State of Utah

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ADDENDUM NO. 1

Date: June 20, 2011

To: Commissioning Consultants

From: Matthias Mueller – Project Manager

Reference: The Army School System (TASS) Complex – Phase 2
Utah National Guard – Camp Williams, Utah
DFCM Project No. 11020480

Subject: **Addendum No. 1**

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	Air Barrier Standard	10 pages
	Total	11 pages

Note: This Addendum shall be included as part of the Contract Documents. Items in this Addendum apply to all drawings and specification sections whether referenced or not involving the portion of the work added, deleted, modified, or otherwise addressed in the Addendum. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to Disqualification.

While we contend that SB220 should only be potentially applicable to a contract issued after the effective date of said bill, this is to clarify that for purposes of this contract, regardless of the execution or effective dates of this contract, the status of Utah Law and remedies available to the State of Utah and DFCM, as it relates to any matter referred to or affected by said SB220, shall be the Utah law in effect at the time of the issuance of this Addendum.

1.1 SCHEDULE CHANGES: No Project Schedule changes.

1.2 GENERAL ITEMS: See attached Air Barrier Standard dated September 3, 2009.

Standardize

1.0 AIR BARRIER STANDARD

1.1 General

A. This section identifies air barrier function, materials, performance characteristics, and quality assurance options.

1.2 Commentary

A. Introduction

Air barriers, by traditional definition, are membranes or boundaries that permit below 10 perms, which is a measure of air diffusion per area. They differ from vapor barriers in that vapor barriers permit a maximum of .1 perms. Hence, all vapor barriers are air barriers, but it is possible for air barriers to not qualify as vapor barriers.

Air barriers have a significant influence on energy usage, durability, protection of interior wall components, and often waterproofing. Energy usage is directly related to air infiltration and exfiltration. As a general rule, the less air that travels across the air barrier from the inside to the outside, and vice versa, the more efficient energy usage the building has, such that well specified, designed, and installed air barriers generally yield better energy efficiency.

Air barriers play a vital role in protecting the interior contents of a building from the exterior environment, and the often overlooked negative effects the interior environment can have on exterior wall components. Both 3-dimensional water and water vapor can adversely affect the building envelope components through corrosion, dissolving, or softening, and is a necessary element for mold growth. It is well documented that water damage is the largest source of construction defect claims. Additionally, a significant portion of post construction dollars is spent resolving water intrusion problems, even in non-litigious situations.

The intent of this standard is to provide a means for specifying an air barrier that is manufactured, designed, and installed in a manner to eliminate or reduce air and water flow through the building envelope. This standard addresses numerous air and vapor barrier properties, including physical properties one should expect this material to obtain, as well as installation criteria such as the continuity of the membrane between elements. This standard provides guidance on how to specify appropriate products and qualified installers through requiring physical properties, performance history, training, and documentation. Additionally, this standard provides options for field QA/QC to verify and/or qualify field performance of the installed products.

B. Types of Air Barriers

Air barriers can be accomplished using a variety of materials including: fluid applied membranes, self adhered sheet membranes, torch applied sheets, mechanically fastened sheets, rigid boards/panels and polyurethane spray foams

(SPF). Rigid air barriers can be constructed out of several different materials, and are not limited to only sheet rock and metal panels. However, it is difficult to attain an air barrier with these systems due to the complex detailing required at terminations, penetrations, and transitional conditions. The use of spray foam polyurethane foam as air barriers is relatively new, and involves the installation of a high density foam at defined minimum thickness, and can be designed as a vapor barrier. Similar to rigid boards, a high quality degree of workmanship and detailing is required to achieve a true air barrier from SPF. Mechanically fastened sheets are commonly referred to as house wraps, and their typical uses are on single or multi-family low rise residential structures. The use of torch applied air barriers is not common. This standard only addresses fluid applied membranes and self adhered sheet membranes.

