# General

**RoD SPEC NOTE:** This Section outlines the process for third-party testing of newly installed exterior enclosure elements, to verify that minimum performance requirements identified in the Contract Documents have been obtained.

**RoD SPEC NOTE:** Use the following Section on larger new builds or exterior building retrofits targeting specific energy targets.

## Summary

* + 1. The Work of this Section includes, but is not limited to the following:
       1. Provide labour, materials, Products, equipment and services to complete the exterior enclosure performance and testing Work specified herein. This includes, but is not necessarily limited, to:
          1. Below-grade construction, including foundation walls and slabs-on-grade.
          2. Above-grade construction, including:

Exterior opaque wall materials and assemblies;

Roofing systems, including steep-slope and low-slope roofing; and;

Openings and glazed assemblies including windows, doors, curtain wall and sloped glazing systems.

* + - * 1. Interface and penetration conditions (flashings, expansion joints and sealants) between each of the materials, components and systems that comprise the above and below-grade building exterior enclosure.
      1. This Section includes the general design and performance requirements for the Work of Sections which comprise the building enclosure portion of the Work. The requirements specified in this Section shall be read in conjunction with other requirements specified in Contract Documents.
      2. This Section also outlines the process for independent, third-party verification that the installed performance of the building enclosure meets or exceeds the minimum performance requirements stipulated in the Contract Documents for this Project.
         1. Provision of inspection and testing services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
         2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
         3. Use of testing to discover deficiencies will not be permitted where Contractor's quality-control procedures would make these tests unnecessary.

## References

* + 1. Definitions:
       1. Post-disaster building: This facility is classified as post disaster as defined in the OBC. Post-disaster building means a building that is essential to provision of services in event of a disaster.
       2. “Building envelope” and “building enclosure”: Means the part of the building that physically separates the exterior environment from the interior environment. It includes above-grade walls and openings, below-grade walls, roofs, and the various components and accessories used to achieve continuity and physical connections and transitions between various assemblies.
       3. “Air barrier assembly”: Means a collection of air barrier materials (i.e. self-adhered sheet air barriers, liquid applied membranes, medium density sprayed polyurethane foam, mechanically fastened commercial building wraps and board-stock air barriers) and air barrier accessories (i.e. sealants, tapes and transition membranes) assembled together to form a continuous barrier to air infiltration into the environmental separator.
       4. “Air barrier material”: Mans a primary material that controls the movement of air into and out of a building.
       5. “Air barrier accessory”: Means the materials or Products which are used to connect different air barrier materials to form a continuous air barrier assembly.
       6. “Vapour barrier”: Means material or system within the building construction assembly that impedes water vapour transmission to less than 72 ng/(s-sq.m-Pa) when tested in accordance with ASTM E96 to prevent the accumulation of moisture having potential to cause deterioration of the building enclosure.
       7. “Testing with sealed openings”: Means testing with intentional openings sealed means that mechanical openings are purposely closed off. Mechanical systems that are intended to be sealed with dampers are only be sealed by closing the damper, with no additional sealing provided. Windows and doors are left in the closed and locked position.
       8. “Enclosure-only testing”: Similar to sealed openings approach, except all mechanical penetrations are temporarily masked to completely prevent air leakage through them.
    2. Reference standards:
       1. Latest published editions of reference standards listed in this Section in effect as of the closing date and time of the Contract, including any amendments adopted, are applicable unless otherwise indicated.

