

5. This Amendment contains all of the terms and conditions agreed upon by the Parties as amendments to the original Contract, as amended. No other understandings or representations, oral or otherwise, regarding amendments to the original Contract, as amended, shall be deemed to exist or bind the Parties, and all other terms and conditions of the Contract, as amended, remain in full force and effect.

IN WITNESS WHEREOF, the Owner, with the prior approval of the Authority, and the Owner's Project Manager have caused this Amendment to be executed by their respective authorized officers.

OWNER

(signature)

(date)

Bill Lovallo
(print name)

Chair, Belmont High School Building Committee
(print title)

OWNER'S PROJECT MANAGER

(signature)

(date)

Richard Marks
(print name)

President
(print title)

Certification of Available Funding:

(signature)

(date)

Chitra Subramanian
(print name)

Town Accountant
(print title)



Civil

March 9, 2020

Site Utilities

Mr. Shane Nolan

CHA Companies

Structural

One Faneuil Hall Marketplace
South Market Building, Suite 4195
Boston, MA 02109

Mechanical

Re: MSBA - Belmont Middle High School
Building Envelope Quality Assurance Testing

Electrical

Dear Shane:

Plumbing

After collaboration with Perkins & Will to develop a comprehensive envelope testing matrix based on specification requirements, BVH would like to propose testing services for the Belmont Middle High School project in Belmont, Massachusetts. Based directly off of the collaborative envelope field testing matrix discussed with Perkins and Will in our email conversations, and drawings and specifications, BVH proposes the following base scope of services.

Fire Protection

Technology

BASE SCOPE

Waterproofing Inspections

Commissioning

1. While fluid-applied and crystalline waterproofing products are actively being sprayed, **visit the site two (2) times** to inspect the waterproofing application. We anticipate that waterproofing will be installed ahead of the majority of the envelope's construction, and that the two (2) types of waterproofing systems will be installed during different periods.
2. Survey the thickness of the uncured fluid-applied waterproofing in up to ten (10) locations to ensure that the wet film thickness is appropriate for each layer of waterproofing.
3. Provide a written report of our findings and recommendations.

Building Envelope

Connecticut

206 West Newberry Road
Bloomfield, CT 06002
T: 860-286-9171

First Instance Testing of Envelope Details and Assemblies

Massachusetts

One Gateway Center
Suite 701
Newton, MA 02458
T: 617-658-9008

1. Test major building envelope details at their "first instance" of construction per ASTM E1186, with pressurized fog or an infrared camera. The goal of first instance testing is to verify the air tightness of a given detail the very first time it is constructed or at the "first instance" of construction and before the detail is repeated several times. This is a noninvasive process that can occur while construction is ongoing and with minimal disruption to the site.
2. We anticipate testing approximately twenty (20) different major detail types over the course of three **(3) non-consecutive test days.**
3. Provide a written report for each test visit.

start@bvhis.com
www.bvhis.com



ASTM D4541 Membrane Adhesion Tests

1. Test fluid-applied membrane for adhesion in accordance with ASTM D 4541 except that the membrane shall be cut through to separate the material attached to the disk from the surrounding material. Recommend performing the test after the curing period recommended by the manufacturer. We anticipate testing approximately twenty-nine (29) test areas per the schedule outlined in the envelope field testing matrix. We anticipate completing many of these tests concurrent with already contracted site visits; however, pricing of this proposal accounts for two (2) additional mobilizations to accommodate this testing in its entirety. Note that Perkins & Will has asked for a higher quantity of pull testing in the specifications, and verbally, than what is proposed above; however, we believe that a greater quantity will not allow for a testing schedule that is feasible to abide by, and will only increase cost.
 - a. This test is best performed on a temperate and cloudy day so the membrane is not overheated by the sun.
2. The inspection report shall indicate whether the minimum adhesion level established by the manufacturer for the products on the particular substrate has been met, and if not, the mode of failure.