Self-adhered membranes are available as either vapor permeable or non-vapor permeable. Vapor permeable membranes are designed to limit air movement while allowing vapor to diffuse through, but also preventing the intrusion of water. Generally, a primer is needed to prepare the substrate surface before application of the membrane. Self adhered membranes are best suited for surfaces with few small penetrations and changes of plane. Self adhered membranes are better suited for spanning moderate voids or gaps compared to fluid applied membranes.

Fluid applied membranes are applied using either a solvent or water base liquid, for winter or summer conditions, respectively. These membranes can be designed to be either vapor permeable or non-vapor permeable as well. The conditions and locations where liquid applied membranes are utilized mirror the characteristics for sheet applied type membranes. However, liquid applied membranes can not generally span voids, gaps, or connections of dissimilar materials. It is very common to use sheet type membranes to accomplish penetration and transition details within the liquid applied membrane system.

C. Design

When designing an air barrier system, one needs to determine the placement of the air barriers within the wall assembly. The thermal, water vapor condensation, and water intrusion performance of the building envelope is dependent on the proper location of the air barrier, water-resistive barrier and vapor retarder, which may be accomplished with one material. If a dew point analysis determines that there is the potential for condensation to develop within a building envelope, an air barrier that is vapor permeable should be chosen if the air barrier must be installed exterior of the dew point. Often, the easier solution is to install the air barrier interior of the dew point, which places much less importance on the vapor permeability of the air barrier. A thorough evaluation of an exterior wall's performance often includes hygrothermal computer analysis. These types of analysis are more common for buildings with special environmental conditions such as natatoriums, libraries, museums, hospitals and laboratories. Moderate and high performance building should include some level of peer review of the Architectural Drawings.

It is the job of the designer to determine where to place the air barrier within a wall assembly. While there could be many different possible configurations of a wall assembly that could perform satisfactory in a given environment, there is a generally accepted configuration among designers that is considered satisfactory in most colder climates. This particular wall assembly includes (from interior to exterior):

- Interior gypsum wall board
- Back-up wall constructed from block or studs with exterior sheathing
- Air barrier that also serves as a vapor barrier and water-resistive barrier
- Continuous layer of insulation
- Drainage cavity
- Cladding

The design should accommodate for the degree of difficulty that is anticipated to construct the design. For complex projects, this is typically accomplished by providing robust details in the context of a comprehensive QA/QC program.

D. Workmanship

If the air barriers in a wall system are not installed correctly, then the entire wall system could be rendered ineffective. Proper installation can be a challenge since installers generally do not have a lot of experience with air barriers, since many different trades often attempt air barrier installation. Furthermore, poor detailing by the manufacturers can make a correct installation even more difficult to achieve. Finally, the crews need to be consistent during the fabrication process to ensure quality systems.

Prior to installation, all substrates that receive the air barrier should be examined to verify they are in compliance with contract documents and manufacturer's requirements and other conditions affecting performance. The surfaces should be free of debris, protrusions and other contaminants that would impede the application of the air barrier. All materials such as concrete and sealants should be cured to at least the minimum suggested time period. Excess mortar from masonry ties, shelf angles, and other components needs to be removed. To create smooth transitions among planes, changes in the substrate plane require the application of sealant or termination mastic beads at sharp corners and edges.

Detailing is required to ensure the air barrier membrane creates a continuous seal at all construction elements such as foundations, roofs and walls, and at junctions with different materials or construction types (windows, doors, etc.). Minimum thicknesses need to be met for fluid applied membranes and maximum thicknesses are important for vapor permeable fluid applied membranes. Air barrier membranes need top be fully adhered in all areas, such that the air barrier is considered a structural element of the wall. Air barriers should be installed on parapets, and transition membranes utilized to create continuity between roof and walls, which is a common area of air barrier discontinuities.

