

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 07 21 13 - Board Insulation.
- .3 Section 07 27 00.01 - Air Barriers and Vapour Retarders.
- .4 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .5 Section 07 61 00 - Sheet Metal Roofing.
- .6 Section 08 11 00 - Metal Doors and Frames.
- .7 Section 08 44 13 - Glazed Aluminum Framing Systems.

1.02 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D4541-09e1, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - .2 ASTM D7234-12, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
 - .3 ASTM E283-04(2012) Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .4 ASTM E779-10 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
 - .5 ASTM E2178-13, Standard Test Method for Air Permeance of Building Materials.

1.03 DEFINITIONS

- .1 Air Barrier: Air Barriers are systems of materials designed and constructed to control airflow between conditioned and unconditioned spaces.
- .2 Air / Vapour Barrier: Systems of materials exhibiting both low air leakage (airtight) and low Vapour Permeance (vapour impermeable) levels, and functioning as a combined Air Barrier and Vapour Retarder.
- .3 Enclosure: The enclosure is the boundary or barrier separating the interior of a building from the outside environment; it may also serve to separate conditioned from

unconditioned space. Note: 'Enclosure' may also be referred to as 'envelope' or 'shell' in the Contract Documents and has the same meaning for the purposes of this Contract.

- .4 Vapour Permeance: The moisture transmission rate of a material is referred to as its 'permeability'. This number is not dependent on the material's thickness. Its 'permeance', however, is dependent on thickness much like the R-value in heat transmission. Dividing the 'permeability' of a material by its thickness gives the material's 'permeance'.
- .5 Vapour Permeance Classes:
 - .1 Vapour impermeable: $5.72 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$ or less.
 - .2 Vapour semi-impermeable: $57.21 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$ or less, and greater than $5.72 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$.
 - .3 Vapour semi-permeable: $572.14 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$ or less, and greater than $57.21 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$.
 - .4 Vapour permeable: Greater than $572.14 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$.
- .6 Vapour Retarder (vapour diffusion retarder): The element that is designed and installed in an assembly to retard the movement of water by vapour diffusion.

1.04 PERFORMANCE CRITERIA

- .1 Minimum Air Barrier Performance:
 - .1 The building enclosure shall be constructed with a continuous Air Barrier system to control air leakage into, or out of, the conditioned space. An Air Barrier system shall also be provided for interior partitions between the conditioned space and a space designed to maintain temperature or humidity levels that differ from those in the conditioned space by more than 50% of the difference between the conditioned space and the design ambient conditions.
 - .2 The installed Air Barrier system shall meet the following minimum requirements:
 - .1 Airtight: The installed Air Barrier system shall not exceed the following maximum air leakage rates:
 - .1 Air Barrier materials in accordance with ASTM D2178: $0.020 \text{ L}/(\text{m}^2 \cdot \text{s})$ @ $75 \text{ Pa } \Delta P$ ($0.072 \text{ m}^3/\text{m}^2 \cdot \text{h}$).
 - .2 Assemblies comprising the Enclosure in accordance with ASTM E283: $0.200 \text{ L}/(\text{m}^2 \cdot \text{s})$ @ $75 \text{ Pa } \Delta P$ ($0.720 \text{ m}^3/\text{m}^2 \cdot \text{h}$).
 - .3 Enclosures in accordance with ASTM E779: $2.000 \text{ L}/(\text{m}^2 \cdot \text{s})$ @ $75 \text{ Pa } \Delta P$ ($7.200 \text{ m}^3/\text{m}^2 \cdot \text{h}$).
 - .2 Continuity: The Air Barrier system shall be continuous across construction, control and expansion joints, across junctions between different building assemblies, and around penetrations through the building assembly.
 - .1 The Air Barrier system shall be continuous at the following connections:
 - .1 Roof / wall connections, wall / foundation connections, wall / window connections, wall / door connections, soffit connections, corner details, and connections between different exterior wall systems.
 - .2 Connect the roof waterproofing membrane system to the Air Barrier at the walls.
 - .3 Structural integrity: The Air Barrier system shall resist peak wind loads, stack pressure effects, or sustained pressurization loads without exhibiting signs of detachment, rupturing, or creep load failure.

- .1 The Air Barrier shall be able to resist a minimum air pressure difference of ± 2.0 kPa without tearing, rupturing or breaking away from its fastening.
 - .4 Durability: The Air Barrier system must be able to perform its intended function, be compatible with adjoining materials, and resistant to the mechanisms of deterioration that can be reasonably expected given the nature, function and exposure of the materials, over the life of the building envelope.
 - .5 Compatibility: The physical characteristics, chemical properties, and application methods of the building materials that comprise the Air Barrier system shall be compatible.
- .2 Minimum Vapour Retarder Performance:
 - .1 The Vapour Retarder shall retard the passage of moisture as it diffuses through the assembly of materials of the Enclosure.
 - .2 At above-grade walls, provide a combined Air / Vapour Barrier system at the warm side of the insulation. Both insulation and Air / Vapour Barrier shall be installed in full contact with each other at the exterior of the structure.
 - .3 Combinations of vapour semi-impermeable or vapour impermeable membranes, films, sheets or wall coverings shall not be installed on both sides (interior and exterior facings) of an Enclosure, in order to facilitate drying in at least one direction.
 - .4 Vinyl wall coverings, polyethylene vapour barriers, foil-faced batt insulation or reflective radiant barrier foil insulation shall not be installed on the interior of Enclosures.
 - .5 Vapour management of combined Air-Vapour Barrier Membranes: Water Vapour Permeance shall be $5.72 \text{ ng/Pa} \cdot \text{s} \cdot \text{m}^2$ or less, before and after aging.

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Select products to be compatible with adjoining membranes previously installed under related Sections
 - .2 Select products from a single manufacturer, or products that are compatible from different manufacturers.

- .3 Coordination between all installers of each component of vapour and air retarder system is required; ensure continuity of system and that junctions between the various components are effectively sealed.
- .4 Verify with manufacturers and all trades involved with installation procedures of building products incorporated into air barrier and vapour retarder elements including, but not limited to, various membranes, coating and sealants as well as continuity with roofing systems.
- .2 Pre-installation Meeting:
 - .1 Convene one week before commencing work at building enclosure (shell).
 - .2 Arrange for manufacturer(s)' factory-trained agent(s) to be on site at beginning of installation(s) to provide training and supervision of personnel who will install membrane. Agent(s) shall also provide inspection visits thereafter to assure quality and competence of membrane installations.

1.06 ACTION AND INFORMATION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and datasheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit statement from manufacturer(s), indicating products supplied are compatible with one another and with products previously installed under the Work of other Sections.
 - .3 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Samples:
 - .1 Provide duplicate 200 mm x 200 mm samples of membrane adhered to all project substrates, including adjoining membranes specified in other Sections.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Departmental Representative.

- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and replacement procedures at end of lifecycle.
- .4 Manufacturer's Field Reports: submit manufacturer's written reports within 3-days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.07 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Applicator: company specializing in performing work of required with installation of air and vapour membrane systems.
 - .1 Completed installation must be approved by the material manufacturer.
 - .2 Applicator: company:
 - .1 Currently licensed by National Air Barrier Association, Canadian Urethane Foam Contractor's Association, or national certifying organization.
 - .2 Must maintain their license throughout the duration of the project.
- .2 Mock-Up:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct typical exterior wall panel, 3 m long by 4 m wide, incorporating window and frame and sill, insulation, building corner condition, and junction with roof system; illustrating materials interface and seals.
 - .3 Locate where directed.
 - .4 Mock-up may remain as part of finished work.
 - .5 Allow review of mock up by Departmental Representative before proceeding with air/vapour barrier Work. Accepted mock-up will demonstrate minimum standard of quality required for this project.
- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

- .1 After delivery and storage of products, and when preparatory Work 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.

1.08 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Avoid spillage: immediately notify Departmental Representative if spillage occurs and start clean up procedures.
- .4 Clean spills and leave area as it was prior to spill.

1.10 AMBIENT CONDITIONS

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

1.11 SEQUENCING

- .1 Sequence work in accordance with Construction Progress Schedule.
- .2 Sequence work to permit installation of materials in conjunction with related materials and seals.
- .3 Overlap (shingle) materials to direct water down and away from the structure.