ASTM C1193 and ASTM C1401 Sealant Adhesion Pull Tests

1. Test one (1) mock-up sample of joint sealant for each unique substrate type per ASTM C1193 Appendix X1, Method A. We anticipate two (2) unique sealant types, across the joint locations identified under 079200, 3.8, A and B, as they relate to the building envelope. We anticipate completing this work over two (2) days under two (2) separate mobilizations.
 - a. Sealant repairs are by others.

According to the specifications, during pre-construction, adhesion to each substrate will need to be verified separately. In order to do that, either a mock-up will need to be built that represents every type of substrate, or a sample of each type will need to be installed on the structure and repaired after testing. Otherwise, we will test samples of completed joints.

2. Where applicable, test curtain wall structural sealant joints at four (4) locations per facade per ASTM C1401. Based on exterior glazing elevations, we anticipate approximately twenty-four (24) individual tests. We anticipate completing some of this testing concurrent with site visits already in our contract; however, pricing in this proposal assumes an additional three (3) visits to accommodate this testing in its entirety.
 - a. Sealant repairs are by others.



3. We anticipate some of the various types of sealant testing can occur simultaneously and during site visits already contracted; therefore, we anticipate we can accommodate the above sealant testing with three (3) additional visits.
4. Provide a written report of test results.

Curtain Wall and Fiberglass Sandwich Panel Water Penetration Tests

1. Conduct water infiltration testing per ASTM E1105/AAMA 503 at seven (7) curtain wall areas, inclusive of an in-place mock-up test and as outlined in the envelope field testing matrix.
2. Conduct water infiltration testing per ASTM E1105/AAMA 503 at two (2) Area E fiberglass sandwich panel areas, approximately 80 SF in size, and as outlined in the envelope field testing matrix.
3. Additionally, for testing to be successful, we require the following:
 - a. Prior to testing, and upon acceptance of this proposal, we will need a copy of the manufacturer's specifications for the window type that will be tested.
 - b. Curtain walls that have both fixed and operable sections will be tested at the more lenient airtightness limit.
 - c. We require the area in front of the curtain wall - inside and outside, to be clear for at least 8 ft. back in order to build a test enclosure. The test enclosure will be sealed to the window unit itself and will not include the surrounding wall.
 - d. We assume interior finishes and/or sheetrock returns have been left off so the window can be inspected at the rough opening for water penetration.
 - e. We assume all interior brackets, shades, blinds, and screens have been left off or removed so a test enclosure can be fit to the window.
 - f. We assume all exterior shades, awnings, or brackets have been left off or removed so the spray rack can be installed outside.
 - g. If the walls surrounding the window are not uniform in composition (i.e.; framing or drywall is incomplete), we will build a test enclosure around the window that best approximates the test requirements.
 - h. We require a standard 3/4" hose bibb connection within 200 ft. of each test area.
 - i. The test cannot be conducted in the rain, temperatures below 40 deg. F, or in high wind conditions.
4. Conduct water infiltration testing per AAMA 501.2 at six (6) curtain wall areas, inclusive of an in-place mock-up and as outlined in the envelope field testing matrix.
5. Conduct water infiltration testing per AAMA 501.2 at two (2) fiberglass sandwich panel areas, approximately 80 SF in size, and as outlined in the envelope field testing matrix.
 - a. AAMA 501.2 testing is designed for fixed glazing units only. If operable units are part of the test area, the operable portions will be masked out of the test.
 - b. The water test pressure will be 30 to 35 psi or as high as the local water system can provide. Note that some building water systems are set at lower pressures than 30 psi. The Building Operator may need to increase water pressure for the test.



- c. We require a standard 3/4" hose bibb connection within 200 ft. of each test area.
 - d. The test cannot be conducted in the rain, freezing temperatures (40 deg. F or above required), or in windy conditions. We propose having a primary test date and a back-up date to adjust for weather conditions.
6. We anticipate the above testing to take seven (7) total days to complete across four (4) separate mobilizations.
7. Provide a written report of test results and recommendations.