## Administrative requirements

* + 1. Pre-installation meetings: Arrange pre-installation meetings attended by third-party inspection and testing company, Consultant, and Subcontractors whose Work is directly associated with or impacted by building enclosure activities prior to starting Work on the building enclosure.
       1. Quality management plan: Review Contractor's quality control plan, and confirm that approaches to quality control and quality assurance procedures are coordinated with third-party inspection and testing company monitoring and testing requirements.
       2. Document and Product review: Review Contract Documents and confirm compatibility between overlapping and adjacent components supplied and installed by multiple parties who are contributing different Products associated with the assembly of the building enclosure.
    2. Scheduling: Schedule construction of sample panels and mock-ups, and associated pre-construction testing thereof to account for site-specific installation conditions. Ensure sufficient time is accounted for to permit corrections to proposed construction methods without negatively impacting the Construction Schedule.
    3. Role of the Consultant: Consultant is the registered professional of record and is responsible for responding to the Owner's stated project requirements and providing statements of compliance to the Authorities Having Jurisdiction indicating that the objectives of building code functional statements for building enclosure performance are met.
       1. Consultant will rely on third-party inspection and testing company reports in conjunction with the Contractor's field quality control reports to provide opinion on building enclosure performance.
    4. Role of the third-party inspection and testing company: Owner will engage third-party inspection and testing company acceptable to Owner and Consultant that specializes in building enclosure testing, and that has documented experience with construction of similar extent and complexity as that required for the Project.
       1. Third-party inspection and testing company will schedule and arrange testing during construction of the building enclosure and provide observation during installation of building enclosure components in accordance with their contract with Owner.
       2. Third-party inspection and testing company must assist in establishing best-practice installation procedures for Products forming the building enclosure.
       3. Third-party inspection and testing company must assist in establishing methods for corrective action where site conditions or actual installation result in non-conforming building enclosure performance.
       4. Third-party inspection and testing company will perform testing as directed by the Owner and Consultant, and will schedule with Contractor mutually agreed timing for access to site and performance of their activities.
       5. Third-party inspection and testing company will make recommendations for correction to observed deficiencies to Consultant. Consultant will make final recommendation for any assembly modifications to Contractor.
    5. Role of the Contractor:
       1. Provision and coordination of trades, and sequence of construction to ensure total performance of building enclosure from substructure to walls and to roof, including proper insulation depths, continuity of air barrier system joints, junctures and transitions between materials, assemblies of materials, and Products.
       2. Organize preconstruction meetings between trades involved in entire building enclosure system to discuss where each trade scope begins and ends, responsibility and sequence of installation for proper insulation, waterproofing, air-tight joints, junctures, and transitions between materials, Products and assemblies of Products specified in technical trade Sections.
       3. Build mock-ups satisfactory to Consultant and third-party inspection and testing company of each assembly type including, junctures, and transitions between Products, materials and assemblies.
       4. Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify third-party inspection and testing company sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, following:
          1. Provision of access to the Work;
          2. Provision of incidental labour and facilities necessary to facilitate inspections and tests;
          3. Provision of adequate quantities of representative samples of materials that require testing or assistance in taking samples;
          4. Delivery of samples to testing laboratories;
          5. Provision of security and protection of samples and test equipment at site.

## Action submittals

* + 1. Product data: Provide in accordance with Section 01 33 00, for the following:
       1. Submit manufacturer's instructions, printed Product literature and data sheets for the exterior enclosure commissioning Work and include Product characteristics, performance criteria, physical size, finish and limitations;
       2. Include recommendations for Product application and use;
       3. Include test data substantiating that Products comply with requirements.
    2. Shop Drawings: Provide Shop Drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction:
       1. Energy simulation: Submit energy simulation data conforming to the following:

**RoD SPEC NOTE:** The following paragraphs identify examples of software programs, which should be edited to reflect software programs required on the Project.

* + - * 1. Performance of glazing: Simulated using WINDOW (latest edition) software by Lawrence Berkley Laboratories (“LBL”), or approved equivalent software.
        2. Performance of framing (opaque and glazed assemblies): simulated using THERM software by LBL, or approved equivalent software.
      1. Simulations must be carried out by a qualified simulator and summary reports must bear seal of a Professional Engineer and clearly demonstrate materials used to reduce thermal bridging in the field and at the interfaces of building enclosure assemblies.
      2. Alternatively test results based on testing in accordance with   
         AAMA 1503.1 may be submitted in lieu of energy simulation to verify performance.