1.12 WARRANTY

- .1 For sealant and sheet materials, the 12-month warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 months.

- .2 Warranty: include coverage of installed sealant and membranes materials that:
 - .1 Fail to achieve air tight and watertight seal.
 - .2 Exhibit loss of adhesion or cohesion.
 - .3 Do not cure.

2 PRODUCTS

2.01 MATERIALS

- .1 Provide materials identified in individual technical sections as required to maintain continuity of air barrier and vapour retardance at building enclosure.
- .2 Refer to Related Requirements.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturers' printed installation instructions, technical datasheets, and transition details.

3.02 GENERAL

- .1 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

3.03 FIELD QUALITY CONTROL

- .1 At adhered membrane application locations, perform pull-off tests on applied membrane material to ensure adequate adhesion of the membrane to the substrate using equipment specifically design for that purpose. Pull-off adhesion shall be ≥ 15 psi to ASTM D4541 or ASTM D7234 depending on substrate (modified, 100 mm wood puck). Ensure that adhesion test results meet these criteria before Work by other trades proceeds. Re-do work as required to ensure adequate adhesion.
 - .1 Perform at least one test randomly per every 25 m² as directed by Departmental Representative; repair test areas at no addition to Contract Price.

- .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 Schedule site visits to review Work as required.
- .3 The Departmental Representative shall inspect installed membrane for continuity of air barrier and vapour membrane prior to placement of insulation or other covering materials, systems or assemblies.
- .4 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 06 10 00 - Rough Carpentry.
- .3 Section 07 61 00 - Sheet Metal Roofing.

1.02 REFERENCES

- .1 ASTM International
 - .1 ASTM C356-10, Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
 - .2 ASTM C591 13, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - .3 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .4 ASTM C665-12, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .5 ASTM C795-08(2013), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .6 ASTM C1104/C1104M-13a, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - .7 ASTM C1320-10(2016), Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
 - .8 ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - .9 ASTM D2842-12, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
 - .10 ASTM E84-16, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .11 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .12 ASTM E136-16a, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 71-GP-24M-AMEND-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 220, Standard on Types of Building Construction, 2015 Edition.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .3 CAN/ULC S604-16, Standard for Factory Built Type A Chimneys.
 - .4 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .5 CAN/ULC S702-14, Standard for Thermal Insulation Mineral Fibre for Buildings.
 - .6 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.03 ACTION AND INFORMATION 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 board insulation and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's during application and curing.

- .3 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports:
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.04 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from distortion, deterioration, wetting, or damage.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 INSULATION

- .1 Foundation Wall Insulation: Extruded polystyrene (XPS) to CAN/ULC S701 and meeting or exceeding following minimum requirements:
 - .1 CAN/ULC S701 Type 4.
 - .2 Thermal Resistance: RSI 0.87/25 mm minimum.
 - .3 Edges: ship-lapped.
 - .4 Size: 610 mm x 2440 mm x thickness as indicated on Drawings.
 - .5 Compressive Strength: minimum 170 kPa at 10% deformation in accordance with ASTM D1621.

- .6 Water Absorption: maximum 0.7% (% by volume) in conformance with ASTM D2842.
- .2 Cavity Wall Insulation: unfaced preformed rigid mineral wool insulation, to CAN/ULC S702 Type 1, and meeting or exceeding following minimum requirements:
 - .1 Recycled Option: supply fiber with minimum 75% recycled content.
 - .2 ASTM C665: non-corrosive, Type I.
 - .3 ASTM C795: Pass.
 - .4 ASTM C612: Type IA, IB, IVA.
 - .5 ASTM E136: non-combustible as defined per NFPA(Fire)220.
 - .6 CAN/ULC S114: Compliant.
 - .7 ASTM E96: 50 Perms as tested.
 - .8 CAN/ULC S102: Flame Spread 0, Smoke Developed 5.
 - .9 ASTM C1104: absorbs $\leq 0.03\%$ by volume.
 - .10 ASTM C356: Linear Shrinkage $< 2\%$ 650°C.
 - .11 ASTM E518 ("k" @ 24°C): 4.5 pcf density, ≥ 0.23 BTU.in/hr.sq.ft.°F.
- .3 Polyisocyanurate (Polyiso) Wall Insulation: Foil faced polyisocyanurate, preformed rigid board insulation in accordance with CAN/ULC S704 and as follows:
 - .1 Type: 1.
 - .2 Thermal Resistance: facing 2 having LTTR of RSI 1.05/25 mm minimum.
 - .3 Flamespread: classification of 500 or less in accordance with CAN/ULC S102.
 - .4 Edges: square.
 - .5 Size: manufacturers maximum standard x thickness as indicated on Drawings.
- .4 Roof Insulation: high-density unfaced preformed rigid mineral wool insulation, to CAN/ULC S702 Type 1, and meeting or exceeding following minimum requirements:
 - .1 Recycled Option: supply fiber with minimum 75% recycled content.
 - .2 ASTM C665: non-corrosive, Type I.
 - .3 ASTM C795: Pass.
 - .4 ASTM C612: Type IA, IB, II, III, IVA.
 - .5 ASTM E136: non-combustible as defined per NFPA(Fire)220.

- .6 CAN/ULC S114: Compliant.
- .7 ASTM E96: 50 Perms as tested.
- .8 CAN/ULC S102: Flame Spread 0, Smoke Developed 5.
- .9 ASTM C1104: absorbs $\leq 0.03\%$ by volume.
- .10 ASTM C356: Linear Shrinkage $< 2\%$ 650°C.
- .11 ASTM E518 ("k" @ 24°C): 6.0 pcf
density, ≥ 0.23 BTU.in/hr.sq.ft.°F.
- .12 Fire resistant to temperatures above 1093°C.

2.02 ADHESIVE

- .1 Insulation Adhesive: synthetic rubber-based insulation adhesive compatible with polystyrene insulation; suitable for application in temperature down to 12°C, as recommended by insulation manufacturer, suitable for conditions and substrates.

2.03 ACCESSORIES

- .1 Insulation Spindles: spindle type insulation anchors, perforated 50 x 50 mm Type 304 stainless steel base, 0.8 mm thick, spindle of 2.5 mm diameter Type 304 stainless steel, length to suit insulation, 25 mm diameter washers of self-locking type or speed clips.
 - .1 Anchor Adhesive: thermoplastic rubber high-strength, heavy-bodied adhesive, specifically formulated for adhering anchors for hanging insulation, meeting or exceeding the following minimum requirements:
 - .1 Shear strength: greater than 600 psi (AFG 01).
 - .2 Gun grade mastic.
 - .3 Compatible with substrate.
- .2 Protection Board: asphalt-impregnated fibreboard: 13 mm thickness.
- .3 Perimeter Insulation Flashings: Coordinate supply of end closures and flashings for perimeter insulation system with Section 07 62 00 - Sheet Metal Flashing and Trim.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for board insulation application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied. Proceeding with work means acceptance of conditions.

3.02 INSTALLATION

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

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

3.03 PERIMETER FOUNDATION WALL INSULATION

- .1 Install board insulation to vertical surfaces with adhesive applied in accordance with manufacturer's written instructions, and as follows:
 - .1 Exterior Application: Extend boards as indicated on Drawings to top of footing, installed on exterior face of perimeter foundation wall. Concrete faced board to be used at upper course of insulation where exposed above grade.
 - .2 Apply adhesive to the substrate by the "dab" method not less than 10 mm x 20 mm size at 150 mm centres. Bed the insulation in the adhesive before the adhesive loses its tack or skins over.
 - .3 Install cement board as indicated, adhesively bonded.
 - .4 Protect below grade installations from damage during backfilling by applying protection board; set in adhesive according to insulation manufacturer's written instructions.

3.04 ROOF INSULATION

- .1 Fit courses of insulation between ties and other confining obstructions; butt edges tightly in vertical and horizontal directions, and as follows:
 - .2 Mechanically install insulation with a tight fit to substrate materials, provide additional fasteners where uneven substrates cause air spaces behind insulation.
 - .3 Apply insulation fasteners using a minimum of 6-fasteners in 2-rows located near the centre of board along the narrow dimension and near the 3rd points along the long dimension; secure boards with 2-clips at the centre where both dimensions are less than 600 mm.
 - .4 Coordinate application of insulation with installation of girts, Z-bars and other connecting and structural components.
 - .5 Apply sheet membrane vapour retarder behind Z-bars prior to installation of insulation between Z-bars supporting cladding and roofing.
 - .6 Install insulation clips to substrates before sheet membrane vapour retarder (roof) or air barriers (walls) are applied.