COMPENSATION

We propose that these Building Envelope Services be billed as a lump sum based on percentage of completion. The total cost of this building envelope service is as follows:

Base Scope	
Waterproofing Inspections	\$ 1,550.00
First Instance Testing of Envelope Details and Assemblies	\$ 8,775.00
ASTM D4541 Membrane Adhesion Tests	\$ 2,450.00
ASTM C1193 and ASTM C1410 Sealant Adhesion Pull Tests	\$ 2,135.00
Curtain Wall and Fiberglass Sandwich Panel Water Penetration Tests	\$ 23,550.00
Grand Total	\$ 38,460.00

To support this testing effort, some support time may be required by the General Contractor. Their time has NOT been included in this proposal.

Please note the following:

- Pricing does not include a man lift or staging. We assume a man lift will be available for our use for accessing any location above 8 ft. from ground level.
- Pricing provided is for the scope outlined above. The above scope is defined based on our best attempt to accurately interpret documents made available to BVH for bidding.

EXCLUSIONS

- Any changes to previously approved scope.
- Any contractor time associated with this effort.
- Additional return visits to the project site for re-testing purposes beyond that which is indicated in this proposal.
- Any time beyond normal working hours (defined as 6:00 a.m. to 6:00 p.m.).
- Any scope associated with the existing garage or the new salt shed on the same property.

Mr. Shane Nolan
March 9, 2020
Page 5



BVH HOURLY RATES

2020 HOURLY RATES	
Principal-In-Charge	\$215.00
Building Envelope Services Director	\$200.00
Building Envelope Services Project Manager	\$175.00
Building Envelope Services Provider	\$140.00
CAD / Revit Technician	\$118.00
Clerical	\$ 82.00

(Hourly rates are reviewed and adjusted on a yearly basis)

We would like to thank you for the opportunity to submit this proposal. Please contact us to review the details of this proposal to make sure they meet your needs and the project's requirements, or if this proposal is acceptable to you, please sign in the space provided below and return a copy of this letter to my attention as your authorization to proceed.

Sincerely,

BVH Integrated Services, P.C.

A handwritten signature in black ink, appearing to read "Mike LaCrosse".

Mike LaCrosse
Building Envelope Services Project Manager

ML/kac

Attachment: BVH Terms & Conditions

Accepted By: _____ Date: _____

Project: MSBA - Belmont Middle High School
Building Envelope Quality Assurance Testing
Date: March 9, 2020



TERMS AND CONDITIONS

The Client and BVH Integrated Services, P.C. hereby agree as follows:

Definitions:

BVH – For the purposes of these Terms and Conditions, BVH Integrated Services, P.C. shall be referred to as “BVH”.

Client – For the purposes of these Terms and Conditions, the addressee of the BVH proposal for the project at issue and the entity for which BVH is performing the work shall be referred to as the “Client”.

Contract – For the purposes of these Terms and Conditions, the term “Contract” shall refer to the most recent Proposal submitted by BVH for services on the project and to which these Terms and Conditions are appended by reference.

Access to the Site – Unless otherwise stated BVH shall have access to the site for activities necessary for the performance of the services indicated.

Compensation for Services and Payment Terms – The Client agrees to pay BVH in accordance with the payment terms provided for in the Contract. Invoices for services and reimbursable expenses shall be submitted monthly. Invoices that are unpaid 30 days after the invoice date may be subject to a monthly service charge of 1.5% on the unpaid balance. If an invoice remains unpaid for more than 90 days after the invoice date, the Client shall pay all costs of collection including reasonable attorney’s fees.

Suspension of Services - For Past Due accounts, BVH may, at its sole discretion, suspend its performance of services for the project until all outstanding fees have been paid in full. BVH shall provide written notice of suspension. BVH shall not be responsible for any damages arising from, or relating to, its suspension of its services. Furthermore, upon the commencement of the project after the suspension, BVH shall be compensated for any reasonable costs associated with the delay. Alternatively, BVH reserves its rights to terminate the project for non-payment of fees in accordance with the following paragraph.

