The City of WORCESTER

Administration & Finance – Purchasing Division
Christopher J. Gagliastro, MCPPO – Purchasing Director
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November 14, 2024

To All Bidders:

Subject: **Bid No. 8314-W5, Window Replacement – Worcester East Middle School / WPS**

ADDENDUM NO. 2

To Whom It May Concern:

With reference to our bid request relative to the above subject, please refer to the changes/modifications/clarifications to the original proposal request.

- **BID DUE DATE EXTENDED TO TUESDAY, NOVEMBER 26, 2024 AT 10:00 AM**
- **SEE ADDITIONAL CLARIFICATIONS ATTACHED**

Bidders are requested to acknowledge and/or include this addendum with submission. All other terms, conditions and specifications remain unchanged.

Very truly yours,

Christopher J. Gagliastro
Purchasing Director

City of Worcester, Massachusetts
Sealed Bid No. 8314-W5

Window and Door Replacement
Worcester, East Middle School
420 Grafton Street, Worcester, MA 01604

Habeeb & Associates Architects
H&A Job No. 2124.17

ADDENDUM NO. 02
November 14, 2024

The attention of Bidders submitting proposals for the above subject project located in Worcester, MA is called to the following Addendum to the Contract Documents. The items set forth herein, whether of omission, addition, substitution, or clarifications are all to be included in and form a part of the proposal submitted. This Addendum consists of one (1) type-written page and one attachment of fifteen (15) total pages.

THE NUMBER OF THIS ADDENDUM (02) MUST BE ENTERED IN THE APPROPRIATE SPACE PROVIDED ON DOCUMENTS IN THE FOLLOWING SECTIONS:

DIVISION 00 - FORM FOR GENERAL BID

A. General:

1. Bid Date extended to 11/26/2024 at 10:00 AM

B. Drawing Changes:

1. Sheet A-617
    a. Detail 1: Revised detail
    b. Detail 2: Revised detail
    c. Detail 3: Revised detail

C. Specification Changes:

1. Section 01 9100: Commissioning
    a. Added in its entirety.

D. Questions:

None

All other portions of the Contract Documents remain **unchanged**.

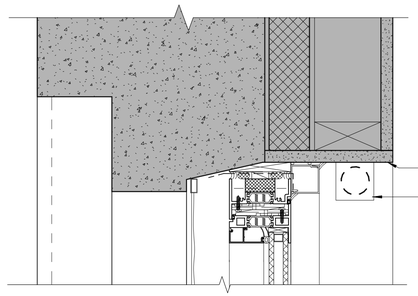
Please be reminded to acknowledge this Addendum on the bid forms.

END OF ADDENDUM NO. 02

This Border is intended for a 22" x 34" sheet. If printed sheet size differs, refer to graphic bar scales only.

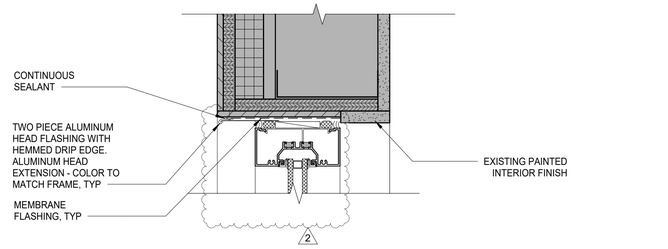
PLOTTED ON: 11/14/2024 12:52:54 PM

SHEET ADDED IN ITS ENTIRETY DURING ADD 01



5 A-610 **WINDOW TYPE O - HEAD - NEW**

SCALE: 3" = 1'-0"



3 A-611 **WINDOW TYPE Z - HEAD - NEW**

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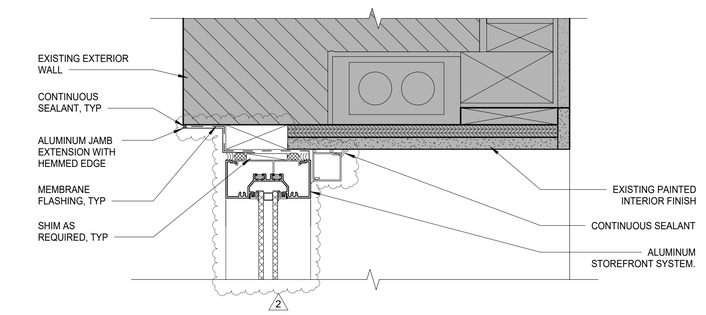

