wires in communication cables, matched throughout system.

**2.8 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue

Type	Prime	Auxiliary
Other Security Systems	Red	Yellow

## 2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint indoor switchgear and distribution enclosures light gray.

## 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise

### 3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed

### 3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### 3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed

3,000 mm, and information is given before installation.

- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

### **3.6 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1,400 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1,400 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 300 mm.
  - .5 Wall mounted telephone and interphone outlets: 1,500 mm.

### **3.7 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.8 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.

- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Consultant.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.9 SYSTEM STARTUP**

- .1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

### **3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **1 GENERAL**

### **1.1 SUMMARY**

- .1 This Section includes requirements for selective demolition and removal of electrical components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete work described in this Section ready for new construction.

### **1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA S350 M1980 – Latest Edition, Code of Practice for Safety in Demolition of Structures

### **1.3 DEFINITIONS**

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: (where Indicated) Detach items from existing construction and deliver them to Owner ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

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

- .1 Action Submittals: Provide in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:
  - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal
  - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

### **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

## 1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
  - .1 Provincial/Territorial Workers' Compensation Boards/Commissions
  - .2 Provincial/Territorial Occupational Health and Safety Standards and Programs

## 1.7 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
- .2 Existing Hazardous Substances: Owner has performed a hazardous substances assessment and identified materials requiring abatement as follows:
  - .1 Hazardous substances are as defined in Hazardous Products Act.
  - .2 Hazardous substances will be removed by Contractor as a part of Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Consultant if materials suspected of containing hazardous substances are encountered and perform following activities:
  - .1 Refer to Section 01 41 00 - Regulatory Requirements] for directives associated with specific material types.
  - .2 Hazardous substances will be as defined in Hazardous Products Act.
  - .3 Stop work in area of suspected hazardous substances.
  - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
  - .5 Proceed only after written instructions have been received from Consultant.

## 1.8 SALVAGE AND DEBRIS MATERIALS

- .1 Demolished items become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Owner's property.

## 2 PRODUCTS

### 2.1 MATERIALS

- .1 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed
- .2 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

### 3 EXECUTION

#### 3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Consultant will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

#### 3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Consultant and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Owner and users is minimized and as follows:
  - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
  - .2 Notify Consultant and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

#### 3.3 EXECUTION

- .1 Demolition and Removal: Coordinate requirements of this Section as follows:
  - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
  - .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
  - .3 Disconnect and remove existing fire alarm system including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
  - .4 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
  - .5 Disconnect and remove telephone outlets, associated conduit, cabling and sub terminal backboards and related accessories; maintain telephone service and main terminal backboard as is.
  - .6 Perform demolition work in a neat and workmanlike manner:
    - .1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
    - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
  - .7 Disconnect panel feeders back to main distribution panel and re label respective

circuit breaker as "SPARE".

- .8 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
- .9 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .10 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- .11 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

### **3.4 CLOSEOUT ACTIVITIES**

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction.

**END OF SECTION**





## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
  - .1 CAN/CSA-C22.2 No.18-Latest Edition, Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No.65- Latest Edition, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

### 1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common work results for Electrical

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
  - .2 Clamp for stranded copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper bars.
  - .7 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

## **3 EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and cables] and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65
  - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 CSA Group
  - .1 CSA C22.1-Latest Edition, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 Amendments

### 1.2 RELATED REQUIREMENTS

- .1 Division 01.
- .2 Section 26 05 00 - Common Work Results for Electrical
- .3 Section 26 05 20 - Wire and Box Connectors - (0-1000 V)
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

### 1.3 PRODUCT DATA

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

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## 2 PRODUCTS

### 2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketed.
- .3 Neutral supported cable: 1, 2 or 3 phase insulated conductors of Copper and one neutral conductor of Copper steel reinforced, size as indicated. Type: NS90 Insulation: Type NSF-2 flame retardant rated 600 V.

### 2.2 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .5 Connectors: anti short connectors.

### **2.3 CONTROL CABLES**

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket and armour of closely wound aluminum wire.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: PVC.
  - .2 Shielding: tape coated with paramagnetic material over each conductor.
  - .3 Overall covering: PVC jackets interlocked armour of aluminum strip.