Termination of Services - This Contract may be terminated upon ten (10) days written notice by either party should the other fail to perform its obligations hereunder, including but not limited to failure to pay for services. In the event of termination, Client shall pay BVH for all services rendered to the date of the termination, all reimbursable expenses, and reasonable termination expenses.

Standard of Care- BVH’s services shall be performed in accordance with generally accepted practices of engineers providing similar services at the same time, in the same locale, and under like circumstances. The Client agrees that services provided shall be rendered without any warranty, expressed or implied. BVH shall put forth reasonable professional efforts to comply with applicable codes, regulations and laws in effect at the time the work is being performed.

Permits and Approvals - The Client shall be responsible for applying for and securing necessary permits and approvals for the project. BVH shall assist the Client in applying for applicable permits and approvals typically required for the work performed by BVH. This assistance shall consist of completing and submitting forms typically submitted that relate to the work included in BVH’s scope of services. However, this assistance shall not include special studies, special research, attendance at meetings with public authorities beyond those listed in the Contract, or special testing or special documentation not normally required for this type of project. BVH does not guarantee the permits and approvals will be obtained and payment of invoices is not contingent on approvals.

Jobsite Safety – Neither BVH nor its consultants shall be responsible for jobsite safety. Neither the activities of BVH, nor the presence of BVH or its employees and/or consultants at the project site, shall relieve the Construction Manager or General Contractor or any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequences, techniques, or procedures necessary for performance of the work in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. BVH, its employees and consultants shall have no authority to exercise any control over any construction contractor or other entity or their employees with connection with the work or any health or safety precautions. The Client agrees that the sole responsibility for jobsite safety shall lie with the Construction Manager, General Contractor or some other third party.

Hazardous Materials – Neither BVH nor its consultants shall be responsible for the inspection, testing, identification, or remediation of materials suspected to be hazardous, including asbestos, mold, lead, radon and polychlorinated biphenyls (PCB). The Client agrees that if the presence of such materials on the jobsite is suspected, prior testing and remediation of such materials will be performed by the Owner.

Risk Allocation – In recognition of the relative risks, rewards, and benefits of the project to both the Client and BVH, the risks have been allocated so that the Client agrees that, to the fullest extent permitted by law, BVH and BVH’s employees’ and agents’ total aggregate liability to the Client, for any and all injuries, claims, losses, expenses, damages or claim expenses arising out of this Contract, from any cause or causes, shall not exceed the lesser of \$50,000 or the total amount of BVH billings.

Contingency Fund – The Client acknowledges and agrees that changes to the project scope may be required because of possible omissions, ambiguities or inconsistencies in the plans and specifications and that the costs of the project may increase. The Client agrees to set aside a contingency reserve to be used, as required, to pay for any such increased project costs.

Insurance – BVH shall maintain the following insurances for the duration of the project until completion: workers’ compensation insurance as required under the laws of the state in which the services will be performed; commercial general liability insurance with a combined single limit of \$1,000,000 per occurrence and \$2,000,000 in the aggregate for bodily injury, including death and property damage; and, automobile liability insurance with a combined single limit of \$1,000,000 per occurrence.

Consequential Damages - Notwithstanding any other provision of this Contract, neither party shall be liable to the other for any consequential damages incurred due to the fault of the other party, regardless of the nature of this fault or whether it was committed by the Client or BVH, their employees, consultants, or agents. Consequential damages include, but are not limited to, loss of use and loss of profit.

Governing Law – This Contract shall be governed in accordance with the laws of the State of Connecticut.

Dispute Resolution - If a dispute arises out of or relates to this Contract, or breach thereof, and if said dispute cannot be settled through direct discussions, the parties agree to first endeavor to settle the dispute in an amicable manner by non-binding mediation under the Construction Industry Mediation Rules of the American Arbitration Association, before having recourse to arbitration or a judicial forum.

