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SECTION 07 16 16  
CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section outlines the requirements for the installation of the crystalline waterproofing.

1.2 RELATED WORK

- A. Execution Requirements: Section 01 73 00 - Execution.
- B. Parge Coatings: Section 04 05 13 - Masonry Mortaring.
- C. Division 07 Section "Joint Sealants".

1.3 PERFORMANCE REQUIREMENTS

- A. The crystalline waterproofing shall be a type that chemically controls and permanently fixes a non-soluble crystalline structure throughout capillary voids of cementitious substrates preventing penetration of liquids.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Product Data: Submit the following:
1. Manufacturer's product data for waterproofing system materials giving physical properties.
  2. Manufacturer's printed instructions for application of waterproofing materials.
- C. Product Certificates: Signed by waterproofing manufacturer certifying that the waterproofing system complies with specified requirements.
- D. Certification and Approval:
1. Provide manufacturer's BOND TEST certification in compliance with Section 01 73 00 - Execution.
- E. Laboratory Test Reports:
1. Test report from an independent testing laboratory showing that the membrane materials meet specified requirements.
- F. QUALITY CONTROL
- G. Installer Qualifications: Company specializing in work of this Section with minimum 5 years continuous documented experience for waterproofing work comparable to Project Scope.

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- H. Manufacturer's Qualifications: Must have a minimum of 10 years experience manufacturing waterproofing membrane system specified in this Section.
  - I. Testing Laboratory: An independent laboratory meeting the requirements of ASTM E329 and certified by the United States Bureau of Standards.
  - J. Pre-installation Conference: Conduct conference at Project site to review methods and procedures related to crystalline waterproofing. Include all parties responsible for work of this Section, as well as Manufacturer's Representative.

#### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver packaged waterproofing materials to project site in original undamaged containers, with manufacturer's labels and seals intact.
- B. Storage: Store waterproofing materials in dry, enclosed location, at temperature and humidity conditions recommended by manufacturer

#### 1.6 PROJECT CONDITIONS

- A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.7 WARRANTY

- A. Provide written warranty signed by manufacturer and installer agreeing to repair work which exhibits defects in materials and workmanship. "Defects" shall be defined to include, but is not limited to, leakage of water, abnormal aging or deterioration, and failure to perform as required. Include removal and replacement of interior finishes (if any) and connected work.
  - 1. Warranty Period: 5 years.

#### 1.8 APPLICABLE PUBLICATIONS (Latest edition unless otherwise noted)

- A. The publications listed below form a part of this specification to the extent referenced.
- B. American Society for Testing and Materials (ASTM):
  - 1. C39 - Compressive Strength of Cylindrical Concrete Specimens.
  - 2. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
  - 3. C321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
  - 4. C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
  - 5. C452 - Standard Test Method for Potential Expansion of Portland-Cement Mortars Exposed to Sulfate.

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- 6. C944 - Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method.
  - 7. E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- C. Army Corps of Engineer (CRD):
- 1. CRD-C48-73 - Permeability of Concrete.
- D. NSF International (NSF).

## PART 2 - PRODUCTS

### 2.1 CRYSTALLINE WATERPROOFING PRODUCT

- A. Crystalline Waterproofing: Prepackaged, blend of Portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates by capillary action into cementitious substrates and reacts chemically with free lime in the presence of water to develop crystalline growth within the substrate capillaries to produce an impervious, dense, waterproof substrate.
- B. The product shall meet the following characteristics:
- 1. Permeability: 0.00 cm/sec negative side at 150 psi after 28 days per CRD C-48.
  - 2. Compressive Strength: 6330 psi at 24 hours per ASTM C109.
  - 3. Flexural Strength: 730 psi at 28 days per ASTM C348.
  - 4. Bond Strength: 690 psi at 28 days per ASTM C321.
  - 5. Sulfate Resistance: 0.0012% per ASTM C452.
  - 6. Abrasion Resistance (4000 psi concrete): 1.28 grams per ASTM C944.
- C. Patching Compound: Manufacturer's approved repair mortar for filling and patching tie holes, honeycombs, reveals, and other imperfections.
- D. Water: Potable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Conditions: Examine substrates, with Applicator present, where waterproofing is to be applied.
- 1. Proceed with application only after satisfactory conditions have been achieved.
  - 2. Notify Architect in writing of active leaks or structural defects that would affect system performance.