### **2.4 NON-METALLIC SHEATHED CABLE**

- .1 Non-metallic sheathed copper cable type: NMD90XLPE, size as indicated.

## **3 EXECUTION**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

### **3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .7 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.3 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

**3.5 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

**END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.1-Latest Edition, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No.41- Latest Edition, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
  - .3 CSA C22.2 No.65- Latest Edition, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from inspection authority and include it with maintenance manuals.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**2 PRODUCTS**

**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 2, 3 or 4 way joint boxes, dry location type.

**3 EXECUTION**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**





## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837 latest edition, Qualifying Permanent Connections Used in Substation Grounding.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance Submittals:
  - .1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

## 2 PRODUCTS

### 2.1 MATERIALS

- .1 Conductors: bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.
- .2 Conductors: bare, PVC insulated coloured green, stranded tinned soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .3 Bolted removable test links.
- .4 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.
- .5 Wire connectors and terminations: as indicated.
- .6 Zig-zag grounding transformer: indoor, 3 phase, star connected, 15 kVA, 600 V, air cooled, iron core.
- .7 Cable sheath isolating sleeves.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Ground fences to grounding system independent of station ground.
- .3 Install connectors and cadweld in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors during and after construction.
- .5 Make buried connections, and connections to electrodes, structural steel work, using permanent mechanical connectors to ANSI/IEEE 837.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.
- .8 Use tinned copper conductors for aluminum structures.
- .9 Do not use bare copper conductors near un-jacketed lead sheath cables.
- .10 Install grounding resistor bank.
- .11 Install zig-zag grounding transformer.

#### **3.2 EQUIPMENT GROUNDING**

- .1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

#### **3.3 NEUTRAL GROUNDING**

- .1 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.
- .2 Interconnect electrodes and neutrals at each grounding installation.
- .3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.
- .4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

**3.4 SITE QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

**END OF SECTION**



## 1 GENERAL

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## 2 PRODUCTS

### 2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

## 3 EXECUTION

### 3.1 EXAMINATION

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

### **3.2 INSTALLATION**

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using cliSps, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.1, Canadian Electrical Code, Part 1, 20th Edition.

### **1.2 RELATED REQUIREMENTS**

- .1 26 05 00 - Common Work Results for Electrical

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit drawings stamped and signed by Certified Electrical Contractor.

## **2 PRODUCTS**

### **2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

### **2.2 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

### **2.3 CABINETS**

- .1 Construction: welded sheet steel, hinged door, handle, lock 2 keys and catch
- .2 Type E Empty: surface return flange mounting.
- .3 Type T Terminal: surface return flange mounting containing 19 mm fir plywood backboard.

**3 EXECUTION**

**3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1

**3.3 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase.

**END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.1, Canadian Electrical Code, Part 1, 20th Edition.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common work results for Electrical

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples for devices as requested by the consultant in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **2 PRODUCTS**

### **2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

### **2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster and tile walls.

### **2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.



## **2.4 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 FLOOR BOXES**

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex single receptacles. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 25 mm conduit. Minimum size: 73 mm deep.

## **2.6 CONDUIT BOXES**

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

## **2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE**

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

## **2.8 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **2.9 SERVICE FITTINGS**

- .1 'High tension' receptacle fitting made of 2 piece stainless steel with brushed aluminum housing finish for 1 or 2 duplex receptacles. Bottom plate with two knockouts for centered or offset installation..
- .2 Pedestal type 'low tension' fitting made of 2 piece stainless steel with brushed aluminum housing finish to accommodate one or two amphenol jack connectors.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
  - .1 CAN/CSA C22.2 No. 18-Latest Edition, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45- Latest Edition, Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56- Latest Edition, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83- Latest Edition, Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2- Latest Edition, Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3-[05], Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
  - .1 Test reports: submit certified test reports.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.

### 1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## 2 PRODUCTS

### 2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
  - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

## **2.2 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid conduit: to CSA C22.2 No. 211.2
- .5 Flexible metal conduit: to CSA C22.2 No. 56, aluminum, liquid-tight flexible metal.
- .6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

## **2.3 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
  - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

## **2.4 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## **2.5 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.6 FISH CORD**

- .1 Polypropylene.