Force Majeure – Except for Client’s obligation to pay for services rendered, no liability shall attach to either party from delay in performance or nonperformance caused by circumstances or events beyond the reasonable control of the party affected, including but not limited to, acts of God, fire, flood, unanticipated site or subsurface conditions, explosion, war, terrorism, request or intervention of a governmental authority (foreign or domestic), court order (whether at law or in equity), labor relations, accidents, delays or inability to obtain materials, equipment fuel or transportation.

Assignability - Neither the Client nor BVH shall assign this Contract without the written consent of the other.

Entire Agreement - This Contract represents the entire and integrated agreement between the Client and BVH and supersedes all prior negotiations, representations or agreement, either written or oral. This Contract may be amended only by written instrument signed by both the Client and BVH.

Third-Party Beneficiaries - Nothing contained in this Contract shall create a contractual relationship with or a cause of action in favor of a third-party against either the Client or BVH.

Required Enclosure Field Tests:

Required enclosure field tests are those that are directly specified in the “Field Quality Control” articles of the technical specifications in divisions 07 and 08. The required enclosure field tests for this project are as follows:

1. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
2. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors.
3. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
4. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.,
5. ASTM C1193 - Appendix X1, Method A, Field-Applied Sealant Joint Hand Pull Tab. (by contractor)
6. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
7. ASTM C1401 – Standard Guide for Structural Sealant Glazing

Optional Tests:

Optional enclosure field tests are those that may be found in the general division 01 specifications or the technical division 07 or 08 specifications, commonly described as “at the owner’s discretion” or “at the owner’s option”. The optional enclosure field tests for this project are as follows:

1. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors. (for air barrier)
2. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers (for air barrier)
3. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems. (for air barrier)

Required Field Testing Matrix

The following matrix outlines the required field testing and describes the test type, test location, quantity, size, and test parameters for each.

Referenced Specification	Envelope Component(s)	Test Standard	Size of Test Area	Qty.	Locations	Test Pressure	Tolerance
071416 3.8	Cold Fluid Applied Waterproofing	N/A – Mil depth check	N/A	Up to 10 areas	TBD by BECxA	N/A	Manufactures Min. Req.
071616, 3.5	Crystalline Waterproofing	Visual Inspections	N/A	N/A	Throughout	N/A	N/A
072726 1.8, 3.5	Air Barrier Membrane	ASTM E1186	See description below	18 details	See description below	N/A	No visual leakage
072726 1.8, 3.5	Air Barrier Membrane	ASTM D4541 (Protocol 1)	4 sq. in/each	See description below	TBD by BECxA	N/A	16 psi
079200 1.7	Mock-up Joint Sealant	ASTM C1193	3 inch tab	1/each substrate	Mock-up	N/A	No adhesive failure
084413 1.8	Mock-up Glazed Aluminum Curtain Wall	AAMA 501.2	80-100 sf./each	1	Mock-up	30-35 psi (at nozzle)	No evidence of water
084413 1.8	Mock-up Glazed Aluminum Curtain Wall	ASTM E1105	80-100 sf./each	1	Mock-up	Per product test data, otherwise 6.24 lbf/sf	No evidence of water
084413 3.5	Glazed Aluminum Curtain Wall	AAMA 501.2	80-100 sf./each	5	CW A16 – Area A CW B5 – Area B CW B1 – Area B CW C1 – Area C CW D14 – Area D	30-35 psi (at nozzle)	No evidence of water
084413 3.5	Glazed Aluminum Curtain Wall	ASTM E1105	20-80 sf./each	6	2 in Area A (1 CWA1, 1 other) 2 in Area B (1 CWB8, 1 other)	Per product test data,	No evidence of water



					1 in Area C 1 in Area D	otherwise 6.24 lbf/sf	
084413 3.5	Glazed Aluminum Curtain Wall	ASTM C1401	N/A	4 per elevation	TBD by BECx A	N/A	N/A
084523 3.3	Fiberglass Sandwich Panel Assemblies	AAMA 501.2	80 sf.	2	Area E	30-35 psi (at nozzle)	No evidence of water
084523 3.3	Fiberglass Sandwich Panel Assemblies	ASTM E1105	80 sf.	2	Area E	4.18 lbf/sf.	No evidence of water

The following tests are required by the specifications, but we omit them as they do not properly apply to the envelope components they are required to test.