### 3.2 PREPARATION

- A. Protect other work from damage from cleaning, preparation, and application of crystalline waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

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- B. Stop active water leaks according to waterproofing manufacturer's written instructions.
  - C. Repair damaged or unsatisfactory substrates according to manufacturer's written instructions.
  - D. Surface Preparation:
    - 1. Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, curing compounds, form-release agents, and other contaminants to ensure waterproofing bonds to substrate surfaces.
  - E. Substrate Joints: Clean reveals according to waterproofing manufacturer's written instructions.

### 3.3 APPLICATION

- A. Comply with waterproofing manufacturer's written instructions for application.
- B. Apply in a sufficient number of coats as required to achieve the project performance requirements.

### 3.4 PROTECTION

- A. Protect applied crystalline waterproofing from rapid drying, severe weather exposure, and water accumulation in compliance with manufacturer's written instructions.

### 3.5 FIELD QUALITY CONTROL

- A. Inspection: Manufacturer's representative to inspect completed application and to provide a written report that the crystalline waterproofing application complies with manufacturer's written instructions and warranty requirements.

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**SECTION 07 18 15**  
**PEDESTRIAN TRAFFIC COATINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. This section specifies a surface applied elastomeric and composition waterproofing type membrane suitable for light pedestrian traffic and recreation areas, but not intended for heavy industrial use.
- B. Installer to advise Construction Manager in writing, of finish and curing requirements of concrete surfaces, as relates to application of the traffic coating materials, before installation of those substrates.

**1.2 RELATED WORK**

- A. Execution Requirements: Section 01 73 00 – Execution.
- B. Preparation of floor slab: Section 01 73 00 – EXECUTION.
- C. Cast-in-Place Concrete: Section 03 30 00. See EWP-5.
- D. Metal flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Color and texture of finish coat: Section 09 06 00, SCHEDULE FOR FINISHES.
- F. Interior Foot Grilles: Section 12 48 16.

**1.3 SYSTEM DESCRIPTION**

- A. Design deck coating system for concrete decks subject to pedestrian traffic and provide watertight seal of all areas receiving coating system.
- B. Provide for the following conditions:
  - 1. Mechanical room floors with the following attributes:
    - a. Elevated; e.g. supported by framing; not slab on grade.
    - b. Contain wet functions; e.g. pumps, boilers, tanks, etc.; not separate electrical rooms.
  - 2. Combined mechanical/electrical rooms with attributes as specified above for "Mechanical rooms".
  - 3. Recessed pit for foot grilles.

**1.4 TEST AREA**

- A. Before start of general application, apply the elastomeric coating as specified in a representative test area. The area shall be approximately 9 m<sup>2</sup> (100 square feet). The area to be covered by the coating shall include all site conditions such as flashings bases, corners and

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projections through the coating. Location of test area shall be determined by the Resident Engineer, and after approval, shall serve as an example for the remaining work.