### **3 EXECUTION**

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

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

#### **3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- .4 Use epoxy coated conduit in corrosive areas.
- .5 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.
- .6 Use rigid PVC conduit underground.
- .7 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions].
- .8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in mechanical rooms and outdoor.
- .9 Use explosion proof flexible connection for connection to explosion proof motors.
- .10 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .11 Minimum conduit size for lighting and power circuits: 19 mm.
- .12 Install EMT conduit from computer room branch circuit panel to outlet boxes located in sub floor.
- .13 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .14 Mechanically bend steel conduit over 19 mm diameter.
- .15 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .16 Install fish cord in empty conduits.
- .17 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
  - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .18 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .19 Dry conduits out before installing wire.
- .20 Coordination installation with mechanical division, do not obstruct equipment and ensure adequate clearance are available for servicing of all equipment.

### **3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel.
  - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
  - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

### **3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

- .1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
  - .1 Provide 50 mm of sand over concrete envelope below floor slab.

### **3.7 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

### **3.8 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
  - .1 CAN/CSA-C22.2 No.47-Latest Edition, Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-Latest Edition, Dry-Type Transformers.
  - .3 CAN/CSA-C802.2-Latest Edition, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

### 1.2 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.



## 2 PRODUCTS

### 2.1 DESIGN DESCRIPTION

- .1 Design.
  - .1 Type: ANN.
  - .2 3 phase, power and voltage requirements as indicated.
  - .3 Voltage taps: standard.
  - .4 Insulation: Class B, 150 degrees C temperature rise.
  - .5 Basic Impulse Level (BIL): standard.
  - .6 Hipot: standard.
  - .7 Average sound level: standard
  - .8 Impedance at 17 degrees C: standard
  - .9 Enclosure: NEMA 3, removable metal front panel.
  - .10 Mounting: as indicated.
  - .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .12 Copper windings.
  - .14 Harmonic Mitigating Phase Shifting transformers as indicated on drawings.
  - .15 KL-Rated Transformers as indicated on drawings.
  - .16 Voltage Regulation to be 4% or better.

### 2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.

## 3 EXECUTION

### 3.1 EXAMINATION

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





### **3.2 INSTALLATION**

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

### **3.4 PROTECTION**

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

**END OF SECTION**



**1 GENERAL**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No.29, Panelboards and Enclosed Panelboards.

**1.2 RELATED REQUIREMENTS**

- .1 26 05 00 - Common Work Results for Electrical

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by Certified Electrical Contractor
  - .2 Include on drawings:
    - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect panelboards from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 PANELBOARDS**

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand
- .2 Panelboards: bus and breakers rated for symmetrical interrupting capacity or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Isolated ground bus.

### **2.2 BREAKERS**

- .1 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .2 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .3 Lock-on devices for breakers installed where indicated..
- .4 Lock-on devices for fire alarm, emergency, intercom, stairway, exit and night light circuits.

### **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

## **3 EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under

other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed Consultant.

### **3.2 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

### **3.4 PROTECTION**

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

### **END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No.42-Latest Edition, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No.42.1- Latest Edition, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No.55- Latest Edition, Special Use Switches.
  - .4 CSA C22.2 No.111- Latest Edition, General-Use Snap Switches (Bi-national standard, with UL 20).

### **1.2 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

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## 2 PRODUCTS

### 2.1 SWITCHES

- .1 15 A, 120 V or 347 V, single pole or double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White toggle default, or as specified.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads and heating loads.
- .4 Switches of one manufacturer throughout project.

### 2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1 White urea moulded housing default, or as specified.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
  - .1 White urea moulded housing default, or as specified.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

### 2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
  - .1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.
  - .2 Electric shaver outlets, 15 A, 125 V, AC with 20 VA isolating transformer with stainless steel cover plate marked RAZOR ONLY.
  - .3 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

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## 2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel 1 mm thick cover plates or plastic white cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

## 2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

## 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as indicated.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:

- .1 Install suitable common cover plates where wiring devices are grouped.
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

**END OF SECTION**





## **1 GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 28 23 – Disconnect Switches Fused and Non Fused.
- .2 Section 26 05 00 - Common Work Results for Electrical

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide fuse performance data characteristics for each fuse type. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
  - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit drawings stamped and signed by Certified Electrical Contractor

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet, moisture free location.