Referenced Specification	Envelope Component(s)	Test Standard	Reason for Omission
072726 1.8	Mock-Up Air Barrier Membrane	ASTM E783	It is difficult to build an enclosure that will isolate the air barrier and provide an accurate reading to quantify the amount of air leakage. Pressurized fog testing per ASTM E1186 is more valuable at this stage in knowing where the leaks are, rather than quantifying the sum amount of leakage.
072726 3.5	Air Barrier Membrane	ASTM E783	It is difficult to build an enclosure that will isolate the air barrier and provide an accurate reading to quantify the amount of air leakage.
074213 1.7	Mock-up Insulated Metal Panel Wall	AAMA 501.2	Due to the construction of the insulated metal wall panel system, leaks will not be visible if they occurred during the test.
074213 3.5	Insulated Metal Panel Wall	AAMA 501.2	Due to the construction of the insulated metal wall panel system, leaks will not be visible if they occurred during the test.
084413 1.8	Mock-up Glazed Aluminum Curtain Wall	ASTM E783	Complete isolation of a curtain wall for purposes of quantifying air leakage typically is not feasible due to in ability to connect an enclosure directly to the performance components of the CW system on both sides. AAMA testing standards suggest against quantifying air leakage of CW systems for this reason.
084413 3.5	Glazed Aluminum Curtain Wall	ASTM E783	Complete isolation of a curtain wall for purposes of quantifying air leakage typically is not feasible due to in ability to connect an enclosure directly to the performance components of the CW system on both sides. AAMA testing standards suggest against quantifying air leakage of CW systems for this reason.

Test Descriptions and Commissioning Team Responsibilities

- 1) On or Off-structure mock up tests including:
 - a) 1 Curtain Wall water penetration tests per ASTM E1105 combined.
 - b) 1 Curtain Wall water penetration test per AAMA 501.2
 - c) 1 joint sealant adhesion test per ASTM C1193
 - d) Roles and Responsibilities:
 - i) The BECxA/TA will participate with the CM and A/E in mockup preconstruction meetings.
 - ii) The CM will work with the BECxA/TA to provide tenting, heat, or lifts as needed for the mockup tests.
 - iii) BECxA/TA will perform the tests. CM, applicable subs, A/E, and Owner to observe tests.
 - iv) The CM, A/E, and BECxA and applicable subs will work together to resolve any enclosure deficiencies discovered through testing or visual inspection of the mock ups.
 - v) BECxA/TA will provide written reports of each test to the Owner. BECxA will update the issues log.

- 2) 18 on-structure first installation tests per ASTM E1186 tests while construction is ongoing. These are quality assurance tests using pressurized fog and/or infrared imaging under pressure to check individual envelope details for air tightness at or near their first installation. This allows individual details to be evaluated for performance before they are replicated multiple times. The test results are visual and qualitative and used to identify the location and relative size of air leaks in a given detail. A list of typically tested details follows.
 - a) Door rough openings
 - b) Sloped Glazing
 - c) Overhead doors
 - d) Installed man door
 - e) Wall to slab/foundation in 2 directions
 - f) Curtain wall rough openings
 - g) Installed curtain wall (with and without fins, and including CW heads at roof coping)
 - h) Corner curtain wall units
 - i) Expansion joints within window assemblies
 - j) MEP Penetrations

- k) Wall inside corner and outside corner per wall type
 - l) At wall type transitions (brick and metal panel)
 - m) Wall to roof at parapet in 2 directions
 - n) Wall to roof at canopies
 - o) At a roof mechanical curb
 - p) At a roof drain
 - q) At overhangs
 - r) At louver
 - s) At a expansion joint