## Informational submittals

* + 1. Contractor's quality control plan: Submit quality control plan before pre-construction conference, describing approach to maintaining material and installation quality including the following:
       1. Lists of third-party standards, guidelines or reference documents forming part of proposed construction best-practices used to achieve specified performance requirements;
       2. Substrate preparation and installation of air barrier and vapour retarding membranes;
       3. Treatment of transitions between building enclosure components and their penetrations (including doors, frames, glazing, flashings, louvers and other penetrations);
       4. Confirmation of compatibility between building enclosure components;
       5. Proposed list of observations and tests forming a part of Contractor's quality assurance and quality control activities;
       6. Methods for addressing corrective action plans and addressing deficient or incompatible installation procedures;
       7. Format and frequency of reports, records of pre-construction meetings and site modifications; and
       8. Proposed construction schedule indicating stages of building enclosure construction and potential dates for Consultant's, and third-party inspection and testing company's review activities.
    2. Manufacturer's certificates: Submit third-party verification stating conformance with Project requirements, including any material compatibility or limitations specific to Project conditions.
    3. Test and evaluation reports: Submit reports indicating test methods and results and stating specifically which attributes apply to the Products supplied to the Project.
    4. Manufacturer's installation instructions: Submit written installation requirements stating required workmanship practices to achieve assembly performance required for the Project.

## Closeout submittals

* + 1. Maintenance schedule: Submit summary table that indexes building enclosure components requiring maintenance and indicates frequency at which each component requires repair or replacement (i.e. replacement of sealants, gaskets, glazing units, paints or coatings and similar components).
    2. Operation and maintenance data: Submit operation and maintenance data for each component listed in aforementioned schedule including the following as a minimum:
       1. Product data sheets as specified in this Section.
       2. Extended warranty information: Include warranties for Products, equipment, components, and sub-components whose duration exceeds one year. Include warranties on components with the system they are a part of. Reference all specific operation and maintenance procedures that must be performed to keep warranty valid.
       3. Sources of material: Include reference to contact information where specific materials can be obtained.
       4. Installation and maintenance instructions: Submit information for each material, component or system.

## Quality assurance

* + 1. Mock-ups: Construct mock-ups of each assembly as specified in this Section, including junctures, transitions and interfaces to establish baseline quality for installation and workmanship.
    2. Mock-ups to evaluate enclosure-related constructability and performance, with a specific emphasis on required coordination of Subcontractors and sequencing necessary to ensure that performance of enclosure materials, components, systems, assemblies, and interfaces meets or exceeds requirements of Contract Documents.
       1. Required mock-ups: Provide “first installation” in-situ or onsite mock-up (as determined by Consultant) of each major building enclosure system, including:

**RoD SPEC NOTE:** Adjust the following paragraphs to reflect Project requirements.

* + - * 1. Each below grade underslab and vertical waterproofing system;
        2. Each type of horizontal waterproofing system enclosing occupied space below;
        3. Each type of waterproofing system used for containment of water, such as pools or holding tanks;
        4. Each substantially different type of vertical enclosure assembly (including associated air barriers, insulation, and support materials) including, but not limited to precast concrete assemblies, masonry assemblies, curtain wall and glazed assemblies, and rain screen cladding assemblies;
        5. Each low-slope and each steep-slope roofing assembly;
        6. Each expansion joint assembly.
      1. Extent of mock-ups: Ensure extent of each mock-up includes interface of various materials and systems, both between various major assemblies (e.g. foundation waterproofing connection to wall assembly) and between various materials in the same assembly (e.g. interface between window and wall).
         1. Wall mock-ups must be minimum of 10 sq. m (100 sq. ft.) and extend one full structural bay wide by one full story high plus additional height as required to connect to assemblies below and above. Ensure mock-up includes typical exterior wall-to-interior floor slab connection. In addition, conform to the following:

**RoD SPEC NOTE:** Adjust the following paragraphs to reflect Project requirements.

Curtain wall systems, entrances and windows: Minimum of one full sized unit within rough opening demonstrating installation of transition membranes, sealants and flashings.

Masonry unit panels: Assemble a test panel including placement of a single opening (window and/or door) demonstrating installation of joint sealants and flashings, and placement of vents and weeps.