3.05 CLEANING

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

3.06 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 07 05 27.01 - Common Work Results for Air Barriers and Vapour Retarders.
- .2 Section 07 27 00.01 - Air Barriers and Vapour Retarders.
- .3 Section 08 11 00 - Metal Doors and Frames.
- .4 Section 08 44 13 - Glazed Aluminum Framing Systems.

1.02 REFERENCES

- .1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-06, Architectural Coatings.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 CAN/ULC S705.1-15, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification.
 - .4 CAN/ULC S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.

1.03 ACTION AND INFORMATION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.
- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Submit test reports in accordance with CAN/ULC S101 for fire endurance and CAN/ULC S102 for surface burning characteristics.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and replacement procedures at end of lifecycle.
 - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3-days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.04 QUALITY ASSURANCE

- .1 Applicators to conform to CUFCA Quality Assurance Program.
- .2 Qualifications:
 - .1 Installer: Use company that is a member of and licensed by CUFCA, and committing trained and certified installers to the project in accordance with CAN/ULC S705.2 and CUFCA requirements.
 - .2 Manufacturer: Obtain air and vapour seal materials from a single manufacturer regularly engaged in manufacturing the products specified in this Section.

- .3 Cooperate and coordinate with the requirements of other units of work specified in other specification sections.
- .4 Health and Safety Requirements: worker protection:
 - .1 Protect workers to CAN/ULC S705.2 and manufacturer's recommendations.
 - .2 Workers must wear gloves, dust masks, long sleeved clothing, and eye protection when applying foam insulation.
 - .3 Workers must not eat, drink or smoke while applying foam insulation.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.06 SITE CONDITIONS

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

2 PRODUCTS

2.01 MATERIALS

- .1 Foamed-in-place insulation: Class 1, single-component polyurethane foam conforming to CAN/ULC S710.1, with flame spread rating of 20 and smoke developed 25. Must be ozone friendly and containing no fluorocarbons. Density of (20.8 to 28.8 kg/cu.m.) (1.3 to 1.8 lbs./cu.ft.) and minimum (RSI-value of 0.79 per 25 mm) (R-value of 4.5 per 1") thickness. VOC limit is 250 g/L. (Classified as Special Purpose Contact Adhesive).
- .2 Primers: in accordance with manufacturer's recommendations for surface conditions.
 - .1 VOC limit to SCAQMD Rule 1113.
- .3 Thermal Barrier: spray-applied fire-retardant overcoat meeting applicable requirements of the NBC for thermal barrier of foamed plastic.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's printed installation instructions, technical datasheets, and details.

3.02 PREPARATION

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

3.03 GENERAL APPLICATION REQUIREMENTS

- .1 Apply insulation to clean surfaces in accordance with CAN/ULC S705.2 and manufacturer's printed instructions.
- .2 Use primer where recommended by manufacturer.

3.04 HOLLOW STEEL DOOR FRAMES

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

3.05 EXTERIOR WINDOW AND DOOR FRAMES

- .1 Install foam in place insulation around all exterior window frames to maintain continuity of the thermal barrier, after air barrier has been installed and sealed to windows.
- .2 Ensure that foam completely fills spaces, without voids, and that foam is continuous at corners.

3.06 PROTRUSIONS THROUGH AIR SEAL

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

3.07 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.07 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Cut back excess foam in place insulation once cured, flush with surrounding surfaces, or recess back for application of sealant as specified in Section 07 92 00.
- .5 Upon completion of foam-in-place insulation work, clean adjacent surfaces of overspray and dusting.
- .6 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 05 50 00 - Metal Fabrications.
- .3 Section 06 10 00 - Rough Carpentry.
- .4 Section 07 21 13 - Board Insulation.
- .5 Section 07 61 00 - Sheet Metal Roofing.

1.02 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .2 ASTM D882-12, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - .3 ASTM D903-98(2010), Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
 - .4 ASTM D1970/D1970M-17, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - .5 ASTM D5034-09(2013), Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
 - .6 ASTM E84-16, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .7 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .8 ASTM E1745-17, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
 - .9 ASTM E2357-11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- .2 American Association of Textile Chemists & Colorists (AATCC)
 - .1 AATCC TM127:2014, Water Resistance: Hydrostatic Pressure Test.
- .3 International Code Council (ICC) Evaluation Services (ES)
 - .1 ICC-ES AC308 Acceptance Criteria for Water-resistive Barriers, 2015.

- .2 ICC-ES AC58 Acceptance Criteria for Adhesive Anchors in Masonry Elements, 2015.
- .4 Air Barrier Association of America (ABAA) / National Air Barrier Association (NABA)
 - .1 ABAA Section 072761 Self-Adhered Sheet Air Barrier.
- .5 Sealant Waterproofing and Restoration Institute (SWRI)
 - .1 Sealants: The Professionals' Guide, 2013.
- .6 Underwriters Laboratories of Canada(ulc)
 - .1 CAN/ULC 741-08, Standard for Air Barrier Materials - Specification.

1.03 ACTION AND INFORMATION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and datasheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit statement from manufacturer(s), indicating products supplied under this Section are compatible with one another and with products previously installed under the work of related Sections.
 - .3 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Departmental Representative.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and replacement procedures at end of lifecycle.

- .4 Manufacturer's Field Reports: submit manufacturer's written reports within 3-days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Avoid spillage: immediately notify Departmental Representative if spillage occurs and start clean up procedures.
- .3 Clean spills and leave area as it was prior to spill.

1.05 AMBIENT CONDITIONS

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

1.08 SEQUENCING

- .1 Sequence work in accordance with Construction Progress Schedule.
- .2 Sequence work to permit installation of materials in conjunction with related materials and seals.
- .3 Overlap (shingle) materials to direct water down and away from the structure.

1.09 WARRANTY

- .1 For the work of this Section, the 12 month warranty period prescribed in Subsection GC 32.1 of General Conditions "C" is extended to 24 months.

2 PRODUCTS

2.01 SINGLE SOURCE

- .1 Single Source Requirement: for each product specified, supply from a single manufacturer of that product.
- .1 Systems shall be compatible with adjacent systems, and capable of effective overlap and tie-ins achieving continuous vapour retarder and air barrier performance.

2.02 HIGH TEMPERATURE ROOF UNDERLAYMENT (MEMBRANE WEATHERPROOFING)

- .1 Refer to Section 07 05 27.01 - Common Work Results for Air Barriers and Vapour Retarders.
- .2 Substrate: sheathing to Section 06 10 00.
- .3 High Temperature Roof Underlayment: self-adhered composite membrane consisting of a high softening point, SBS rubberized asphalt compound integrally laminated to a cross-laminated polyethylene film with anti-slip coating. Membrane shall meet or exceed the following minimum physical properties and tested values:
 - .1 Thickness: 1 mm.
 - .2 Minimum Application Temperature: $\geq 5^{\circ}\text{C}$.
 - .3 Elongation, to ASTM D412 Die C Modified, tested to ultimate failure of rubberized asphalt: 250%.
 - .4 Minimum Tensile Strength, to ASTM D412: $\geq 4128 \text{ kN/M}^2$.
 - .5 Flow @ 110°C , to ASTM D1970: None.
 - .6 Flexibility at -43°C , to ASTM D1970: $< 0.004 \text{ cfm/ft}^2$.
 - .7 Water Vapour Transmission, to ASTM E96: 2.8 ng/Pa.s.m^2 .

2.03 SELF ADHERED WATER-RESISTIVE AIR BARRIER

- .1 Refer to Section 07 05 27.01 - Common Work Results for Air Barriers and Vapour Retarders.