1.3 Referenced Standards and Codes.

A. American Society of Testing and Materials (ASTM)

1. ASTM D4541-02, Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.

2. ASTM D4263-83 (2005), Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

3. ASTM D5147-07b, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.

4. ASTM E96/E96M-05, Standard Test Methods for Water Vapor Transmission Materials.

5. ASTM E283-04, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

6. ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

7. ASTM E331-00, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

8. ASTM E783-02, Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

9. ASTM E1186-03, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.

10. ASTM E779, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.

11. ASTM E2178-03, Standard Test Method for Air Permeance of Building Materials.

12. ASTM E2357-05, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

B. National Institute of Standards and Technology (NIST)

C. Code of Federal Regulations (CFR)

1.4 Performance Requirements

A. General Air Barrier Requirements

(1) An air barrier shall perform as a continuous boundary to prevent the passage of interior condition air or exterior air from passing through the building envelope, and as a liquid-water drainage plane to control both water from condensation and liquid water penetration.

(2) An air barrier shall serve as a liquid-water drainage plane to control both water from condensation and liquid water penetration.

(3) An air barrier must accommodate substrate and building movement.

(4) All materials used to form the air barrier must be compatible and capable of sealing to adjacent assemblies and penetrations.

(5) Air barrier shall resist movement and damage from positive and negative air pressure loads, such that it is designed as a structural element.

B. Air Barrier Leakage Rates

(1) For both liquid applied and sheet applied air barrier materials, the air permeability of the material cannot exceed 0.004 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference per ASTM E2178.

(2) For both liquid applied and sheet applied air barrier materials, the air permeability of the assembly cannot exceed 0.01 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E783.

(3) For the entire structure, which includes opaque wall air barriers, fenestration products, roofing materials and below grade barriers, the air permeability of the whole building should not exceed 0.1 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft.; ASTM E779 for moderate and high performance structures. Leakage rates may be increased for lower performance structures.

(4) Vapor permeable membranes shall have a minimum of 10 perms per ASTM E96.

(5) Vapor retarding membranes exhibit a permeability between 10 and 0.1 perm per ASTM E96.

(6) Vapor barriers shall have a maximum of 0.1 perms per ASTM E96.

(7) Air barriers shall meet the requirements in ASTM E2357-05.

C. Physical Property Performance Requirements

(1) Fluid applied air barriers-to-substrate tensile adhesion: to be a minimum of 35 psi; ASTM D4541.

(2) Self adhered air barriers-to-substrate adhesion: to be a minimum of 16 psi; per ASTM D4541.

(3) Fluid applied air barrier type must be considered to have no long-term fracturing per Canadian General Standards Board (CGSB) 71-GP+24M or pass an extensibility test over ¼" crack with heat aging per ASTM C836.

(4) Fluid applied and sheet applied air barriers must pass low temperature flexibility and crack bridging tests at 23 degrees F per CGSB 37-GP-56M. Alternatively, both air barrier systems are required to pass low temperature flexibility and crack bridging testing with no cracking at 1/8" crack cycling with a minimum 10 cycles at -15 degrees F per ASTM C836.

1.5 Products

A. Membrane materials shall be approved by the manufacturer for use on the substrate to which it is being applied and for both the conditions during installation and the long-term operating conditions of the building. The manufacturer shall provide test reports identifying compliance with the performance criteria listed above. Test results shall be from an independent test agency using approved test methods to establish expected performance of the air barrier membrane.

B. Accessory products including transition membranes, caulks and sealants, primers, etc. which are in direct contact with or form part of the air barrier system, must be chemically and physically compatible with the materials to which they are applied or in contact with, and must be approved for that use by their manufacturer and the manufacturers of the air barrier materials they are in contact with.

C. Air barrier manufacturer shall provide a complete system that includes products, details and installation guidance.

1.6 Submittals

A. The following submittals are required on moderate and high performance structures:

(1) Contractor's experience in installation of the proposed products.

(2) Independent test laboratory's reports showing compliance with performance date listed above.

(3) Manufacturer's installation instructions and proof of manufacturing air barrier materials for a minimum of five years.

(4) Physical samples.

(5) Air and vapor barrier shop drawings showing the locations and extent of air barrier, including details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction. Non project specific shop drawings shall not be accepted.

(6) Contractor's Quality Control Program – The contractor shall demonstrate their approach toward maintaining quality throughout the project through testing, training and inspections.