2 A-611 **WINDOW TYPE Z - JAMB - NEW**

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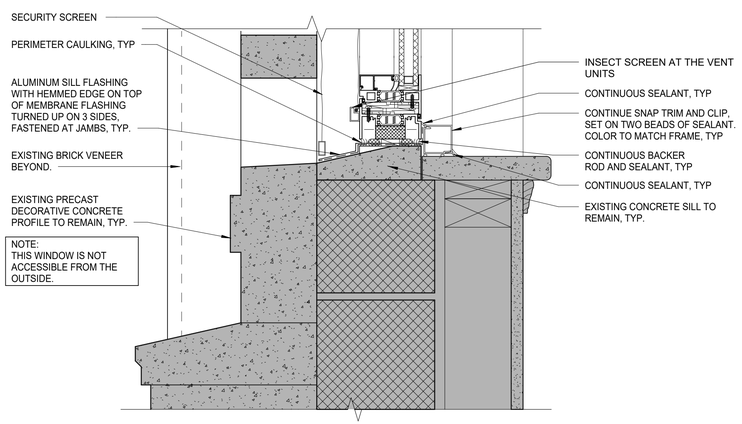
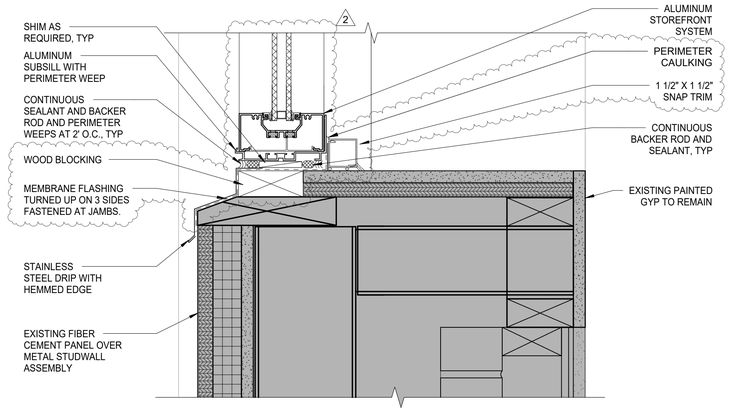


4 A-610 **WINDOW TYPE O - SILL - NEW**

SCALE: 3" = 1'-0"



1 A-611 **WINDOW TYPE Z - SILL - NEW**

SCALE: 3" = 1'-0"

HABEEB & ASSOCIATES ARCHITECTS
H&A
150 LONGWATER DR
NORWELL, MA 02061
41 HARVARD ST
WORCESTER, MA 01609
781.871.9804
habeebarch.com

WINDOW AND DOOR REPLACEMENT
WORCESTER EAST MIDDLE SCHOOL
420 Grafton Street
Worcester, MA 01604

REVISIONS		
Δ	MM-DD-YYYY	DESCRIPTION
1	11/08/2024	ADD-01
2	11/14/2024	ADD-02

PROJECT NO:	2124.17
DATE:	11/14/24
SCALE:	AS NOTED
DRAWN BY:	JW
CHECKED BY:	MB

WINDOW DETAILS

A-617

SECTION 01 9100

COMMISSIONING

TABLE OF CONTENTS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Attention is directed to the Contract and General Conditions and all Sections within Division 01 – General Requirements, which are hereby made a part of this Section of the Specifications.

B. This Section includes commissioning of the building envelope.

1.2 RESPONSIBLE PERSONNEL

A. Commissioning Authority: An independent commissioning authority will be retained by the Owner to act as the Commissioning Authority for the Project. The Commissioning Authority directs and approves the commissioning work.