#### 1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data: Each material, indicating compliance with specification requirements.
- C. Samples: Each finish color on 100 by 200 mm (4 by 8 inch) 1/8 inch thick cementitious board substrate, layered to show each coat and finish. Board to be saw-kerfed on back side to allow crack to be developed.
- D. Shop Drawings: Show areas of deck coating; identify the various wear areas.
  - 1. Detail the following at not less than half scale (6" = 1'-0"); identify all materials; show specific wall and deck construction:
    - a. Joints: Expansion joints, control joints, splices, moving and non-moving including cracks.
    - b. Changes in Plane: Corners, curbs, wall/slab, penetrations.
    - c. Terminations: Drain connections, wall and floor terminations, sleeves.
- E. Sample Warranty: Submit with shop drawings in accordance with Section 01 33 25.
- F. System Description: Provide complete description of installation of system including all components, fully described, and sequenced installation. Provide installation limitations, if any, and precautions.
- G. Installation Instructions: Furnish manufacturer's printed instructions for installation of traffic coating, including procedures and materials for flashing, splicing, bonding and fastening, where applicable. Submittal is for information only and will not be returned or approved. It shall also be include in the Owner's maintenance manual.
- H. Contamination Profile: The manufacturer shall provide the applicator, building owner and/or occupant with a tabular profile of chemicals, solutions, oils, compounds or materials which are injurious to the traffic coating membrane system. This profile shall be established by a generic (or trade name) basis, including those materials normally found to exist in the work environment or likely to occur on this work. Also, the system should not be exposed to materials (directly or indirectly) as established by the Contamination Profile.
- I. Applicator's License Certificate: Copy of "Certificate of License" issued to system applicator by manufacturer.
- J. Certification and Approval:
  - 1. Manufacturer shall certify, in writing, that Pedestrian Traffic Coating submitted is compatible with other products specified in this Section and is in conformance with Section 07 18 15 - Pedestrian Traffic Coatings.
- K. Close-out Submittals:
  - 1. Warranty: Upon completion of work under this section, submit an executed copy of the warranty in accordance with Section 01 33 25.
  - 2. Maintenance Data: Submit one copy of manufacturer's maintenance recommendations.

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- L. LEED Submittals:
1. Product Data for Credit IEQ 4.2: For interior field-applied traffic coatings, documentation including printed statement of VOC content.
- 1.6 QUALITY ASSURANCE
- A. Materials: Obtain primary traffic coating materials of type required from single manufacturer. Provide secondary materials as specified and approved by manufacturer of primary materials.
  - B. Installer: Licensed by the materials manufacturer, and shall have five years experience in the application of deck coating systems similar to the type required for this Project.
  - C. Fire: System shall have a Class A fire rating on concrete surfaces; ASTM E 108.
  - D. Pre-Traffic Coating Conference: Before installation of traffic coating and associated work, meet at project site with installer, manufacturer representatives, installers of related work, and other entities concerned with traffic coating performance, including the Construction Manager and Architect. Record discussions and agreements and furnish copy to each participant.
  - E. Material Compatibility: Provide primers; base, intermediate, and top coats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- 1.7 SEQUENCING AND SCHEDULING
- A. Mechanical Rooms: Construction Manager to coordinate and schedule work in Mechanical rooms to assure activities and sequence conforms to requirements of this Article.
  - B. Work Required Before Waterproofing Work Begins:
    1. Walls and partitions completed.
    2. Curbs completed. See "Special Work" below.
    3. Dowels for Housekeeping and Inertia Pads completed. See "Special Work" below.
    4. Concrete: Cured and moisture content at or below required level.
    5. Floor drains completed.
    6. Sleeves set. See "Special Work" below.
  - C. Prohibited Work Before Waterproofing Work Completed:
    1. Work which may:
      - a. Soil concrete substrate with deleterious substances; i.e. cutting oils.
      - b. Interfere with unobstructed surface to install waterproofing.
    2. Housekeeping Pads and Inertia Pads. See "Special Work" below.
    3. Elevated Pads for isolation pads; curbs for pads placed before waterproofing work begins.
    4. Core Drilling. See "Special Work" below.
  - D. Once waterproofing work begun, no traffic or work of any type by other trades is permitted in areas receiving waterproofing until protection assembly completed. See PROTECTION in Part 3 below.
  - E. Special Work:
    1. Curbs: Require waterproofing.
    2. Housekeeping and Inertia Pads: Waterproofing to be continuous below pads.

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- a. Pads do not require waterproofing.
  - b. Rebar dowels required to be installed with epoxy before waterproofing; waterproofing to seal dowels completely.
  3. Isolation Pads:
    - a. Curbs: To be installed before waterproofing work begins.
    - b. Pads: To be placed after waterproofing installed on curbs and below pad areas.
  4. Core Drilled Penetrations: To be sealed under this Section after post-set sleeves completed. Such penetrations, if used in lieu of pre-set sleeves, to be accessible after trade's work requiring penetration is complete in area. Flashing penetrations after installation of waterproofing subject to reimbursement in accordance with Section 01 73 29 - Cutting/Patching & Sleeves.