 - t) Roles and Responsibilities:
 - i) BECxA/TA is in close communication with the CM to determine when details are ready to test.
 - ii) CM will participate in pre-test coordination phone calls or meetings, if such calls/meetings are necessary.
 - iii) The BECxA/TA will provide temporary test enclosures and remove enclosures after testing.
 - iv) CM will provide manlifts, staging, ladders, and/or forklifts as needed to provide access to test areas.
 - v) BECxA/TA will perform the tests. CM, and applicable subs will observe. A/E and Owner to observe at their discretion.
 - vi) BECxA will determine from the qualitative results if the tested detail is acceptable or if it needs corrective action.
 - vii) The BECxA/TA will provide a written report of the test results to the owner. The BECxA will update the Issues Log.
- 3) ASTM E1105 is a test which subjects the tested window/skylight/curtain wall to water delivered at a constant rate of 5 gallons/sf/hr. via calibrated spray rack while under induced air pressure of at least 1.57 psf (75 Pa.) or higher depending on the type of glazing system tested. Test pressures of 6.24 psf (300 Pa.) are common. This test is intended to simulate a rainstorm with wind, the condition by which water entry is most likely to occur. This test must be conducted as early as possible after the start of the installation of the glazing system and before interior finishes are installed so both the system and the rough opening can be inspected during testing. This may require out of sequence work. This test cannot be conducted at less than 40°F air temperatures. This test standard is generally co-specified with AAMA 502 or AAMA 503, which further specify test requirements for newly installed fenestration or storefronts/curtain walls/sloped glazing/skylights, respectively. This test is specified on this project curtain walls and fiberglass panel assemblies.
- a) Roles and Responsibilities:

- i) A/E to select storefronts/curtain walls to be tested. CM ensures that selected areas are fully installed for testing but no interior finishes are installed.
 - ii) BECxA/TA is in communication with the CM to determine when windows are ready to test.
 - iii) CM will participate in pre-test coordination phone calls or meetings, if such calls/meetings are necessary.
 - iv) The BECxA/TA will provide temporary test enclosures and remove enclosures after testing.
 - v) CM will provide manlifts, staging, ladders, tenting, temporary heat, and/or forklifts as needed to provide access to test areas.
 - vi) CM will provide manufacturer’s laboratory test reports and certifications for window water penetration of the tested window.
 - vii) BECxA/TA will perform the tests. BECxA, CM, and window/curtain wall subs will observe. A/E and Owner to observe at their discretion.
 - viii) If the tested window/storefront/curtain wall does not meet the project specifications of no water entry the installer will provide corrective action and the window will be retested at the contractor’s expense.
- 4) AAMA 501.2 is a qualitative field check for water penetration on storefronts, curtain walls, and sloped glazing systems using a water hose and a calibrated tip. Water is delivered to the glazing system from the exterior at a pressure of 30-35 psi and at ambient air pressure and an observer watches from inside. The water is applied in 5 minute intervals to 5 linear foot of joint from bottom to top. This test is not intended for use on any operable glazing systems. This test procedure allows for up to 15 ml (1/2oz.) of water entry within a 5 minute test period as long as the water is contained within an interior stool or stoop integral with the glazing system but the Owner or A/E may opt for a more stringent requirement in writing. This test must be conducted as early as possible after the start of the installation of the glazing system and before interior finishes are installed so both the system and the rough opening can be inspected during testing. This may require out of sequence work. This test cannot be conducted at less than 40°F air temperatures. This test is specified on this project for curtain walls and fiberglass sandwich panels.
- a) Roles and Responsibilities:
- i) A/E to select storefronts/curtain walls to be tested. CM ensures that selected areas are fully installed for testing but no interior finishes are installed.
 - ii) BECxA/TA is in communication with the CM to determine when windows are ready to test.
 - iii) CM will participate in pre-test coordination phone calls or meetings, if such calls/meetings are necessary.
 - iv) The BECxA/TA will provide temporary test enclosures and remove enclosures after testing.
 - v) CM will provide manlifts, staging, ladders, tenting, temporary heat, and/or forklifts as needed to provide access to test areas.
 - vi) CM will provide manufacturer’s laboratory test reports and certifications for window water penetration of the tested window.