B. Responsibility of Disciplines: The parties listed below are part of the commissioning team and will be required to participate in the commissioning process. The responsibilities relative to commissioning for each of these parties is defined in this section.

1. Designer

2. Owner

3. Commissioning Authority (Including Building Envelope Commissioning Authority)

4. Building Envelope Contractors

5. Building Envelope Testing Authority

6. General Contractor

7. All Subcontractors and building envelope elements suppliers/manufacturers that are associated with the above disciplines.

1.3 DESCRIPTION OF WORK

A. Commissioning during the construction phase shall as a minimum, achieve the following specific objectives in concert with the contract documents:

1. Verify that applicable building envelope systems are installed according to the manufacturer’s recommendations, to industry accepted minimum standards, per the contract documents and that they receive adequate operational checkout and testing by installing contractors and suppliers.

2. Verify that the As-Built Drawings have been properly completed.

3. Verify that the building envelope systems comply with the contract documents. Identify non-complying items.

4. Issue a “Recommendation of Acceptance” to the Owner stating that the systems have successfully passed functional and integrated performance testing. Describe the building envelope systems that have failed and not passed and make a recommendation for acceptance or rejection of each by the Owner.

5. Verify that O&M documentation delivered to the Owner is complete.

6. Verify that Owner’s operations staff is properly trained.

B. The commissioning process does not eliminate or reduce the responsibility of the system designers and installing contractors to provide a finished and fully functioning product.

1.4 ABBREVIATIONS AND DEFINITIONS:

1. The following are common abbreviations used in the Specifications and in the commissioning process.

A/E- Designer and Design Engineers

BEC- Building Envelope Contractors

BETA- Building Envelope Testing Authority

BECA- Building Envelope Commissioning Authority

CA- Commissioning Authority

Cx- Commissioning

FT- Functional Performance Test

GC- General Contractor

O&M- Operation and Maintenance Manuals

OPR- Owner’s Project Requirements

PFC- Prefunctional Checklist

RFI- Request For Information

Subs- Subcontractors

2. Definitions
   a. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests, O&M documentation review, and training occurs.
   b. Building Envelope Commissioning Agent (BECA): Contracted to Owner through the CA. BECA directs and coordinates day-to-day building envelope commissioning activities independently from CA.
   c. Commissioning Plan: Overall plan developed after bidding that provides structure, schedule, and coordination planning for commissioning process. A specific building envelope section will be added into the project’s commissioning plan.
   d. Contract Documents: Documents binding on parties involved in construction of this project (drawings, specifications, change orders, amendments, contracts, etc.).
   e. Deferred Functional Tests - FTs that are performed later, after Substantial Completion, due to partial occupancy, building envelope elements, seasonal requirements, design or other site conditions that disallow the test from being performed.
   f. Deficiency - a condition in the installation or function of a component or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
   g. Functional Performance Test (FT) - test of the dynamic function and operation of systems using manual (direct observation) methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is performed by the installing contractor or vendor. FTs are performed after prefunctional checklists and startup are complete.

h. Manual Test - using hand-held instruments or direct observation to verify performance.
i. Non-Compliance - See Deficiency.
j. Non-Conformance - See Deficiency.
k. Owner-Contracted Tests - tests paid for by the Owner outside the GC's contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented.
l. Phased Commissioning - Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.
m. Prefunctional Checklist (PFC) - a list of items to inspect and elementary component tests to conduct to verify proper installation of systems by the Sub. Prefunctional checklists are primarily static inspections and procedures to prepare system for initial operation. However, some prefunctional checklist items entail simple testing of the function of a component or system. The word prefunctional refers to before functional testing. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the prefunctional check listing, except for larger or more critical pieces of building envelope elements.
n. Sampling - functionally testing only a fraction of the total number of identical or near identical systems.
o. Subs or Sub-contractor- the Subcontractors to the GC who provide and install building components and systems.
p. Test Procedures - the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CA.
q. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures.
r. Post Construction Phase - Post Construction Phase for entire project.. Warranty begins at the date of Substantial Completion. Guarantees or warranties that start at the date of shipment from the factory, or from the completion date of an individual portion of the project, are not acceptable. Guarantees or warranties shall extend for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.5 COORDINATION