#### 1.8 DELIVERY AND STORAGE

- A. Deliver materials to the site in original sealed containers, clearly marked with manufacturer's name and brand, and type of material.
- B. Store materials in weathertight and dry storage facility. Protect from damage from handling, weather and construction operations before, during and after installation. Store materials at temperatures and under conditions recommended by the manufacturer.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
  1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
- B. Do not install traffic coating until items that penetrate membrane have been installed.

#### 1.10 SAFETY REQUIREMENTS

- A. Keep products away from heat, sparks and flame. Do not permit use of spark-producing equipment during application of flammable products or where explosive fumes are present.

#### 1.11 WARRANTY

- A. Warranty surfaces, where elastomeric coating has been applied, against leaks and other failures, over and above normal wear and failure of substrate, and subject to the terms of the "Warranty of Construction", FAR clause 52.246-21, except that the warranty period is five years.

#### 1.12 APPLICABLE PUBLICATIONS (Latest edition unless otherwise indicated)

- A. The publications listed below form a part of this specification to the extent referenced. The publications may be referenced in the text by basic designation only.

- B. American Society for Testing and Materials (ASTM):
1. C794-06 Adhesion-in-Peel of Elastomeric Joint Sealants
  2. C 1127 Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Water-proofing Membrane with an Integral Wearing Surface.
  3. D412-06 Vulcanized Rubber and Thermoplastic Elastomers-Tension
  4. D2240-05 Rubber Property - Durometer Hardness
  5. E96-05 Water Vapor Transmission of Materials

## PART 2 - PRODUCTS

### 2.1 PRIMER

- A. Primer: Type recommended by the coating system manufacturer.

### 2.2 ELASTOMERIC BASE AND TOP COAT

- A. Elastomeric base and top coat materials shall meet or exceed the following requirements:

Property	Test Method	Base Coat	Top Coat
Tensile Strength	ASTM D412	275 pounds per square inch or more	600 pounds per square inch or more
Elongation	ASTM D412	500 percent or more	200 percent or more
Hardness	ASTM D2240	40-50, Shore A	50, , Shore D
Peel Strength (on concrete)	ASTM C794	30 pounds or more, 100 percent cohesion	100 percent cohesion to base coat
Permeability	ASTM E96	0.12 metric perms	NA
Abrasion Resistance	120 PSI Cycles	NA	100,000
Abrasion Loss	ASTM D4060	NA	33mgms

- B. Performance Requirements:
1. Watertight seal.
  2. Traffic coating to be capable of bridging cracks in substrate up to 1/16 inch wide, developed after cured membrane installed, without damage or loss of watertight seal. System to recover to original shape upon closing of crack without loss of its properties.
  3. Traffic coating to perform within temperature extremes of -40 degrees F to 150 degrees F
- C. Top Coat Colors: Provide color and texture of finish coat indicated in Section 09 06 00 - SCHEDULE FOR FINISHES
1. Locations where color is not indicated in Construction Documents: As selected by Architect from manufacturer's full range.
  2. Architect may select up to 4 different colors. Different colors will not be used adjacent to each other.

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### 2.3 AGGREGATE

- A. Thoroughly washed, clean, medium grained sharp indigenous stone granules, graded between 1 mm and 4 mm in size, and having a hardness of 6.5 or greater on the Moh's scale.

### 2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Materials: Primer, detail coatings, flashing, bonding, adhesive, splicing, cement, lap sealant, water cut off, mastic, pipe seals, pourable sealer, and other related items shall be as recommended by membrane manufacturer.
1. Aggregate: Manufactures standard. Uniformly graded washed silica sand having minimum hardness of 6 on Moh's scale
  2. Backer Rod: As recommended by traffic coating manufacturer.
  3. Sealant: Compatible with deck coating system.
  4. Sealant Primer: Required, regardless if "self-priming". Compatible with deck coating system. As recommended by sealant manufacturer for optimum adhesion of sealant to substrates.
  5. Cants: Medium Modulus Silicone Sealant as specified in Section 07 92 00 – Joint Sealants,
  6. Filler and Joints: Low modulus, unmodified polyurethane or polysulfide as recommended by traffic coating manufacturer.
  7. Flashing Reinforcement: Woven, uncoated fiberglass mesh.
  8. Protection Board: A premolded semi-rigid protection board consisting of bitumen, mineral core and reinforcement.
    - a. Minimum Thickness: 1/8".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate and conditions under which traffic coating work is to be performed and notify Construction Manager in writing of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
1. Verify floor drains installed in areas receiving work of this Section.
- B. Cure concrete substrate a minimum of 28 days before installing traffic coating, unless this requirement is specifically waived by manufacturer, and is within permissible moisture limits recommended by manufacturer.
1. Moisture Content: Test for moisture content. Install no deck coating over concrete until the slabs have been cured and are sufficiently dry to achieve permanent bond with traffic coating assembly as determined by traffic coating manufacturer's recommended bond and moisture test.