- vii) BECxA/TA will perform the tests. BECxA, CM, and window/curtain wall subs will observe. A/E and Owner to observe at their discretion.
 - viii) If the tested storefront/curtain wall/skylight does not meet the project specifications of no water entry the installer will provide corrective action and the window will be retested at the contractor's expense.
- 5) ASTM D4541 is an adhesion compliance test that verifies membranes, typically self-adhered, meet a minimum adhesion standard of 16 pounds per square inch (psi) utilizing a test disc adhered to the membrane and pulled via a calibrated apparatus. For this project, test quantities shall be based on each elevation, per the following schedule:
- Area A: East Elevation (3), West Elevation (3), South Elevation (1)
 - Area B: North Elevation (3), West Elevation (1), South Elevation (1)
 - Area C: North Elevation (3), East Elevation (1), South Elevation (1)
 - Area D: North Elevation (1), East Elevation (1), South Elevation (3)
 - Area E: N/A
 - Area F: North Elevation (1), West Elevation (3), East Elevation (3)
- a) Roles and Responsibilities:
- i) BECxA/TA in close communication with the CM to determine as soon as membrane is ready to test.
 - ii) CM will participate in pre-test coordination phone calls or meetings, if such calls/meetings are necessary.
 - iii) CM will provide manlifts, staging, ladders, and/or forklifts as needed to provide access to test areas.
 - iv) CM will provide manufacturer's laboratory test reports and certifications for the installed membrane as necessary.
 - v) BECxA/TA will perform the tests. CM, and sealant subs will observe. A/E and Owner to observe at their discretion.
 - vi) The BECxA/TA will provide a written report of the test results to the owner. BECxA/TA will indicate by building name, elevation, and column line the location of the tested sealant in their test report.
 - vii) If the tested membrane does not meet the project and manufacturer's specifications the installer will provide corrective action and the membrane will be retested at the contractor's expense. The tested membrane that meets project and manufacturer's specifications will be repaired by the air barrier at the test locations.
 - viii) The BECxA will update the Issues Log.
- 6) Sealant tests per ASTM C1193 Appendix X1, Method A. ASTM C1193 Appendix X1, Method A is a destructive field check for the adhesion of joint sealants to their substrates. The test determines how far the sealant will stretch before it pulls away from the substrate.

- a) Roles and Responsibilities:
- i) BECxA/TA in close communication with the CM to determine as soon as sealant is ready to test.
 - ii) CM will participate in pre-test coordination phone calls or meetings, if such calls/meetings are necessary.
 - iii) CM will provide manlifts, staging, ladders, and/or forklifts as needed to provide access to test areas.
 - iv) CM will provide manufacturer's laboratory test reports and certifications for the installed sealant.
 - v) BECxA/TA will perform the tests. CM, and sealant subs will observe. A/E and Owner to observe at their discretion.
 - vi) The BECxA/TA will provide a written report of the test results to the owner. BECxA/TA will indicate by building name, elevation, and column line the location of the tested sealant in their test report.
 - vii) If the tested sealant does not meet the project and manufacturer's specifications the installer will provide corrective action and the sealant will be retested at the contractor's expense. The tested sealant that meets project and manufacturer's specifications will be repaired by the sealant sub at the test locations.
 - viii) The BECxA will update the Issues Log.
- b) According to the specifications, during pre-construction, adhesion to each substrate will need to be verified separately. In order to do that, either a mock-up will need to be built that represents every type of substrate, or a sample of each type will need to be installed on the structure and repaired after testing.