- .2 Membrane:
 - .1 Self-Adhered Vapour-Permeable Water-Resistive Air Barrier: self-adhering reinforced modified polyolefin tri-laminate sheet air barrier membrane for wall construction, specifically designed to be water-resistant and vapour-permeable. Membrane shall meet or exceed the following minimum physical properties and tested values:
 - .1 Thickness: 1.0 mm (40 mils),
 - .2 Air leakage: <0.005 L/s.m² @ 75 Pa to ASTM E283-91,
 - .3 Tested to ASTM E 2357 for the air barrier assembly,
 - .4 Water vapour permeance: 1.71 ng/Pa.m².s (0.03 perms) to ASTM E96,
 - .5 Low temperature flexibility: -30 °C to CGSB 37-GP-56M,
 - .6 Elongation: 200% to ASTM D412-modified.
 - .7 Flame Spread Index, to ASTM E84: 0, Class A.
 - .8 Smoke Developed, to ASTM E84: 105, Class A.
 - .9 NFPA 285 standard fire test method in various wall assemblies: Complies.

2.04 VAPOUR-PERMEABLE WATER-RESISTIVE AIR BARRIER

- .1 Refer to Section 07 05 27.01 - Common Work Results for Air Barriers and Vapour Retarders.
- .2 Substrate:
 - .1 Walls: sheathing board to Section 06 10 00.
 - .2 Metal Roofing: sheathing board to Section 06 10 00.
- .3 Self-Adhered Vapour-Permeable Water-Resistive Air Barrier: self-adhering reinforced modified polyolefin tri-laminate sheet air barrier membrane for wall construction, specifically designed to be water-resistant and vapour-permeable. Adhesive backing to be protected with 3-piece release film. Membrane shall meet or exceed the following minimum physical properties and tested values:
 - .3 Thickness: 0.58 mm (23 mils)
 - .4 Water Vapour Permeance (ASTM E96): 1658 ng/Pa.m².s., (29 perms)
 - .5 Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass

- .6 Air Permeance (ASTM E2178): Pass
- .7 Nail Sealability (ASTM D1970): Pass
- .8 Dry Tensile Strength (ASTM D882):
 - .1 41 lbf /182N MD
 - .2 29 lbf /129N CD
- .9 Surface Burning Characteristics (ASTM E84):
 - .1 Flame Spread: Class A
 - .2 Smoke Development: Class A
- .10 Low Application Temperature: -7 degrees C (20 degrees F)

2.05 UNDER-SLAB VAPOUR RETARDER

- .1 Vapour Retarder for installation under concrete slabs shall meet or exceed the requirements of ASTM E1745, Class A, minimum 0.38 mm thick.
- .2 Accessories: Provide the manufacturer's recommended seam tape and accessories as required for a complete installation.

2.06 FOAMED-IN-PLACE INSULATION AND JOINT SEALANTS

- .1 Foam-in-place insulation: to Section 07 21 19 - Foamed-in-Place Insulation.
- .2 Joint Sealants: to Section 07 92 00 - Joint Sealants.
- .3 Primers: as recommended by manufacturer for substrate and conditions.

2.07 ACCESSORIES

- .1 Membrane Tape and Sealants: structural adhesive sealants and tape for variable vapour-permeable vapour retarder membrane capable of permanently sealing joints without losing bond or adhesion over time.
- .2 Thinners and cleaners: as recommended by membrane manufacturer.
- .3 Attachments: hot dipped galvanized steel bars and anchors.

- .4 Transition Membranes: Manufacturer's recommended reinforced self-adhesive, compatible with adjacent air and vapour membranes, self-adhering sheet waterproofing and wall materials specified in this Section.
- .5 Through-wall flashing membrane (self-adhering) shall be manufactured by Self-Adhered Vapour-Permeable Water-Resistive Air Barrier manufacturer; an SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film.
- .6 Self-adhering membrane for all window jambs, headers, door openings, inside and outside corners, and other transitions shall be pre-cut Window & Door Flashing manufactured by Self-Adhered Vapour-Permeable Water-Resistive Air Barrier manufacturer; a self-adhering reinforced modified polyolefin tri-laminate sheet air barrier membrane for wall construction, specifically designed to be water resistant and vapour permeable.
- .7 Adhesive Primers and Adhesives: all primers and adhesives shall be manufactured by the air barrier system manufacturer and compatible with systems installed:
 - .1 Adhesive Primer for primary self-adhering water resistive air barrier membrane, self-adhering transition membrane and SBS modified bitumen membranes at all temperatures; synthetic rubber based adhesive, quick setting.
 - .2 Adhesive with low-VOC content for self-adhering membranes at all temperatures; synthetic rubber based adhesive, quick setting.
 - .3 Primer for self-adhering membranes at temperatures above -4°C; polymer emulsion based adhesive, quick setting.
- .8 Penetration and Termination Sealants: all penetration and termination sealants shall be manufactured by the air barrier system manufacturer and compatible with systems installed.
 - .1 Termination Sealant shall be moisture cure, medium modulus polymer modified sealing compound.
 - .2 Termination sealant shall be a non-sag, non-staining, one-component, high performance thermoplastic sealant.

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's printed installation instructions, technical datasheets, guide specifications and details.

3.02 GENERAL

- .1 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.
- .2 Work shall meet or exceed the requirements of ABAA Section 072761 Self-Adhered Sheet Air Barrier, latest edition.

3.03 EXAMINATION

- .1 Verify that surfaces and conditions are ready to accept work of this section.
- .2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Report unsatisfactory conditions to Departmental Representative in writing.
- .4 Do not start work until deficiencies have been corrected.
 - .1 Beginning of Work implies acceptance of conditions.

3.04 ENVIRONMENTAL REQUIREMENTS

- .1 All membrane shall be installed at surface and ambient temperature of 5 degrees C or above, in dry weather conditions.
- .2 For applications below 5 degrees C consult membrane manufacturer's technical representative for instructions and, obtain Departmental Representative's approval before proceeding with Work.
- .3 Do not install during rain or inclement weather. Do not install materials over frost covered or wet surfaces.
- .4 Store material above 50°F (10°C) prior to installation.

- .5 Cut manageable lengths and lay out material in the sun prior to installation.
- .6 Use a manufacturer-approved primer/adhesive to aid in adhesion.

3.05 SUBSTRATE CONDITIONS

- .1 Appropriate substrate conditions are critical to obtain proper adhesion; ensure surfaces are ready for product installation and are in accordance with manufacturer's installation guideline.
- .2 Do not install until substrate conditions are in accordance with this installation guideline.
- .3 Substrate must be continuous and secure.
- .4 Mechanical fasteners used to secure substrate shall be set flush with substrate and secured into solid backing.
- .5 Adjacent or multiple pipe penetrations through sheathing should be sufficiently spaced apart, typically 100-150 mm, to allow proper detailing of individual pipes.

3.06 PREPARATION

- .1 Ensure all required preparatory work is complete prior to applying air barrier assembly products.
- .2 Surfaces shall be sound, dry to touch, clean, and free of oil, grease, dirt, excess mortar, frost, laitance, loose and flaking particles, and other contaminants.
- .3 Repair or replace products that are not installed to create a continuous and secure substrate.
- .4 Protect adjacent surfaces to prevent spillage and overspray.
- .5 Cap and protect exposed back-up walls against wet weather conditions during and after application.
- .6 Ensure metal closures are free of sharp edges and burrs.
- .7 Prime all substrate surfaces to receive adhesive and sealants.

- .8 Prime all substrate surfaces to receive self-adhesive air barrier membrane products and accessories.

3.07 SELF ADHERED WATER-RESISTIVE AIR VAPOR BARRIER

- .1 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
- .2 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps. Promptly roll all laps and membrane with a counter top roller to affect the seal.
- .3 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
- .4 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. Refer to manufacturers' standard details.
- .5 Ensure all projections, including wall ties, are properly sealed with a caulk application of liquid air seal mastic.
- .6 Mechanically fasten membrane through securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.
- .7 Membrane applied to the underside of substrate surfaces shall receive special attention on application to ensure maximum surface area adhesion is obtained.

3.10 HIGH TEMPERATURE ROOF UNDERLAYMENT (MEMBRANE WEATHERPROOFING)

- .1 Location: install under metal roof and drainage material and over sheathing at metal roof assemblies.