A. Commissioning Team. The members of the commissioning team consist of the Commissioning Authority (CA), the designated representative of the General Contractor (GC), the Designer and design engineers (A/E), and any other installing Subcontractors or suppliers of building envelope elements. The Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management: The CA is hired by the Owner, directs and coordinates all commissioning activities and reports to the Owner. All Project Team members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

C. Scheduling: The CA will work with the GC according to established protocols to schedule commissioning activities. The CA will provide sufficient notice to the GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1. The CA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. As construction progresses more detailed schedules are developed by the CA and are incorporated into the project schedule by the GC.

1.6 COMMISSIONING PROCESS

A. Building Envelope Review Process. The following narrative provides a brief overview of the typical building envelope review tasks during construction and the general order in which they occur.

1. The General Contractor will engage with the Building Envelope Testing Agency (BETA) to perform the testing identified below.

2. Building envelope review during construction begins at the Cx scope meeting conducted by the BECA where the building envelope review process is reviewed with the team members.

3. Additional meetings will be required throughout construction, scheduled by the BECA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.

4. Building envelope documentation is submitted to the BECA during the normal submittals process, including detailed installation procedures.

5. An additional “Pre-installation” meeting will be convened a minimum of two weeks prior to commencing envelope work reviewed in this section. Attendees shall include representatives from the BECA, BETA, BEC contractors of each building envelope component, the exterior wall installers, and project superintendent. Agenda shall include the following:
   a. Review of approved submittals
   b. Review of mock-ups
   c. Coordination with sequence of installation with adjacent materials
   d. Schedule for building envelope components
   e. Procedures for quality assurance

6. The BECA works with the BETA and Subs in developing the mock-up program for building envelope including which configurations should have mock-ups, when they should be completed, notification requirements of completion, tests to be performed and who shall witness and evaluate each mock-up.

7. As construction progresses, the BECA will periodically perform site walk-downs of the building envelope components and installation and document any issues or deficiencies identified.

8. The Subs, under their own direction, will complete mock-ups in accordance with the building envelope mock-up program and notifies the building envelope team that the mock-ups are ready for evaluation. The BETA and BECA evaluate the mock-ups and document observations and test results as applicable.

9. The mock-up test procedures are created and executed by the BETA and witnessed by the BECA. Items of non-compliance in material, configuration or installation are corrected at the Sub’s expense and the system retested.

10. Between the installations of each building envelope component, the BECA will perform a periodic inspection and final punch list inspection of each building envelope component and document items of non-compliance in material, configuration or installation.

1.7 RELATED WORK

A. All of the following sections apply to the Work of this section. This list does not limit the work that may be required by the GC under additional specification section for the completion of the Commissioning process.

1. Section 01 3100 – Project Management And Coordination.

2. Section 01 7700 –Closeout Procedures.

3. Divisions 2 through 12.

1.8 COMMISSIONING COMPLETION

A. The GC will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Functional Completion.

B. Commissioning activities are non-compensable and cannot be a cause for delay claims.

1.9 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned in this project. Testing requirements are part of this section. Each member of the commissioning team shall review all test procedures in this section to determine if his/her presence is required for each test.

System	**Functional Test Requirements Specified In:**
Building Envelope	4.1

1.10 RESPONSIBILITIES

A. The responsibilities of all parties in the commissioning process are provided in this section.

B. All Parties:

1. Attend commissioning scoping meeting and additional meetings, as necessary.

C. Designer:

1. Construction Phase
   a. Attend the commissioning scoping meeting and selected commissioning team meetings.
   b. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
   c. Provide any design narrative documentation requested by the CA.
   d. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
   e. Prepare and submit design intent documentation clarifications for inclusion in the O&M manuals. Review and approve the O&M manuals.