### 3.2 SURFACE PREPARATION

- A. Clean substrate of projections, curing compounds, and substances detrimental to work or adversely affecting bond; comply with instructions of prime materials manufacturer.
- B. Concrete Slabs: Clean concrete slab using abrasive steel shot process; see PREPARATION under Section 01 73 00 - EXECUTION. Acid etching not acceptable. Small areas of concrete,

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such as stair treads, may be diamond ground in lieu of using abrasive steel shot process if results are acceptable to Resident Engineer.

- C. Bevel or round outside corners of substrate by grinding to produce a minimum 3/4 inch face or radius if not provided under Division 3.
- D. Fill holes, depressions and cracks with fillers compatible with the coating material and as recommended by the coating manufacturer. See Crack and Joint treatment below.
- E. Cleaning: Prior to application of coating, sweep areas to remove bulk residue; follow with vacuuming of concrete substrates to remove remaining dust. Air blasting, where used, must be followed by vacuuming to remove re-deposited dust.
- F. Subsurface imperfections that telegraph through the finish coating surface will not be accepted.
- G. Protect adjoining surfaces not to receive coating system from damage and keep them clean of Pedestrian Traffic Coating materials.

### 3.3 WORK COORDINATION

- A. See SEQUENCING AND SCHEDULING above.
- B. To provide a watertight installation, coordinate this work with flashing and drains required to be installed before the coating work begins and be completed after the coating is in place.

### 3.4 INSTALLATION, GENERAL

- A. General: Comply with recommendations of ASTM C 1127 and manufacturer's written instructions and details, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

### 3.5 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to INSTALLATION, GENERAL above.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced deck-to-wall butt joints.
  - 1. Use bondbreaker at unreinforced joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.
- E. Terminate membranes minimum 4 inch above wearing surface on walls, columns, curbs, and floor penetrations or higher if shown.
  - 1. Provide Concrete or sheet metal curb where suitable surface is not provided by other trades for membrane termination.

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### 3.6 JOINT AND CRACK TREATMENT

- A. Cracks:
  - 1. Comply with manufacturer's recommendations.
  - 2. Up to 1/16 Inch Wide: Strip in with minimum 3 inch wide x 20 to 30 mils coating of waterproof membrane over primed deck.
  - 3. Over 1/16 Inch Wide: Rout to 1/8 inch wide and caulk with sealant; strip sealed joint with membrane as specified above.
- B. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
- C. Fill voids, seal joints, and apply bond breakers as recommended by prime materials manufacturer, with particular attention at construction joints and expansion joints.
- D. Prime moving joints requiring use of sealants.

### 3.7 TRAFFIC COATING APPLICATION

- A. Apply traffic coating material according to ASTM C 1127 and manufacturer's written recommendations.
  - 1. Start traffic coating application in presence of manufacturer's technical representative.
  - 2. Verify that wet film thickness of each component coat complies with requirements every 100 sq. ft.
  - 3. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated and omit aggregate on vertical surfaces.
- B. Prime all surfaces to receive elastomeric waterproofing materials as recommended by the products manufacturer.
- C. Where horizontal surfaces intersect vertical surfaces provide a sealant type fillet as recommended by the manufacturers.
- D. Apply elastomeric base coat at a rate that will ensure a dry film thickness of not less than 35 mils.
- E. Uniformly disperse aggregate topping at the rate of 0.5 Kg per m<sup>2</sup> (10 lbs/100 sq. ft.); inter-bond and vulcanize granules within the fluid elastomeric topping in accordance with manufacturer's instructions.
- F. Apply elastomeric top coat at a rate which will ensure a dry film thickness of 15 mils for the top coat and a total combined dry film thickness for the base and top coats of not less than 50 mils.
- G. Complete the base to a uniform established line as shown.
- H. Allow to cure in accordance with manufacturer's recommendations.
- I. Completed work to match approved samples; be uniform in thickness, sheen, color, and texture and be free from defects detrimental to appearance or performance.