- .2 Ambient and surface temperature at time of installation shall be above 5°C to achieve optimum adhesion. Lower temperatures cause self-adhesive layer to lose adhesive quality.
- .3 Adhesive-prime all substrate surfaces with adhesive primer.
- .4 Apply High Temperature Roof Underlayment beginning at low point of deck and proceed in shingle fashion. Overlap at ends and sides a minimum of 65 mm. Cover entire roof deck.
- .5 Roof Edge Application: Roll out and align manageable lengths of High Temperature Underlayment with the lower roof edge, pebbled film surfaced up. Slowly peel release paper away from membrane in 600 mm to 900 mm lengths. Press firmly in place while proceeding along roof edge. Overlap at ends and sides a minimum of 65 mm. When High Temperature Underlayment is folded over the roof edge, cover it by flashing, gutter or metal edge.
- .6 Ridge Applications: Roll out and align manageable lengths of High Temperature Underlayment, pebbled film surface up. Slowly peel release paper or film away from membrane in 600mm to 900mm lengths. Press firmly in place beginning at centre of ridge or valley. Overlap at ends and sides a minimum of 65 mm. Apply in shingle fashion on valleys.

3.11 UNDER-SLAB VAPOUR RETARDER

- .1 Prepare surfaces and install in accordance with the manufacturer's printed instructions and the requirements of ASTM E1643.
- .2 Continuous Vapour Retarder shall be installed around underground ducts in accordance with the Sheet Metal and Air Conditioning Contractors' National Association's (SMACNA) construction standards. Coordinate Work with other trades.
- .3 Lap the Vapour Retarder and seal to foundation walls.
- .4 Overlap joints 152 mm and seal with the manufacturer's seam tape.
- .5 Seal all penetrations (including pipes) with the manufacturer's pipe boot.

- .6 No penetration of the Vapour Retarder will be allowed, except for permanent utilities, unless approved in writing by Departmental Representative. Seal all penetrations as recommended by the manufacturer.
- .7 Repair damaged areas by cutting patches of Vapour Retarder, overlapping the damaged area 152 mm, and taping all four sides with tape.

3.12 FIELD QUALITY CONTROL

- .1 Make notification when sections of Work are complete to allow review prior to covering air barrier systems.
- .2 At fully adhered air-vapour barrier membrane application locations, perform pull-off tests on applied sheet membrane air-vapour barrier material to ensure adequate adhesion of the membrane to the substrate using equipment specifically design for that purpose. Pull-off adhesion shall be ≥ 15 psi to ASTM D4541 or ASTM D7234 depending on substrate (modified, 100 mm wood puck). Ensure that adhesion test results meet these criteria before Work by other trades proceeds. Re-do work as required to ensure adequate adhesion.
 - .1 Perform at least one test randomly per every 25 m² as directed by Departmental Representative; repair test areas at no extra cost to Owner.
- .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of work in handling, installing, applying, protecting, and cleaning products, and submit Manufacturer's Field Reports to Departmental Representative.
 - .2 Provide manufacturer's field services consisting of attendance of pre-installation meeting, product use recommendations, and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .4 Departmental Representative shall review installed membranes for continuity of membrane installation prior to placement of insulation.

3.13 CLEANING

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

3.14 PROTECTION OF WORK

- .1 Protect finished work in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished work is protected from climatic conditions.
- .4 Cover membranes within thirty days of installation
- .5 Damp substrates shall not be inhibited from drying out. Do not expose the backside of the substrate to moisture or rain.
- .6 Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed air barrier installations.
- .7 Drying time varies depending on temperature and relative humidity. At a temperature of 20 degrees C and 50% RH, protect the work against wet weather conditions for a minimum of 24-hours; consult with manufacturer for other weather conditions.
- .8 Cover with permanent cladding systems within 90 days of membrane installation.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 06 10 00 - Rough Carpentry.
- .2 Section 07 27 00.01 - Air Barriers and Vapour Retarders.
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .4 Section 07 92 00 - Joint Sealants.

1.02 REFERENCES

- .1 Aluminum Association (AA)
 - .1 DAF-45-R03, Designation System for Aluminum Finishes - 9th Edition.
 - .2 ASM-35-October 2000, Specifications for Aluminum Sheet Metal Work in Building Construction, Section 5.
- .2 ASTM International
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
 - .2 ASTM A755/A755M-11, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - .3 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum Zinc Alloy Coated by the Hot Dip Process.
 - .4 ASTM D523-08, Standard Test Method for Specular Gloss.
 - .5 ASTM D822/D822M-13 Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - .6 ASTM E2112-07(2016), Standard Practice for Installation of Exterior Windows, Doors and Skylights.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
- .4 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual.
- .5 CSA Group (CSA)

- .1 CSA A123.3-05(2010), Asphalt Saturated Organic Roofing Felt.
- .2 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members.
- .6 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 National Building Code of Canada 2010(NBC).
- .9 National Research Council Canada (NRC)/Institute for Research in Construction (IRC) - Canadian Construction Materials Centre (CCMC)
 - .1 CCMC Registry of Product Evaluations.
- .10 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 Architectural Sheet Metal Manual, 7th Edition, 2012.
- .11 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992.
- .12 Underwriters Laboratories (UL)
 - .1 UL 1703-02, Flat-Plate Photovoltaic Modules and Panels.

1.03 DESIGN REQUIREMENTS

- .1 Design roof system to resist:
 - .1 Snow loads and snow build-up and rain load, expected in this geographical region NBCC climatic data, 50 year probability.
 - .2 Wind loads, positive and negative, expected in this geographical region NBCC climatic data, 50 year probability.
 - .3 Dead load of roof system.
 - .4 If the roof system is to be designed as a shear diaphragm, then the factored shear design loads "Q" and the flexibility factors "F" must be shown on the structural drawings.
- .2 Deflection of the roof system is not to exceed 1/180th of the span for the specified live loading.

- .3 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - .1 Temperature Change (Range): 20 deg C, ambient;
40 deg C, material surfaces.

1.04 ACTION AND INFORMATION 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 sheet metal roofing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Proof of manufacturer's CCMC listing and listing number.
 - .3 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .1 Indicate arrangement of pre-finished Roof Sheet, including joints, types and locations of supports, fasteners, flashing, gutters, mitres, and all metal components related to the roof installation. Include for underlayment as part of the roof system.
- .4 Samples:
 - .1 Submit samples of finished metal roof sheet for review by the Departmental Representative, prior to fabrication.

1.05 QUALITY ASSURANCE

- .1 Mock-ups:
 - .1 Submit mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Fabricate sample roofing panel assembly, minimum 2 panels wide from ridge to eave, using identical project materials and methods to include typical seam.
 - .3 Mock-up will be used:
 - .1 To evaluate quality of work, substrate preparation, operation of equipment, and material application.
 - .4 Locate where directed.
 - .5 Allow 24-hours for inspection of mock-up by Departmental Representative before proceeding with sheet metal flashing work.
 - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work.
 - .7 Approved mock-up may remain as part of finished Work.

1.06 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect sheet metal roofing from damage and nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.07 WARRANTY

- .1 For the work of this Section, the 12 month warranty period prescribed in Subsection GC 32.1 of General Conditions "C" is extended to 24 months.

2 PRODUCTS

2.01 ROOF SUBASSEMBLY

- .1 Steel deck:
 - .1 Refer to structural drawings and specifications.
- .2 Sheathing: Refer to Section 06 10 00 - Rough Carpentry
- .3 Vapour Retarder:
 - .1 Refer to Section 07 27 00.01 - Air Barriers and Vapour Retarders: Self-Adhered Vapour-Permeable Water-Resistive Air Barrier.
 - .2 Location: installed over coverboard.
- .4 Insulation:
 - .1 Refer to Section 07 21 13 - Board Insulation.
 - .2 Location: installed over Vapour Retarder
- .5 Sheathing: Refer to Section 06 10 00 - Rough Carpentry
- .6 Self Adhered Water-Resistive Air Barrier: Refer to Section 07 27 00.01 - Air Barriers and Vapour Retarders.