2. Post Construction Phase
   a. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. General Contractor (GC), and or Test Technician (TT):

1. Construction Phase
   a. Facilitate the coordination of the commissioning work by the CA. The GC, and TT will ensure that commissioning activities are being entered into the master schedule.
   b. Attend a commissioning scoping meeting and other commissioning team meetings.
   c. Perform the normal review of Contractor submittals and completed commissioning test results.

d. Provide a “Certificate of Readiness” document stipulating that all subject building envelope elements, systems and controls are complete and ready for functional performance testing, including building envelope mock-up installations. This certificate shall be signed by the installing contractors, as well as the GC, and shall be supported by completed pre-functional checklists and start-up reports.
e. When necessary, observe and witness prefunctional checklists, startup, envelope mock-up installations/ test preparations and functional testing of selected building envelope elements.
f. Review commissioning progress and deficiency reports.
g. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
h. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training.
i. Prepare and submit As-built documentation for inclusion in the O&M manuals.
j. Provide written notice for the completion of the commissioning testing.

2. Post Construction Phase
a. Assist the CA and Owner as necessary in the deferred testing and deficiency corrections required by the specifications.
b. Ensure that any deferred testing and any deficiency issues are addressed.

E. All Installing Sub-contractors of commissioned building envelope elements and systems: The commissioning responsibilities applicable to each of the contractors under 1.7 RELATED WORK above is as follows (all references apply to commissioned building envelope elements only):

1. Construction Phases
a. Each subcontractor is to adhere to the Project Schedule prepared at the time of the GMP/bid as it relates to their subcontract. Within 30 workdays of commencing work on this project, each subcontractor is to verify in writing that the schedule, complete with the commissioning activities, is achievable. If adjustment in the schedules is necessary, they will not be made at the “expense” of the commissioning sequence.
b. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
c. Subcontractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned building envelope elements.
d. Provide additional requested documentation (prior to normal O&M manual submittals) to the CA for development of start-up and functional testing procedures.
1) Typically this documentation will clearly identify detailed manufacturer installation procedures. It will also include full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force. In addition, the installation materials that are shipped with the building envelope elements and the field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CA.
2) The CA may request further documentation necessary for the commissioning process.
3) This data request may be made prior to normal submittals.
e. Provide a copy of the O&M manuals and submittals of commissioned building envelope elements, through normal channels, to the CA and A/E for review and approval.
f. Provide assistance to the CA in preparing the specific functional performance test procedures and envelope mock-up test procedures. Subs shall review test procedures to ensure feasibility, safety, and building envelope element protection.

g. Develop an initial checkout plan using the prefunctional checklists from the CA for all commissioned building envelope elements. Submit to CA and A/E for review and approval prior to startup.
h. Execute and document the pre functional checklists.
i. Address current A/E punch list items before functional testing.
j. Include CA in scheduling contractor testing to allow for witnessing as required by the CA.
k. Provide completed pre-functional checklists and start-up reports, signed by the responsible parties in support of the “Certificate of Readiness” stating that all building envelope elements are complete and ready for functional performance testing.

2. Acceptance Phase
a. Provide skilled technicians tools, instrumentation, equipment and materials necessary to perform building envelope testing and building system FPTs under the observation of the CA for specified building envelope elements. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving. Assist the CA in interpreting the monitoring data, as necessary.
b. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and A/E and retest the building envelope elements.
c. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions. O&M manuals are to be complete and approved for use during owner training.
d. During construction, maintain as-built red line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update as-builts as required after completion of commissioning (excluding deferred testing).
e. Provide training of the Owner’s operating staff using expert qualified personnel, as specified. Maintain sign-in sheets and provide copies to CA.
f. Coordinate with building envelope element manufacturers to determine specific requirements to maintain the validity of the warranty.