Air barrier membranes: Apply air barrier membrane to minimum area of 36 sq.m (390 sq. ft), including placement of a single opening (window and/or door) demonstrating overlaps, adhesion to substrates, and compatibility with adjacent materials.

Cladding panels (each type): Assemble a test panel including placement of a single opening (window and/or door) demonstrating progressive installation, attachment to substrate, installation of insulation, joint sealants, and placement of flashings and closure strips.

* + - * 1. Roof mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include parapet or roof edge conditions, as well as typical pipe, supports, and similar penetrations.
        2. Horizontal below-grade waterproofing or slab-on-grade vapour retarder mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include edge conditions and typical penetration details.
        3. Vertical below-grade waterproofing (foundation wall waterproofing) mock-ups must include typical edge, termination, and penetration details.
      1. Sequencing requirements: Stage each component within mock-ups so that each layer of construction can be reviewed and tested as required to verify performance before succeeding layers of materials are applied.
      2. Post mock-up debrief: Arrange for post mock-up debrief meetings attended by Contractor, Owner, third-party inspection and testing company, Consultant, and Subcontractors whose Work is directly associated or impacted by building enclosure activities.
         1. Schedule debrief meeting immediately after testing results and observations of the mock-ups is completed.
         2. Incorporate lessons-learned arising from observed conditions and testing into Contractor's quality control plan.
      3. Modifications to mock-ups: Mock-ups may require modifications to account for site conditions and compatibility between adjacent materials and assemblies.
         1. Provide corrective actions as required to obtain acceptance. Repair mock-ups which are permitted to form a part of the final construction that have been damaged or that failed testing.

# Products

## Description and performance requirements

* + 1. Statement of building enclosure design intent: The design intent of this building’s enclosure is to provide exterior floor, wall, and roof assemblies which prevent uncontrolled air and vapour infiltration into the building; eliminate water infiltration (including condensation) into conditioned spaces; and provide thermal insulation continuity to minimize cold bridging. Products and assemblies used to perform these functions must be technically sound, durable and serviceable.
    2. General assembly performance:
       1. Assemblies described in Contract Documents are expected to achieve the minimum performance requirements specified in this Section as verified by inspection and testing. Performance criteria identified in this Section shall supersede other criteria identified in other parts of Contract Documents.
       2. Comply with applicable Building Code, and other regulations and requirements of authorities having jurisdiction, in design, engineering, fabrication and installation of the Work.
       3. Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.
       4. When difficult-to-construct material connections occur within building enclosure construction, advise Consultant at once so that details can be reviewed and installation methodologies confirmed. Poor installation of a difficult-to-construct detail is not acceptable.
       5. Design of building enclosure assemblies is based on "Rain Screen" principle. The definition of the rain screen principle for the purpose of these Specifications is "as advocated by National Research Council of Canada".
          1. This approach is founded on the premise that multiple-element protection is necessary in most situations to achieve effective control, by means of:

A first line of defense that minimizes rainwater passage into wall by minimizing number and size of holes and managing driving forces acting on wall;

A second line of defense that intercepts all water that gets past first line of defense and effectively dissipates it to exterior.

* + - * 1. All voids between assembly components as well as those between components and structure shall have:

Gaskets, baffles, overlaps, seals and compartmentalization as required to provide a barrier "Rain Screen" to effectively prevent excessive rainwater entry into any of building enclosure cavities but allow pressure moderation of cavity air spaces.

Low permeability vapour barriers to minimize vapour diffusion, where required.

Air barriers and seals as required to prevent entry of interior building air into building enclosure cavities, and exterior air into building. Air barriers and seals shall be able to withstand wind design pressures.

Thermal separators, isolators and seals placed to eliminate direct contact between interior humid air and a cold surface or structural component to prevent condensation and ice build-up on surfaces during cold weather.