(7) Contractor's Guarantee - The air barrier contractor shall warrant installed air barrier materials and sealants from failure to achieve air and water tight seals, and loss of adhesion or cohesion, for a period of at least two (2) years.

(8) Manufacturer's Warranty - Minimum two (2) year warranty that air barrier and accessories are free of defects and are manufactured to meet manufacturer's published properties and the requirements of this Specification. Manufacturer shall promptly replace defective materials without cost or expense to the Owner.

1.7 Quality Assurance and Quality Control Procedures

A. Building Envelope Commissioning Agent (BECA): Envelope Commissioning, including all associated testing of the air barrier, will be carried out by an independent Building Envelope Commissioning Agent working as a subcontractor to the MEP Commissioning Agent or engaged directly by the Owner. The BECA's scope of work includes all

aspects of the building envelope, but the requirements herein reflect solely the tasks related to air barriers.

B. Inspections: Air barrier materials and installation shall be inspected for compliance with following requirements.

(1) Continuity of air barrier system has been achieved, with no gaps or holes.

(2) Required membrane thickness has been achieved.

(3) Continuous structural support of air barrier system has been provided.

(4) Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.

(5) Site conditions for application temperature and dryness of substrates have been maintained.

(6) Maximum exposure time of materials to UV deterioration has not been exceeded.

(7) Transition surfaces have been prepared with adhesive primer.

(8) Laps in strips and transition strips have complied with minimum requirements and have been shingled in the moisture shedding direction (or mastic has been applied on exposed edges), with no fishmouths.

(9) Termination mastic has been applied on cut edges of sheet membrane strips.

(10) Strips and transition strips have been firmly adhered to substrate.

(11) Compatible materials have been used.

(12) Transitions at changes in direction and structural support at gaps have been provided.

(13) Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.

(14) All other specified requirements have been met.

C. Testing: Random field testing of air barrier membrane to include:

(1) A mock-up test[s] must be included to verify component and assembly performance prior to commencing with construction or during the first phase of construction. Mock-ups should include pre-tests for air and water prior to installations of cladding assuming the primary environmental separations elements are in-place.

(2) Qualitative Air Testing: Air barrier assemblies shall be tested for evidence of air leakage according to ASTM E1186, at a test pressure differential not less than 1.57 lb/sf.

a. Chamber depressurization using detection liquids: Test at seams and penetrations. Perform testing on a representative sample of the population for each 600 sq. ft. of wall area, and as selected by the BECA. If leakage is detected, perform additional tests as required and approved by the BECA.

b. Smoke pencil with pressurization or depressurization: All test locations shall include a window, and at least one location shall include a slab edge and relieving angle. Perform testing on (10% for high performance buildings, 5% for moderated performance buildings) of the total number of window units at locations selected by the BECA. The chambers used for quantitative ASTM E783 tests may be utilized for this test. If leakage is detected, perform additional tests as directed by the Commissioning Agent.

(3) Membrane/Substrate Adhesion Testing: Test in accordance with ASTM D4541 to demonstrate pull adhesion to concrete block, 35 psi minimum for fluid-applied air barrier membrane, and 16 psi minimum for modified-bitumen transition materials. Perform at least one test, consisting of a minimum of three 'pulls' for each 600 sq. ft. of wall area, and as selected by the Commissioning Agent. If test fails, perform additional tests as required and approved by the Owner's representative.

a. Each test sample shall be scored to isolate it from the remainder of the membrane material.

b. In the event that the specified tensile-adhesion requirement may exceed the tensile strength of the substrate over which the membrane has been applied, alternate test methods may be used in conjunction with ASTM D4541 if approved by the BECA.

(4) Quantitative Air Testing – Performance for both opaque wall air barriers and penetrations such as fenestration openings can be quantified using ASTM E 783. ASTM E 779 can be used to quantify whole building air infiltration rates.

D. Deficiencies – The first round of tests and inspections shall be paid by the owner and the level of services will be dictated by the complexity of the project, desired level of performance and environmental considerations. The costs for all retests for failed tests or inspections shall be borne by the contractor.