### **1.4 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Six spare fuses of each type and size installed up to and including 600 A.

## **2 PRODUCTS**

### **2.1 FUSES - GENERAL**

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

### **2.2 FUSE TYPES**

- .1 Class L fuses - over 600 A.
  - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type L2, fast acting.
- .2 Class J fuses - up to and including 600 A and for other high inrush circuits.
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
- .3 Class C fuses - for short circuit protection and not overload protection.

**3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment
- .5 Install spare fuses in fuse storage cabinet.

**END OF SECTION**



**1 GENERAL**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CAN/CSA-C22.2 No.4-, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
  - .2 CSA C22.2 No.39, Fuseholder Assemblies.

**1.2 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 28 13.01 - Fuses - Low Voltage.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 DISCONNECT SWITCHES**

- .1 Fusible and/or Non-fusible disconnect switch in CSA enclosure 3R, to CAN/CSA-C22.2 No.4., standard size or as indicated.
- .2 Provision for padlocking in off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39, relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

### **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

## **3 EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No.14-Latest Edition, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA ICS 1-Latest Edition, Industrial Control and Systems: General Requirements.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by certified electrical contractor.
  - .2 Include schematic, wiring, interconnection diagrams.

### **1.4 QUALITY ASSURANCE**

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

### **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 AC CONTROL RELAYS**

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held, poles qty as indicated. Coil rating: as required. Contact rating: as indicated.
- .3 Sealed contact type: contacts field convertible from NO to NC, electrically held, poles qty as indicated. Coil rating: as required. Contact rating: as indicated.

### **2.2 RELAY ACCESSORIES**

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

### **2.3 SOLID STATE TIMING RELAYS**

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.
- .2 Operation: on-delay or off-delay.
- .3 Potentiometer: self contained to provide time interval adjustment.
- .4 Supply voltage: 120 V AC, 60 Hz.
- .5 Temperature range: minus 20 degrees C to plus 60 degrees C.
- .6 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1, as indicated.
- .7 Timing ranges: minimum 1.0 s, maximum 60 s.

### **2.4 INSTANTANEOUS TRIP CURRENT RELAYS**

- .1 Enclosure: CSA Type 1
- .2 Contacts: NO, NC automatic reset with adjustable tripping point.
- .3 Control: 3 wire, with provision for shorting contacts during accelerating period of motor.
- .4 Contact rating: NEMA ICS 1, power requirements as indicated.

### **2.5 OPERATOR CONTROL STATIONS**

- .1 Enclosure: CSA Type 1, surface mounting:

### **2.6 PUSHBUTTONS**

- .1 Illuminated, Standard. Operator flush, mushroom type. Green, with 1-NO and 1-NC contacts rated at 120 V, AC, labels as indicated. Stop pushbuttons coloured red, labelled "emergency stop".

### **2.7 INDICATING LIGHTS**

- .1 Standard, full voltage, LED type, push-to-test, lens colour: as indicated, supply voltage: as indicated, lamp voltage: as required, labels as indicated.

**2.8 CONTROL AND RELAY PANELS**

- .1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

**2.9 CONTROL CIRCUIT TRANSFORMERS**

- .1 Single phase, dry type.
- .2 Primary: 208 V, 60 Hz AC.
- .3 Secondary: 120 V, AC OR 24 V
- .4 Rating: as required.
- .5 Secondary fuse: as required.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

**2.10 THERMOSTAT (LINE VOLTAGE)**

- .1 Wall mounted, for exhaust fan control.
- .2 Full load rating: match requirement of the fan.
- .3 Temperature setting range: 0 degrees C to +40 degrees C.
- .4 Thermometer Range: -10 degrees C to +50 degrees C.
- .5 Markings in 5 degrees increments.
- .6 Differential temperature fixed at 10 degrees C.

**3 EXECUTION**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and Consultant.

**3.2 INSTALLATION**

- .1 Install pushbutton stations, control and relay panels, control devices and interconnect as outlined.