* + 1. Air barrier continuity:
       1. This Project incorporates design principles of positive air and vapour leakage control at building enclosure line. Drawing details illustrate continuity of air barrier/vapour retarder at penetrating elements such as door, window and louver frames.
          1. In order to maintain continuity of air barrier assemblies, interfacing of various building elements requires close coordination by all trades involved with exterior building elements.
       2. Air-barrier assembly extends nominally from foundation line, vertically along exterior walls and to positively contact with roof air barrier/vapour retarder or roofing membrane as applicable. Continuity also extends to waterproofing at podium areas, and to inner surface of glazing units. Provide a continuous, unbroken and non-perforated air and vapour seal to totally enclose building enclosure and to separate interior and exterior environments.
          1. Manufacturers of window and door frames must ensure correctly designed and positioned metallic legs, extensions or recesses are provided at thermal break line to facilitate connections of rigid or flexible transition materials prior to setting these elements in their allotted openings.
          2. Penetrations of air barrier and paths of air infiltration / exfiltration must be sealed.
          3. Air barrier system shall have following characteristics:

It must be continuous, with all joints sealed.

It must be structurally supported to withstand positive and negative air pressures applied to building enclosure.

Connection shall be made between:

Foundation and walls.

Walls and windows or doors.

Different wall systems.

Wall and roof.

Wall and roof over unconditioned space.

Walls, floor and roof across construction, control and expansion joints.

Walls, floors and roof to utility, pipe and duct penetrations.

* + - * 1. Materials used for air barrier system in opaque wall assemblies shall comply with CAN/ULC S741 and shall have an air permeance not exceeding 0.02 L/(s·m2) (0.004 cfm/ft2) under a pressure differential of 75 Pa (1.57 psf) when tested in accordance with ASTM E2178.
    1. Air leakage criteria (in-situ): The air leakage of the following assemblies must not exceed the following criteria when tested in the field in accordance with ASTM E783.

**RoD SPEC NOTE:** Edit the following paragraphs highlighted below to reflect performance values required on this Project. These are common values, but are not “Standard”. These values should be adjusted on a project-by-project basis.

* + - 1. Opaque wall assemblies: less than 0.2 L/(s·m2) under a pressure differential of 75 Pa (0.04 cfm/ft2 @ 1.57 psf).
      2. Fixed glazed assemblies: less than 0.01 L/(s·m2) under a pressure differential of 300 Pa (0.002 cfm/ft2 @ 6 psf).
      3. Operable assemblies:
         1. Glazed windows, sliding doors and swing doors: less than less than 0.06 L/(s·m2) under a pressure differential of 75 Pa (0.01 cfm/ft2 @ 1.57 psf).
         2. Sectional doors: less than 2.0 L/(s·m2) under a pressure differential of 75 Pa (0.4 cfm/ft2 @ 1.57 psf).
         3. Rolling doors: less than less than 5.0 L/(s·m2) under a pressure differential of 75 Pa (1 cfm/ft2 @ 1.57 psf).
    1. Thermal performance criteria: Install insulation materials to maintain continuity of performance of the building enclosure meeting thermal resistance or thermal conductance ratings specified below:
       1. Roofing assemblies: As shown on Drawings.
       2. Opaque wall assemblies above-grade: As shown on Drawings.
       3. Curtain wall and glazed assemblies:
          1. Maximum U0.33 BTU/sq.ft·h·deg F (U1.87 W/sq.m·K)
          2. Solar Heat Gain Coefficient: Maximum 0.28
       4. Spandrel panels: As shown on Drawings.
       5. Opaque door assemblies:
          1. Maximum U0.45 BTU/sq.ft·h·deg F (U2.55 W/sq.m·K)
       6. Slabs-on-grade: As shown on Drawings.
    2. Water infiltration: There must be no uncontrolled water infiltration when following assemblies are tested in the field in accordance with the test method described in this Section.
    3. Thermal bridging: Ensure wall assembly and interface details are thermally broken and meet the OBC SB-10 requirements for continuous insulation to reduce structural connections which create thermal bridging.
       1. As a minimum, provide materials to minimize or prevent thermal bridging at the following locations and interfaces:
          1. Cladding and insulation attachment at opaque wall assemblies.
          2. At-grade transitions.
          3. Slab-edges and transitions.
          4. Glazing-to-wall transitions.
          5. Interior-to-exterior wall intersections.
          6. Assembly corners.
          7. Parapets.
          8. Roof penetrations and transitions.
          9. Exterior-to-interior structural components.