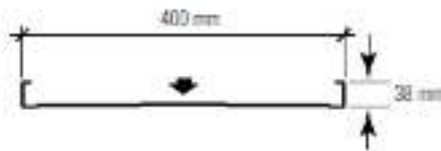
2.02 SYSTEM COMPONENTS

- .1 Allow time in construction schedule to custom order products specified herein, which may be non-standard.
- .2 Clip System:
 - .1 Thermally responsive clips to be fabricated from a minimum of 0.61 mm aluminum-zinc alloy steel with minimum AZ180 galvanized coating, designed to accommodate expansion and contraction of the roof sheet.
 - .2 Roof Fasteners: As specified by manufacturer to resist wind uplift and sliding snow forces.
- .3 Aluminum-zinc alloy (55% Al / 45% Zn) coated steel sheet: to ASTM A792/A792M, commercial quality, grade 37 with AZ180 coating, extra smooth surface, chemically treated (passivated) for unpainted finish and coated both sides with factory-applied clear organic resin coating, 0.61 mm minimum base metal thickness.

- .4 Seam Cap:
 - .1 Seam Caps: Provide seam caps for full length of the roof panel with sealant of non-skinning, non-drying sealant on the unexposed side. Caps to be mechanically seamed onto panel side-laps. Fabricated from AZ180 galvanized (aluminum-zinc coated) sheet steel conforming to ASTM A653M structural quality Grade 230 having a minimum nominal core thickness 0.61 mm. Finish and colour to match roof sheet.

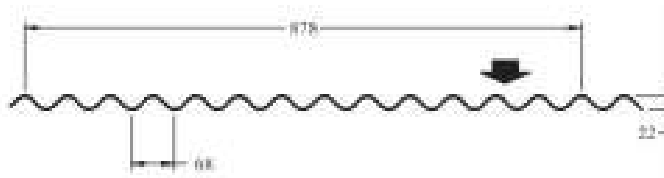
2.03 ROOF/WALL PANEL 1 PROFILE

- .1 Profile of roof panels shall be same as or similar to the following:
 - .1 T-style mechanically seamed side-lap roofing panels with intermediate rib; designed for slopes as low as 2:12 (9.46 degrees); 400 mm wide panels; end ribs 38 mm high; 95 mm wide intermediate rib, centered, with 150 mm either side.



2.04 WALL PANEL 2 PROFILE

- .1 Profile of roof panels shall be same as or similar to the following:
 - .1 style mechanically fastened panels with corrugated rib, minimum .45 mm thickness.



2.05 ACCESSORIES

- .1 Supply components required for complete roofing system assembly, including trim, coping, fascia, soffit and soffit moulding, corner units, premanufactured vented ridge cap and closures, clips, flexible and pre-moulded flashing, sealants, gaskets, fillers, closure strips, and similar items as required; match material and finish of metal roofing system.

- .2 Isolation coating: alkali-resistant bituminous paint.
- .3 Plastic cement: to ASTM D4586/D4586M.
- .4 Sealant/caulking: neutral-cure silicone sealant, to ASTM C920 and ASTM C719 Class 50; \pm 50% movement capability.
- .5 Cold-applied rubber asphalt joint sealing compound: Cold-Applied Rubberized-Asphalt Sealer.
- .6 Fasteners: aluminum zinc alloy coated, suitable for structural deck material.
- .7 Washers: of same material as sheet metal, minimum 1 mm thick with rubber packing.
- .8 Sheet metal flashing, curbs, and trim: prefinished flashing materials to match roofing materials, except 0.8 mm minimum base metal thickness.
- .9 Penetration flashing: pre-manufactured silicone flashings able to withstand constant temperatures at the roofline of -50°C (-58°F) to 200°C (392°F) and up to 250°C (482°F) intermittently.
- .10 Touch-up coating materials: as recommended by sheet metal roofing manufacturer.

2.06 FABRICATION

- .1 Fabricate aluminum-zinc alloy sheet metal system in accordance with AA ASM-35.
- .2 Fabricate roof components to comply with dimensions, profiles, gauges and details as shown on the shop drawings, including fascia and soffit panels and all companion flashing.
- .3 Fabricate all components of the system in the factory, ready for field installation.
- .4 Provide roof sheet and all accessories in longest practicable length to minimize field lapping of joints.

3 EXECUTION

3.01 EXAMINATION

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

3.02 COMPLIANCE

- .1 Comply with Warranty requirements, roofing manufacturer's printed installation instructions, and CRCA Roofing Application Standards Manual guidelines.
- .2 All installation work shall be carried out by trained erection crews in accordance with roofing manufacturer's and these specifications.

3.03 COORDINATION

- .1 Cooperate and coordinate with other trades as required to ensure continuity of waterproofing, vapour retarder and air barrier systems.

3.04 PREPARATION

- .1 Install subassembly materials in accordance with manufacturer's technical datasheets and printed installation instructions and illustrations.

3.05 INSTALLATION

- .1 Roof Materials:

- .1 Membrane Weatherproofing: Install Membrane Weatherproofing fully adhered to substrate according to manufacturer's recommendations. Ensure all joints are properly lapped and sealed. Tie-in with barriers on adjacent surfaces to ensure airtight construction. Provide a continuous seal around all openings in the insulated metal roof system.
- .2 Clip System: Attach Tradition clips using fasteners as recommended by the manufacturer, to suit the substrate.
- .2 Roof Panel Installation
 - .1 Install exterior prefinished roof panels on panel support clips, using manufacturer's proper construction procedure. Ensure metal roofing sheet side-lap is positively retained by clips, and proper sheet coverage is maintained.
 - .2 Install the seam-cap at all side laps as shown on the approved shop drawings. Add sealant as required. Mitre snap-cap as required to resist water entry.
 - .3 Where indicated on approved shop drawings, secure the end-lap of metal roofing sheets in accordance with the manufacturers specifications and details to provide a weather-tight seal. Exposed fasteners to match colour of the roof sheet.
 - .4 Provide notched and formed closures, sealed against weather penetration, at changes in pitch, and at ridges and eaves, where required.
 - .5 Install all companion flashing {gutters}, {ventilators} as shown on the shop drawings. Use concealed fasteners when possible. Exposed fasteners to match colour of roof sheet.
- .3 Other Work:
 - .1 Complete installation of roofing as required in accordance with roofing manufacturer's printed installation instructions and illustrations; ensure a complete weatherproof installation tied-in to adjacent assemblies as required.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.07 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 06 10 00 - Rough Carpentry.
- .2 Section 07 61 00 - Sheet Metal Roofing.
- .3 Section 08 11 00 - Metal Doors and Frames.
- .4 Section 08 44 13 - Glazed Aluminum Framing Systems.

1.02 REFERENCES

- .1 The Aluminum Association Inc. (AAI)
 - .1 AAI ASM35-2000 Specifications for Aluminum Sheet Aluminum Work in Building Construction.
 - .2 AAI DAF45 03, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M 15e1, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
 - .2 ASTM A792/A792M-10(2015) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - .3 ASTM B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric)
 - .4 ASTM D4586-07(2012) e1, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 - .5 ASTM F1667-15, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .3 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 2012.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA A123.3-05(R2015), Asphalt Saturated Organic Roofing Felt.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

- .6 Sheet Aluminum and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA Architectural Sheet Aluminum Manual, 7th Edition.

1.03 ACTION AND INFORMATION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Shop drawings: submit drawings showing proposed method of shaping, forming, jointing, fastening, and application of flashing and sheet metal work, stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
- .4 Samples:
 - .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
 - .2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

1.04 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building trades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 General: Fabricate and install sheet metal flashing and trim in accordance with SMACNA Architectural Sheet Metal Manual, and to the CRCA Roofing Specifications Manual.
- .3 Sheet Metal Flashing: Comply with the applicable recommendations and guidelines of the CRCA Canadian Roofing Reference Manual, CRCA Specification Manual, and applicable CRCA technical bulletins.
- .4 Aluminum Flashing: Comply with the applicable recommendations and guidelines of the CRCA Canadian Roofing Reference Manual, CRCA Specification Manual, and applicable CRCA technical bulletins.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

2 PRODUCTS

2.01 SHEET METAL MATERIALS

- .1 (General Use) Aluminum-zinc alloy (55% Al / 45% Zn) coated steel sheet: to ASTM A792/A792M, commercial quality, grade 37 with AZ180 coating, extra smooth surface, chemically treated (passivated) for unpainted finish and coated both sides with factory-applied clear organic resin coating, 0.55 mm minimum base metal thickness.