3. Post Construction Phase
a. Execute deferred functional performance testing, witnessed by the CA, according to the specifications.
b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.11 TESTING REQUIREMENTS

A. Specific functional testing requirements are listed for each system in Part 3 of this section. From these requirements, the Commissioning Authority (CA) shall develop step-by-step procedures to be executed by the Subs as directed by the Commissioning Authority. Additional testing requirements shall be provided by the CA for those systems not detailed herein. The test requirements for each building envelope element or system contain the following:

1. The contractors responsible to execute the tests, under the direction of the CA.

2. A list of the integral components being tested.

3. Prefunctional checklists associated with the components.

4. Functions and modes to be tested.

5. Required conditions of the test for each mode.

6. Special procedures.

7. Required methods of testing.

8. Required monitoring.

9. Acceptance criteria.

10. Sampling strategies allowed.

B. The testing requirements specified for commissioning are in addition to and do not replace any testing requirements specified elsewhere.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 MEETINGS

A. Scoping Meeting: Within 30 days of commencement of construction, the CA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CA.

B. Miscellaneous Meetings: Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CA will plan these meetings and will minimize unnecessary time being spent by Subs.

3.2 REPORTING

A. The CA will provide regular reports to the Owner and A/E, with increasing frequency as construction and commissioning progresses.

B. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

D. BETA will provide reports for all functional performance testing to the BECA.

E. BECA shall submit non-compliance reports to GC, CA, A/E and Owner as needed.

3.3 SUBMITTALS

A. The Commissioning authority will review submittals related to the commissioned building envelope elements for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the building envelope elements and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures.

B. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

3.4 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation:

1. The CA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review and approval and to the Subs for review. The CA will include the filled out forms in the Systems manuals.

2. BECA and A/E will witness and document results of the envelope FPTs.

B. Non-Conformance:

1. The CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the GC and A/E on a standard non-compliance form. This form may be the CA's master deficiency and resolution log.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form.

3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues.

4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.
   a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
      1) The CA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. The Sub corrects the deficiency, signs the non-compliance form or other approved document certifying that the building envelope element is ready to be retested and sends it back to the CA.
      2) The CA reschedules the test and the test is repeated.
      3) If the deficiency is identified during the retest, the cost for that retest, as well as any other retest effort, will be as indicated below in Item 8 – Cost of Retesting.
   b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
      1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the GC and to the Sub representative assumed to be responsible.
      2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner and the CA.
      3) The CA documents the resolution process.
      4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the non-compliance form or other approved document and provides it to the CA. The CA reschedules the test and the test is repeated. If the deficiency is identified during the retest, the cost for that retest, as well as any other retest effort, will be as indicated below in Item 8 – Cost of Retesting

5. The Contractor shall respond in writing to the CA and GC at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

6. The CA retains the original non-conformance forms until the end of the project.

7. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.

8. Cost of Retesting:
   a. The cost for the Sub to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
   b. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CA will direct the retesting of the building envelope elements once at no “charge” to the Subs for their time.
   c. The added time for the CA and GC to direct any retesting required because a specific start-up test item, reported to have been successfully completed by the installing contractor, but determined during FPTs or ISTs to be faulty, may be back charged to the contractor responsible for the misinformation or deficiency.
   d. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the General Contractor.

C. Approval:

1. The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA and by the A/E. The CA recommends acceptance of each test to the A/E using a standard form. The CA gives final approval on each test using the same form, providing a signed copy to the General Contractor.

3.5 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals:

1. The specific content and format requirements for the standard O&M manuals are detailed in the specific Sections.

2. CA Review:
   a. Prior to Substantial Completion, the CA shall review the O&M manuals, documentation to verify compliance with the Specifications. The CA will communicate deficiencies in the manuals to the A/E and GC. Upon a successful review of the corrections, the CA recommends approval and acceptance of these sections of the O&M manuals to the A/E and GC.

PART 4 - TESTING REQUIREMENTS

4.1 BUILDING ENVELOPE

TESTING OF FENESTRATION ASSEMBLIES

A. Parties Responsible to Execute Functional Test:

1. Vendor Support Representative

2. BETA: To execute the test protocols

3. BECA: To witness and document testing

4. Contractor financially responsible for additional testing cost if work requires retesting.

B. Integral Components or Related Building envelope elements being Tested: Prefunctional tests must be complete for all of the components listed below prior to performing this functional test.