# Execution

## Examination

* + 1. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, supports, and other conditions affecting performance of the Work.

## Preparation

* + 1. Protect construction from weather and other sources of moisture that are deleterious to the tested assemblies.
    2. Repair or replace building enclosure components that are damaged as a consequence of exposure to weather conditions deleterious to the final construction.

## Workmanship

* + 1. Install materials and systems according to best-practices relating to quality of workmanship, and coordination and installation of specified Products to maintain continuity of the building enclosure.
       1. Treatment of penetrations: Use methods for making and sealing penetrations to maintain continuity of vapour, water and air control assemblies.
          1. Ensure mechanical and electrical Work scheduled installed/modified within exterior building enclosure system is properly tied into building enclosure and does not compromise performance of building enclosure.
          2. Ensure mechanical and electrical penetrations through building enclosure are sealed against air leakage and water penetration and are designed to prevent condensation within exterior building enclosure system.
          3. Ensure mechanical water piping that is installed/modified within exterior wall system is free of leaks and protected from freezing.
       2. Modification of installation: Identify installation difficulties and make modification to installation to account for site conditions that differ from manufacturer's standard detailing or testing results. Make such modifications to reduce or eliminate potential for installation deficiencies.
       3. Sequencing and compatibility: Confirm compatibility between Products provided by different parties or that are used to join dissimilar components. Sequence such transitions and overlap materials to ensure they shed water to the exterior face of the building enclosure.
       4. Workmanship: Train installers on building enclosure best-practices and provide them with update when modifications occur resulting from changes to site conditions and testing results.

## Field quality control (performance testing)

* + 1. The objective of performance testing is to demonstrate that each building enclosure system, and system-to-system interface meets or exceeds the performance requirements of the Contract Documents and the building enclosure design intent specified in this Section.
       1. Unless otherwise indicated, costs associated with initial performance testing shall be paid by Owner through cash allowance.
       2. Costs associated with re-testing caused by failure of the building enclosure tests, during mock-up review or during the construction phase, shall be the responsibility of the Contractor.
    2. Contractor's collaboration: Third-party inspection and testing company will coordinate with Contractor's schedule and make themselves aware of current Work. Third-party inspection will bring to attention of the Consultant and Contractor any observation or testing requirement forming a part of their scope of auditing services, but not less than those listed in this Section.
       1. Access to site: Contractor must provide reasonable access to the Project site, and any personnel to assist third-party inspection and testing company in performance of their service and maintain site safety.
       2. Services: Contractor must provide electrical, water or other utilities or services required by third-party inspection and testing company for performance of their Work.
       3. Scheduling and coordination:
          1. Contractor must coordinate sequence of testing activities to accommodate required inspection and testing services with minimum delay.
          2. Contractor must coordinate construction activities to avoid removing and replacing construction to accommodate observations and tests required by third-party inspection and testing company.

## Non-conformance

* + 1. Non-conformance and deficiencies identified during periodic site visits or performance testing shall be resolved as follows:
       1. Third-party inspection and testing company will record the results of the performance test or its site visit observation in a report. All deficiencies or non-conformance issues shall be noted as action items on a punch-list and reported to Contractor through Consultant.
       2. Corrections of identified minor deficiencies may be made during the site visit at the discretion of third-party inspection and testing company. In such cases the deficiency and associated resolution will be documented in the field report.
       3. As site visits or tests progress and a deficiency is identified, the third-party inspection and testing company will discuss the issue with Contractor and Consultant for follow-up and resolution.
          1. Third-party inspection and testing company shall document deficiency and Contractor’s response.
          2. Contractor shall correct the deficiency and notify third-party inspection and testing company and Consultant in writing that issue is resolved and/or Product, material or assembly is ready to be retested.
          3. Contractor shall reschedule the test and the test shall be repeated. This process shall be repeated until test results meet or exceed requirements of Contract Documents.
          4. Contractor shall be responsible for costs associated with re-testing.