- .2 (Flashing in direct contact with concrete or masonry substrates) Hot dip galvanized steel sheet (pre-finished): Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.
 - .1 Class: F1S-Finished one side (manufacturer's standard prime finish on unexposed face).
 - .2 Thickness: minimum 0.55 mm base metal thickness.
 - .3 Surface: regular spangle.
 - .4 Corrosion-Resistant Coating: Hot dip galvanized steel sheet, to ASTM A653/A653M with Z275 designation zinc coating.
 - .5 Manufacturer's Coil Coating System: silicone modified polyester (SMP) system, applied over a zinc phosphate pre-treatment, and high-performance, flexible primer.
- .3 At aluminum window and hollow metal door framing locations, formed aluminum flashing: Tension levelled, commercial quality aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 5005-H14 and as follows:
 - .1 Thickness: minimum 1.2 mm.
 - .2 Aluminum finish: match window framing finish.
 - .3 Unexposed aluminum: Mill finish.
- .4 Form flashing, coping, and fascia to profiles indicated or as required to achieve the design intent illustrated on the Drawings.

2.02 FINISHES

- .1 Colours shall be selected by Departmental Representative from manufacturer's full range, except as follows:
 - .1 Aluminum window flashing: match window framing finish.
 - .1 Appearance and properties of anodized finishes shall be Aluminum Association Architectural Class 1.

2.03 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Roofing Cement: to ASTM D4586, asphalt-based, asbestos free.
- .3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

- .4 Sealants: as indicated in Section 07 92 00 - Joint Sealants.
 - .1 Mastic Sealant: polyisobutylene; non hardening, non skinning, non drying, non migrating sealant.
 - .2 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00.
- .5 Fasteners: of same material as sheet metal, to ASTM F1667, as recommended by sheet metal manufacturer; aluminum-zinc alloy galvanized or aluminum as required. Finish of exposed parts to match material being fastened.
- .6 Washers: of same material as sheet metal, 1 mm thick with rubber packing.
- .7 Solder: to ASTM B32, alloy composition Sn.
 - .1 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .8 Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet metal.
- .9 Metal Accessories: Provide non-corrosive sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work. Accessories shall match or be compatible with material being installed; size and thickness as required.
- .10 Touch up paint: as recommended by prefinished material manufacturer.

2.05 FABRICATION

- .1 Roofing: Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details and as indicated.
- .2 Galvanized (zinc or aluminum-zinc as specified) sheet steel: Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.

- .3 Aluminum flashing (mill finished, pre-finished or anodized as specified) and other sheet aluminum work: Fabricate in accordance with AAI Aluminum Sheet Metal Work in Building Construction. Back-paint aluminum flashing in contact with concrete or masonry, or dissimilar metal, with bituminous paint prior to installation.
- .4 Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .6 Make flashings of prefinished metal for cap flashings as specified above for flashings adjacent to roofing at roof edges and area dividers, and where exposed to view from ground or an interior public area.
- .7 Make flashings for other locations of hot dip galvanized metal, Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating, as follows:
 - .1 Use 0.61 mm metal core thickness except where otherwise specified.
 - .2 Use 0.84 mm metal core thickness for concealed fastening strips.
 - .3 Use material of thickness specified for other applications, and as indicated.
- .8 All straight run joints shall be S-Lock in roof flashings.
- .9 Make joints to allow for thermal movement, space S Lock joints at 1500 mm maximum centers.
- .10 Make flashings for building into masonry and concrete so that joints can be lapped 100 mm or more.
- .11 Strengthen free edges of metal flashings by folding to form a 13 mm hem.
- .12 Make flashings to curbs, walls, and parapets a minimum of 100 mm high, where possible.
- .13 Where curb mounted roof penetrations are not required, provide premanufactured flashing sleeves and collars for all pipes and conduit extending through the roof, meeting roofing manufacturer's warranty requirements.

- .14 Make joints for corners and intersections with standing seams except where exposed of pre finished metal when seams shall be flat locked.
- .15 All bends machine made. Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Install sheet metal flashing and trim in accordance with applicable CRCA 'FL' series details, and as indicated.
- .2 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.
- .3 Do not install metal flashings over flexible roof flashing until the flexible roof flashing has been inspected and approved by the Consultant. This includes curbs for roof mounted items.
- .4 Do not use exposed fastening unless indicated, or concealed fastening is not possible. Locations and methods shall be approved by Departmental Representative.
- .5 Anchor units of work securely in place, providing for thermal expansion of metal units. Conceal fasteners where possible and set units true to line and level.
- .6 Install work with laps, joints, and seams that are watertight and weatherproof.

- .7 Install exposed sheet metal work that is without oil canning, buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weatherproof performance.
- .8 Install surface mounted reglets true and level, and caulk top of reglet with sealant. Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .9 Install pans where shown around items projecting through roof membrane.
- .10 Insert metal flashing into reglets or under cap flashing as indicated to form weather tight junction.
- .11 Fasten metal base flashing to walls or upstands along top of flashing. Do not secure to cant strip. Form lapped corner joints. Extend rolled edge of base flashing approximately 25 mm on to roof from toe of cant, and rest on top of roof surface.
- .12 Roof Edge Flashing: Secure metal flashing at roof edges at a maximum of 610 mm o.c.
- .13 Expansion Provisions:
 - .1 Provide for the thermal expansion of exposed sheet metal Work.
 - .2 Space movement joints at maximum of 3050 mm, with no joints allowed within 610 mm of a corner or intersection.
 - .3 Form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant (concealed within joints) where lapped or bayonet type expansion provisions in the work cannot be used or are not sufficiently weatherproof and waterproof.
- .14 Sealed Joints:
 - .1 Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant.
 - .2 Fill joint with sealant and form metal to conceal sealant completely.
 - .3 Use joint adhesive for non-moving joints specified.

- .15 Lock Seams:
 - .1 Fabricate non-moving seams in sheet metal with flat lock seams.
- .16 Separations:
 - .1 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with bituminous paint or other permanent separation as recommended by the manufacturer.
 - .2 Underlayment: Install a slip-sheet of No. 15 perforated asphalt saturated felt and a course of polyethylene underlayment where installing sheet metal directly on cementitious or wood substrates. Secure in place and lap joints minimum 100 mm.
 - .3 Bed flanges of work in a thick coat of roofing cement where required for waterproof performance.
- .17 Counter Flashing:
 - .1 Coordinate installation of counter flashing with installation of assemblies being protected by counter flashing.
 - .2 Secure in a waterproof manner.
 - .3 Lap counter flashing joints a minimum of 50 mm and bed with sealant.
- .18 Flashing and metal closures: where flashing and metal closures overlap at any point in a system, ensure that flashing and closures are shingled over top lower sheet(s) and not behind, so that water is directed, and drains, to the exterior.
- .19 Install pans, where shown around items projecting through roof membrane.

3.03 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.04 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.

- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 06 10 00 - Rough Carpentry.
- .2 Section 07 61 00 - Sheet Metal Roofing.
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .4 Section 08 11 00 - Metal Doors and Frames.
- .5 Section 08 44 13 - Glazed Aluminum Framing Systems.
- .6 Section 09 21 16 - Gypsum Board Assemblies.

1.02 REFERENCES

- .1 ASTM International
 - .1 ASTM C834 -14, Standard Specification for Latex Sealants.
 - .2 ASTM C919 12, Standard Practice for Use of Sealants in Acoustical Applications.
 - .3 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
 - .4 ASTM C1193-16, Standard Guide for Use of Joint Sealants.
 - .5 ASTM C1330-02(2013) Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
 - .6 ASTM C1521-13 Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 - .7 ASTM D2240-15, Standard Test Methods for Rubber Property, Durometer Hardness.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.03 COORDINATION

- .1 Coordinate work of this specification section with interfacing and adjoining work for proper sequencing of each installation and to provide positive weather resistance, durability of the work, and protection of materials and finishes.

1.04 ACTION AND INFORMATION SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Manufacturer's product to describe:
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .3 Submit 2 copies of WHMIS MSDS.
- .3 Samples:
 - .1 Submit 2 samples of each type of material and colour.
 - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
 - .1 Submit instructions to include installation instructions for each product used.