**3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**





## **1 GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 International Electrotechnical Commission (IEC)
  - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Submit drawings stamped and signed by Certified Electrical Contractor.
    - .2 Provide shop drawings for each type of starter to indicate:
      - .1 Mounting method and dimensions.
      - .2 Starter size and type.
      - .3 Layout and components.
      - .4 Enclosure types.
      - .5 Wiring diagram.
      - .6 Interconnection diagrams.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.

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

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category

### **2.2 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch motor circuit interrupter with operating lever on outside of enclosure to disconnect, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Selector switches: standard labelled as indicated.
  - .2 Indicating lights: standard type and Colour as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

### **2.3 CONTROL TRANSFORMER**

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

### **2.4 ACCESSORIES**

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

### **2.5 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

### **2.6 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Magnetic starter designation label, white plate, black letters, engraved as indicated.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire, starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

#### **3.3 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## 1 GENERAL

### 1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
  - .1 ANSI C82.1-2004, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast
  - .2 ANSI C82.4-2017, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE):
  - .1 ANSI/IEEE C62.41.2-2019, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
- .3 ASTM International (ASTM)
  - .1 ASTM F1137/F1137M-19, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Consultant.
  - .3 Photometric data to include: VCP Table where applicable, spacing criterion.
- .3 Samples:
  - .1 Provide samples as indicated.
- .4 Quality Assurance Submittals: Provide in accordance with Section 01 43 00 - Quality Assurance.
  - .1 Manufacturer's Instructions: Submit manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

### 1.3 QUALITY ASSURANCE

- .1 Provide mock-ups in accordance with Section 01 43 00 - Quality Assurance.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Disposal of old PCB filled ballasts.

## **2 PRODUCTS**

### **2.1 LUMINAIRES**

- .1 As per schedule.

### **2.2 FINISHES**

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

### **2.3 OPTICAL CONTROL DEVICES**

- .1 As indicated in luminaire schedule.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

### **3.2 WIRING**

- .1 Connect luminaires to lighting circuits:
  - .1 Install flexible or rigid conduit for luminaires as indicated.

### **3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations support luminaires independently of ceiling or support luminaires from ceiling grid in accordance with local inspection requirements.

### **3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## 1 GENERAL

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Materials and installation for fire alarm systems.
  - .2 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating [general] [two-stage] alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
  - .3 Trouble signal devices.
  - .4 Power supply facilities.
  - .5 Manual alarm stations.
  - .6 Automatic alarm initiating devices.
  - .7 Audible signal devices.
  - .8 End-of-line devices.
  - .9 Annunciators.
  - .10 Visual alarm signal devices.
  - .11 Ancillary devices.

### 1.2 REFERENCE STANDARDS

- .1 Government of Canada
  - .1 TB OSH Chapter 3-03, 1997-01-28, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.
  - .2 TB OSH Chapter 3-04, 1994-12-22, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .3 National Fire Protection Agency
  - .1 NFPA 72, National Fire Alarm Code.
  - .2 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .4 National Research Council Canada (NRC)
  - .1 National Building Code of Canada [2015] (NBC).
- .5 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC-S525, Audible Signal Device for Fire Alarm Systems.
  - .3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems.
  - .4 CAN/ULC-S527, Control Units.
  - .5 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems.
  - .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.

- .7 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
- .8 CAN/ULC-S531, Standard for Smoke Alarms.
- .9 CAN/ULC-S536-S537, Burglar and Fire Alarm Systems and Components.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures2.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop drawings: stamped and signed by professional engineer registered or licensed in Ontario, Canada.
  - .2 Include:
    - .1 Layout of equipment.
    - .2 Zoning.
    - .3 Complete wiring diagram, including schematics of modules.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
  - .3 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Closeout Submittals:
  - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
  - .2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.
  - .3 Submit to Authority of Jurisdiction 2 sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
  - .4 Submit following:
    - .1 Manufacturer's Data for:
      - .4 Manual pull stations.
      - .5 Heat detectors.
      - .6 Open-area smoke detectors.
      - .7 Duct smoke detectors.
      - .9 Alarm horns.
      - .10 Visible appliances.