## Air Infiltration testing

* + 1. Glazed assemblies (curtain wall and punched windows):
       1. Test method(s): pressurized chamber testing in accordance with ASTM E783.
       2. Scope of testing: Mock-up (first installation) and during construction phase.
       3. Frequency: As determined by third-party inspection and testing company.
       4. Success criteria: As specified in this Section.
    2. Opaque wall assemblies (including transitions to adjacent systems, field of air barrier and penetrations):
       1. Test method(s):
          1. Pressurized chamber testing in accordance with ASTM E783.
          2. Smoke tracer testing in accordance with ASTM E1186.
       2. Scope of testing: Mock-up (first installation) and during construction phase.
       3. Frequency: Minimum 3 tests.
       4. Success criteria: As specified in this Section.

## Water penetration testing

* + 1. Glazed assemblies (curtain wall and punched windows):
       1. Test method(s): pressurized chamber testing in accordance with ASTM E1105.
       2. Scope of testing: Mock-up (first installation) and during construction phase.
       3. No of tests: Minimum of 3 tests. Frequency to be determined by third-party inspection and testing company and coordinated with Contractor’s schedule.
       4. Success criteria: No leakage at 720 Pa (15 psf) pressure differential.
    2. Roof assemblies:
       1. Test method(s):
          1. Water-spray test in accordance with AAMA 501.2 at transitions, corners, penetrations determined by Consultant.
       2. Scope of testing: Mock-up (first installation) and during construction phase.
       3. No of tests: Minimum of 3 tests. Frequency to be determined by third-party inspection and testing company and coordinated with Contractor’s schedule.
       4. Success criteria: No leakage.
    3. Opaque wall assemblies including auxiliary components such as louvers, expansion joints and similar components:
       1. Test method(s): Water-spray test in accordance with AAMA 501.2 at transitions, corners; Penetrations determined by Consultant.
       2. Scope of testing: mock-up (first installation) and during construction phase.
       3. Frequency: As determined by third-party inspection and testing company.
       4. Success criteria: No leakage.

## Thermal performance verification

* + 1. Wall assemblies including openings and auxiliary components such as louvers, expansion joints and similar components:
       1. Test method(s): Thermographic scan in accordance with ASTM C1060 or CAN/CGSB 149-GP-2MP.
       2. Frequency: As determined by third-party inspection and testing company.
       3. Success criteria: Insulation is at full thickness and continuous in all cavities. No unacceptable thermal bridging.
    2. Roof assemblies:
       1. Test method(s): Thermographic scan in accordance with ASTM C1153.
       2. Frequency: As determined by third-party inspection and testing company.
       3. Success criteria: Insulation is at full thickness and continuous. No thermal anomalies associated with wet insulation.

## Adhesion testing

* + 1. Air barrier membrane testing:
       1. Test method(s): Pull-off testing in accordance with ASTM D4541.
       2. Frequency: As determined by third-party inspection and testing company.
       3. Success criteria: Pull-off strength of membrane conforms to manufacturer’s published data.
    2. Sealants adhesion tests:
       1. Test method(s):
          1. Destructive: In accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
          2. Non-destructive: In accordance with ASTM C1521, using Non-destructive Spot Method.
          3. For joints with dissimilar substrates, verify adhesion to each substrate separately.
       2. Frequency: As determined by third-party inspection and testing company.
       3. Success criteria: Sealant adhesion passes sealant manufacturer's field-adhesion hand-pull test published data.

## Repair and protection

* + 1. Repair damaged construction and restore substrates and finishes following observation, testing, sample taking and similar services.
    2. Repair surfaces immediately after testing and sampling is completed to prevent damage to assemblies resulting from moisture diffusion or air leakage.
    3. Protection of installed Products: Take necessary precautions to prevent puncturing, tearing, weakening or damaging of building enclosure membranes during construction; and immediately repair damage as directed by Consultant.

End of section