1.05 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.

1.06 DELIVERY, STORAGE AND HANDLING

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

- .1 Store materials off ground, protected from the elements, in dry location and in accordance with manufacturer's recommendations.
- .2 Store and protect joint sealants from damage.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.07 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.08 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.
- .2 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

2 PRODUCTS

2.01 GENERAL

- .1 Use materials as received from manufacturer without additives. Use one manufacturer's product for each Type specified. Where sealant applications cross or contact each other, ensure compatibility, maintenance of physical properties and performance characteristics, and continuity of seal.
- .2 Joint sealants and caulking shall be commercial-grade.
- .3 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .4 When low toxicity caulks are not possible, confine usage to areas which off-gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.
- .5 Unless otherwise specified, VOC content limits of sealants shall be in accordance with SCAQMD Rule 1168 and as follows:
 - .1 Architectural Materials:
 - .1 Sealants: VOC content limit 250 g/L.
 - .2 Sealant Primers for Non-Porous Surfaces: VOC content limit 250 g/L.
 - .3 Sealant Primers for Porous Surfaces: VOC content limit 775 g/L.
 - .2 All Other Applications:
 - .1 Sealants: VOC content limit 420 g/L.
 - .2 Sealant Primers: VOC content limit 750 g/L.

2.02 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

- .3 Where sealants require primers for suitable adhesion to substrate, use manufacturer's recommended primer.

2.03 SEALANT MATERIAL DESIGNATIONS

- .1 Type S-1: Silicone Sealant; mould and mildew resistant.
 - .1 To ASTM C920; type S; grade NS; class 100/50; use NT, M, G, and A.
- .2 Type S-2: Silicone Sealant; general construction and air-seal sealant.
 - .1 To ASTM C920: type S; grade NS; class 50; use NT, M, G, A, and O.
- .3 Type S-3: Silicone Sealant; structural glazing.
 - .1 To ASTM C920: type S; grade NS; class 25; use NT, A, G, and O.
- .4 Type S-4: Acoustical Sealant; interior, non-hardening.
 - .1 To ASTM C834 Type P, Grade -18°C.
- .5 Type S-5: Multi-component polyurethane sealant; chemical curing, exterior wall sealant.
 - .1 To ASTM C920: type M; grade NS; class 50; use T, NT, M, A, and O.
- .6 Type S-6: One-component polyurethane sealant; non-sag, for general construction.
 - .1 To ASTM C920: type S; grade NS; class 25; use NT, M, A, and O.
- .7 Type S-7: Horizontal joint sealant; two-component, self-levelling.
 - .1 To ASTM C920: type M; grade P; class 25; use T, M, O.
- .8 Type S-8: One-part moisture curing, low modulus polyurethane sealant for sealing joints in level and slightly slope surfaces conforming to ASTM C920, type S, grade P, class 50, use T, M, A, O.
- .9 Type S-9: Control joint sealant: two-component, epoxy-urethane, self-levelling, load bearing saw cut or preformed control joints.

- .10 Type S-10: Exterior door thresholds, and other Wet Areas: two-component, gun grade, slump-resistant elastomeric polyurethane sealant, specially formulated for sealing joints in water-immersion conditions, and highly resistant to biodegradation by both aerobic and anaerobic bacteria; to ASTM C920, Type M, Grade NS, Class 25, use T, NT, M, G, A, O; certified to CAN/ULC S115; Canadian Food Inspection Agency acceptance.

2.04 ACCESSORIES

- .1 Preformed compressible and non compressible back up materials that are non-staining, compatible with joint substrate, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.
 - .1 Rod Type Sealant Backings:
 - .1 ASTM C1330, Type C (closed cell material with a surface skin), Type O (open cell material) or Type B (bi cellular material with a surface skin).
 - .2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
 - .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - .4 Non adhering to sealant, to maintain two-sided adhesion across joint.
 - .2 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m3 density, or neoprene foam backer, size as recommended by manufacturer.
 - .3 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.
- .2 Primer: Non-staining type as recommended by sealant manufacturer.

- .3 Joint Cleaner: Non-corrosive solvent type recommended by sealant manufacturer for applicable substrate materials.

2.03 SEALANT SELECTION

- .1 Where no specified type of sealant is shown or specified, choose one of the sealants specified in this Section appropriate for its location and conditions as recommended by the sealant manufacturer in accordance with its warranty provisions and datasheet.
- .2 Make sealant selections consistent with manufacturer's recommendations.
- .3 Clean and prime bonding surfaces prior to applying sealants.
- .4 Use mould & mildew resistant silicone sealant Type S-1 for non moving joints in washrooms and kitchens. Do not use on floors.
- .5 Use silicone general construction sealant Type S-2 for metal-to-metal joints where no other specific sealant type specified.
- .6 Use structural glazing silicone Type S-3 for sealing glass, interior and exterior.
- .7 Use acoustical sealant Type S-4 at acoustic-purposed joints, only where it will be fully concealed, and only where no constant or consistent air pressure difference will exist across the joint.
- .8 Use multi component sealant type S-5 at masonry and concrete joints.
- .9 Use one-component polyurethane general construction sealant Type S-6 at joints other than metal-to-metal where no other specific sealant type specified.
- .10 Use multi component sealant Type S-7 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.
- .11 Use one-part sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, not subject to pedestrian and vehicular traffic.

- .12 Use control joint sealant S-9 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.
- .13 Use wet area sealant S-10 for horizontal and vertical joints, and perimeter joints, exterior door threshold plates, and other wet area applications. Use traffic grade (TG) at horizontal floor locations.

2.04 COLOURS

- .1 Sealant colour: confirm sealant selections with Departmental Representative prior to ordering materials. Colours shall be selected by Departmental Representative from manufacture's full range, and as follows:
 - .1 Sealants at masonry control joints to match mortar colour.
 - .2 Sealants at other locations to match colour of adjacent exposed material.
 - .3 Where colour match choice is unclear, Departmental Representative will decide.

3 EXECUTION

3.01 EXAMINATION

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

3.02 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.03 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.04 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.05 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.06 APPLICATION

- .1 Sealant:
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .3 Apply sealant in continuous beads.
 - .4 Apply sealant using gun with proper size nozzle.
 - .5 Use sufficient pressure to fill voids and joints solid.

- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing:
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.

3.07 FIELD ADHESION TESTING

- .1 Field test joint sealant adhesion to substrates in the presence of Departmental Representative as follows:
 - .1 Extent of Testing: test completed and cured sealant joints as follows:
 - .1 Perform 10 tests for the first 300 m of joint length for each kind of sealant and joint substrate.
 - .2 Perform 1 test for each 300 m of joint thereafter or 1 test per each floor per elevation.
 - .2 Test Method: test joint sealants according to method A, Field-Applied Sealant Joint Hand Pull Tab, Appendix X1, ASTM C1193 or Method A, Tail Procedure, ASTM C1521.
 - .1 For joints with dissimilar substrates, verify adhesion to each substrate separately. Extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - .3 Inspect tested joints and report on finding for the following requirements:
 - .1 Joint cavities filled and free of voids.
 - .2 Sealant dimensions and configurations comply with sealant manufacturer's data sheet and printed installation requirements.
 - .3 No adhesive or cohesive failure noted during pull tests per ASTM criteria. Include data on pull distance used to test each kind of product and joint substrate.

- .4 Record tests results in a field-adhesion test log. Include dates when sealants were installed, name of worker responsible in each instance, test dates, test locations, whether joints were primed or not, adhesion results and percent elongations, sealant fill, sealant configuration and dimensions.
- .5 Repair sealant test locations by applying new sealants following approved preparation and application procedures.
- .2 Evaluation of Field Adhesion Test results:
 - .1 Sealants passing ASTM pull-tests and compliant with specifications will be considered satisfactory.
 - .2 Remove sealants that fail adhesion tests or do not meet specifications, and apply in accordance with approved preparation and application requirements.
 - .3 Retest re-applied sealants until test results are satisfactory and sealant application is compliant.

3.07 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean adjacent surfaces immediately.
 - .3 Remove excess and droppings, using recommended cleaners as work progresses.
 - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.08 PROTECTION

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

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END OF SECTION