- .11 Passive Graphic
- .12 Mark data which describe more than one type of item to indicate which type will be provided.
- .13 Submit 1 original for each item and clear, legible, first-generation photocopies for remainder of specified copies.
- .2 System wiring diagrams:
  - .1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
  - .2 Show modules, relays, switches and lamps in control panel.
- .3 Design data: Power Calculations:
  - .1 Submit design calculations [for existing system] [and] [new work specified] to substantiate that battery capacity exceeds supervisory and alarm power requirements.
  - .2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
  - .3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.
- .4 Instructions for operation:
  - .1 Projected beam smoke detector.
- .5 Schedules:
  - .1 Conductor wire marker schedule.
- .6 Test Reports:
  - .1 Open-area 2-wire smoke detectors.
  - .2 Preliminary testing:
    - .1 Final acceptance testing.
    - .2 Submit for inspections and tests specified under Field Quality Control.

#### **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company or person specializing in fire alarm system installations with minimum 5-years documented experience.
- .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
- .3 System:
  - .1 To TB OSH Chapter 3-04.
  - .2 Subject to Fire Commissioner of Canada (FC) approval.
  - .3 Subject to FC inspection for final acceptance.
- .4 Maintenance Service:
  - .1 Provide one year's free maintenance with two inspections by manufacturer during



warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Owner's Representative.

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

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

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Equipment and devices: ULC listed and labelled and Matching Existing.
- .2 Power supply: to CAN/ULC-S524
- .3 Audible signal devices: to CAN/ULC-S525
- .4 Visual signal devices: to CAN/ULC-S526
- .5 Control unit: to CAN/ULC-S527
- .6 Manual pull stations: to CAN/ULC-S528
- .7 Thermal detectors: to CAN/ULC-S530
- .8 Smoke detectors: to CAN/ULC-S529
- .9 Smoke alarms: to CAN/ULC-S531

### **2.2 SYSTEM OPERATION**

- .1 Provide separate circuits from control panel to each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.

### **2.3 MANUAL ALARM STATIONS**

- .1 Provide new Manual pull station matching existing.

### **2.4 AUTOMATIC ALARM INITIATING DEVICES**

- .1 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by ionization principle.
  - .1 Detectors: 4-wire or 2-wire type.
  - .2 Provide necessary control and power modules required for operation integral with control panel.
  - .3 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.
  - .4 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.
  - .5 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.

- .6 Provide remote indicator lamps for each detector that is located above suspended ceilings, beneath raised floors, concealed from view.
- .7 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.
- .8 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.
- .9 Screen each detector to prevent entrance of insects into detection chamber(s).
- .2 4-Wire Smoke Detectors: detector circuits 4-wire type capable of transmitting detector operating power over conductors separate from initiating circuit.
  - .1 Provide separate, power circuit for each smoke detection initiating circuit (zone).
  - .2 Failure of power circuit to be indicated as trouble condition on corresponding initiating circuit.
- .3 2-Wire Smoke Detectors: detector circuits of 2-wire type capable of transmitting detector operating power over initiating circuit are permitted, provided detectors used are approved by control panel manufacturer for use with control panel provided and are ULC listed as being compatible with control panel
  - .1 Total number of detectors on any detection circuit: not exceed 80% of maximum number of detectors allowed by control panel manufacturer for that circuit. Provide additional zones if required to meet this requirement.
- .4 Ionization Detectors: multiple chamber type responsive to both invisible and visible particles of combustion.
  - .1 Detectors: not susceptible to operation by changes in relative humidity.
- .5 Photoelectric Detectors: operate on light scattering principle using LED light source.
  - .1 Detector: respond to both flaming and smoldering fires.
- .6 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72, except provide at least 2 detectors in rooms of 54 square meters or larger in area.
- .7 Mount detectors at underside of ceiling or deck above unless otherwise indicated.
  - .1 For mounting heights greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72.
  - .2 For heights greater than 9 m space detectors no farther apart than 34% of their listed spacing.
- .8 Temperature rating of detectors: in accordance with NFPA 72.
- .9 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.
- .10 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, are approved for such locations
- .11 Provide detectors with terminal screw type connections.
- .12 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

## **2.5 ALARM INITIATING DEVICE SPACING AND LOCATION**

- .1 Detector spacing and location: in accordance with manufacturer's recommendations and

requirements of NFPA 72

- .2 Provide at least 2 detectors in rooms of 54 square meters or larger.
- .3 Spacing: not to exceed 9 m by 9 m per detector, and 9 linear m per detector along corridors.
- .4 Locate detectors minimum 1.5 m from air discharge or return grille, and not closer than 300 mm to lighting fixtures.
- .5 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.
- .6 Mount detectors installed beneath raised floors with base within 50 mm of underside of raised floor, with detector facing downward.
  - .1 Where space under raised floor is less than 300 mm in height, mount detectors with their bases either horizontal or vertical, with detection chamber(s) located in upper half of underfloor space.
  - .2 Do not mount detectors facing upward.
  - .3 Space detectors beneath raised floors maximum 4.5 m by 4.5m per detector.