1. Joint Sealants.

2. Glazing.

C. Prerequisites:

1. The applicable construction checklist items shall be complete and signed by the Contractor's employee having direct knowledge that work is completed and sealants are cured as necessary for testing prior to testing. The CxA will also spot-check misc. items on the CK previously completed by the installer, before the beginning of testing.

D. Functions/Modes Required To Be Tested, Test Methods:

1. The following testing requirements in Table 1 in section 4.1 below are an addition to and do not replace any testing requirements elsewhere in the project manual.

4.2 FUNCTIONAL PERFORMANCE TESTING

A. Parties Responsible to Execute Functional Test:

1. Vendor Support Representative

2. BETA: To execute the test protocols

3. BECA: To witness and document testing

4. Contractor financially responsible for additional testing cost if work requires retesting.

B. Integral Components or Related Building Envelope Elements Being Tested: Prefunctional tests must be complete for all of the components listed below prior to performing this functional test.

1. Joint Sealants.

2. Glazing.

C. Prerequisites:

1. The applicable construction checklist items shall be complete and signed by the Contractor's employee having direct knowledge that work is completed and sealants are cured as necessary for testing prior to testing. The BECA will also spot-check misc. items on the CK previously completed by the installer, before the beginning of testing.

D. Functional Performance Testing:

1. Building enclosure elements shall be tested in accordance with the requirements of the Technical Sections for these items of work. Minimum field testing requirements are indicated in the table below in this section.

2. All performance criteria to be used for the basis of field testing should be provided by the Designer. All testing should be performed in accordance with the most current AAMA and ASTM Test Methods for the assembly being tested.

3. Building enclosure assemblies shall be tested by a Third Party Independent Testing Agency retained by the parties indicated in this Project Manual in accordance with the requirements of the Technical Sections for these items of work.

4. The following is a series of functional testing to be performed by a Third-Party Testing Agency and witnessed by the Commissioning Authority:
   a. Fenestration Assemblies:
      Water Penetration and Air Infiltration Tests on representative fenestration assemblies should be performed in accordance with the Project Specifications at a minimum during the following stages of construction:
   b. Mock-Up Assemblies:
      Field testing should be performed as soon as possible after initial installation of the assemblies, at no later than 25% completion. If failure occurs, additional testing to be performed to determine source of failure and no additional installation should occur until mock-up assemblies meet the Project Performance Requirements as demonstrated through successful field testing.
   c. Production Assemblies:
      Field testing should be performed on representative production fenestration assemblies following 25%, 50% and 75% completion. Test specimens shall consist of different fenestration configurations/types during each test, unless indicated as acceptable by CxA in advance.

Fenestration			
Test Method		**Quantity**	**Frequency**
1.	Field test installed fenestration components as directed by BECA in accordance with ASTM E783 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors. The ASTM E783 test shall be conducted at an air pressure difference of 6.24 psf. The maximum allowable rate of air leakage must not exceed 0.3 cfm./ft2.	3 assemblies	Mock-up/25% completion
2.	Field test installed fenestration components as directed by BECA in accordance with ASTM 1105 Standard Test Method for Field Determination of Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform or Cyclic Static Air Pressure Difference. The ASTM 1105 test shall be conducted at an air pressure difference of 6.24 psf. No water leakage.	3 assemblies	50% completion
3.	Field test installed fenestration components as directed by BECA in accordance with AAMA 502 Voluntary Specification of Newly Installed Fenestration Products. No water leakage.	2 assemblies	75% completion
Note: (1) assembly = 100 sf or entire fenestration within wall opening.			

Joint Sealants			
Test Method		**Quantity**	**Frequency**
1.	Adhesion Testing: ASTM D4541	Mock-up/25% completion; (1) additional test after 50% completion.	25% & 50% completion.
2.	Field Adhesion Pull Test: ASTM C1521	As identified in Test Method. Min. (10) test locations per first 1,000 linear feet of joint length; then (1) test per 1,000 linear feet or (1) test floor per elevation after first 1000 linear feet.	25% to 100% completion.

END OF SECTION