## **2.6 DUCT SMOKE DETECTORS**

- .1 Provide detectors installed in ducts of ionization type and listed by ULC duct installation.
- .2 Provide integral control and power modules required for operation with main control panel.
- .3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit.
- .4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.
- .5 Provide a separate, fused power circuit for each smoke detection initiating circuit.
- .6 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.
- .7 Provide duct detectors in accordance with NFPA 90A
- .8 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.
- .9 Activation of duct detectors to cause [shutdown of associated air handling unit] annunciation at control panel and tripping of [master box] [transmitter] and sounding of building evacuation alarms.
- .10 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.
- .11 Provide remote indicator lamp for each detector.
- .12 Permanently label remote indicator with description and number of associated air handling unit(s).
- .13 Provide each detector with remote test switch. Mount switch not more than 1.8 m above finished floor.
- .14 Permanently label test switch with description and number of associated air handling unit(s).

## **2.7 AUDIBLE SIGNAL DEVICES**

- .3 Audible device(s):
  - .1 Horns: weatherproof, mounting, 24 V dc.
- .4 Do not exceed 80 percent of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.
- .5 Provide appliances specifically listed for outdoor use in locations exposed to weather.
- .6 Finish appliances in red enamel.
- .7 For surface mounting provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

## **2.8 END-OF-LINE DEVICES**

- .1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

## **2.9 CONTROL PANEL & REMOTE ANNUNCIATOR PANELS**

- .1 Update main control panel & remote Annunciator panel to suit additional zones per contract document. Include for programming, testing and fire alarm VI.

## **2.10 PASSIVE GRAPHIC**

- .1 Update existing passive graphic with new. Include the design of the new passive graphic layout to suit expansion with additional fire alarm zones.
- 2. Print and install the new upgrade passive graphic with the appropriate frame and mounting kit, etc.

## **2.11 VISUAL ALARM SIGNAL DEVICES**

- .1 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits.
- .2 Appliances: minimum of 75 candela measured as approved by ULC, but not less than effective intensity required by National Building Code of Canada for appliance spacing and location shown.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.
- .4 Provide visible appliances within 300 mm of each audible appliance as indicated.
- .5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in same room or corridor

## **2.12 CONDUIT**

- .1 Rigid Steel Conduit:
  - .1 Zinc-Coated.
- .2 Intermediate Metal Conduit (IMC):
  - .1 Zinc-coated steel only.
- .3 Electrical Metallic Tubing (EMT)

- .4 Surface Metal Raceway and Fittings:
  - .1 Two-piece painted steel.
  - .2 Totally enclosed snap-cover type.

### **2.13 WIRING**

- .1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.
- .2 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor
- .3 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.
- .4 Wire for connection to base telegraphic alarm loop: No. 10 AWG minimum solid copper conductor.
- .5 Insulation 75 degrees C minimum with nylon jacket.
- .6 For underground or wet allocations cable from control panel to master box or auxiliary transmitter and to telegraphic loop: type UF.
- .7 Colour code wiring.

### **2.14 ANCILLARY DEVICES**

- .1 Remote relay unit to initiate fan shutdown.

## **3 EXECUTION**

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

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .5 Connect alarm circuits to main control panel.
- .6 Locate and install horns and visual signal devices and connect to signaling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install end-of-line devices at end of alarm and signalling circuits.
- .9 Install remote annunciator panels and connect to annunciator circuit wiring.
- .11 Locate and install remote relay units to control fan shut down.
- .12 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests:
  - .1 Perform tests in accordance with CAN/ULC-S537.

- .2 Fire alarm system:
  - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, sprinkler system transmit alarm to control panel and actuate first stage alarm, general alarm, ancillary devices.
  - .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
  - .4 Class A circuits.
    - .1 Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
  - .5 Class B circuits.
    - .1 Test each conductor on circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

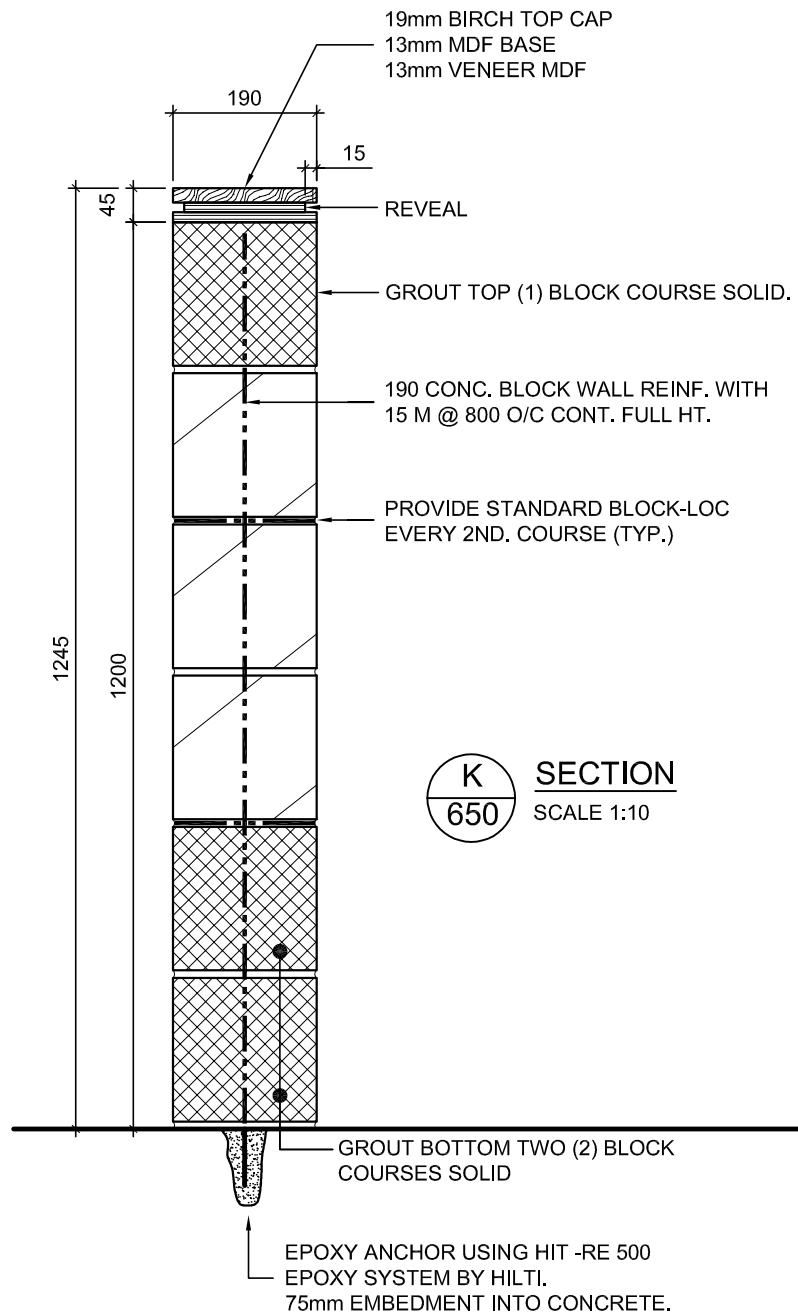
### **3.4 TRAINING**

- .1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

### **3.5 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**BANBURY ELEMENTARY SCHOOL  
 CHILDCARE ADDITION**  
 141 BANBURY ROAD, BRANTFORD, ONTARIO N3P 1E3  
**MILLWORK - SECTION K**  
 (REFERENCE: A2.20 & AD 623)

PROJ: 2022-08  
 SCALE: AS NOTED  
 DRAWN: DW  
 DATE: 2024-04-22

**GRGURIC  
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**TENDER DRAWINGS**

*Refer to next page.*