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### 3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Representative: Manufacturer's representative to be present before start of work and at the various traffic coating stages to assure conformance with proper application and provide instruction, if required, for proper traffic coating procedures, for their product.
- B. Water Test:
  - 1. Before completed membranes on horizontal surfaces are covered by protection course or other work, test for leaks with 2 inch depth of water maintained for 24 hours.
  - 2. Repair any leaks revealed by examination of substructure.
  - 3. Repeat test until no leakage is observed.
- C. Film Thickness Test: Provide test cut to verify specified dry film thickness of membrane is met.
  - 1. Perform test cut and measurement in presence of Resident Engineer and Construction Manager.
  - 2. Provide not less than one test on each floor level, and one for every 1,000 square feet of flooring on each level, in locations directed by Resident Engineer.
  - 3. Repair to approval, all cuts and replace all patches taken for inspection and testing purposes.

### 3.9 CLEANING

- A. Remove smears of elastomeric material from other work.
- B. Remove foreign matter from finished coating surfaces, masking protection, equipment, material, and debris from deck and storage area.

### 3.10 PROTECTION

- A. No traffic permitted on waterproofed deck until system is completed, cured, and tested.
- B. Installer to advise Construction Manager of permissible activity on completed assembly and required protection measures. Construction Manager to provide protection for all activities beyond normal foot traffic.
- C. Temporary Protection: No permanent protection required. Provide temporary protection over entire waterproofed surface until all work in space is completed. Protection assemblies may be increased in layers and thickness at Contractor's option, but shall be not less than listed below. All components to completely cover waterproofed area.
  - 1. Mechanical or Electrical Rooms: Include other areas with similar type activity with possible use of cutting oils and staining products.
    - a. Separator sheet of heavy kraft paper or cotton drop cloth over membrane.
    - b. Protection board, 1/8 inch thick, over separator sheet placing boards with tight butt joints.
    - c. Polyethylene sheet, minimum 6 mils thick; lap joints minimum 6 inches.
    - d. Cardboard with tight butt joints.
    - e. Plywood, particle board, or OSB, minimum ½ inch thick, with tight butt joints.
  - 2. Other Spaces Involving Scaffolding: Dry work; no cutting oils or other staining operations.
    - a. Separator sheet of heavy kraft paper or cotton drop cloth over membrane.
    - b. Protection board, 1/8 inch thick, over separator sheet placing boards with tight butt joints.
    - c. Plywood, particle board, or OSB, minimum ½ thick.

3. Other Spaces Not Involving Scaffolding: Dry work; no cutting oils or other staining operations.
  - a. Separator sheet of heavy kraft paper or cotton drop cloth over membrane.
  - b. Protection board, 1/8 inch thick, over separator sheet placing boards with tight butt joints.

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SECTION 07 19 15  
WATER AND STAIN REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Water repellent treatment with stain-resistant properties for the following exterior exposed surfaces:
1. New cast-in-place concrete work for exterior items. listed below.
    - a. Paving and curbs designated as Architectural Site Concrete.
    - b. Site walls with sandblasted finish.
- B. Related Sections:
1. Cement and Concrete for Exterior Improvements: Section 32 05 23.
  2. Architectural Site Concrete: Section 32 13 15.

1.2 REFERENCES (LATEST EDITION UNLESS OTHERWISE NOTED)

- A. American Society for Testing and Materials (ASTM):
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| C 642  | Test Method for Density, Absorption, and Voids in Hardened Concrete.                  |
| C 672  | Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals. |
| E 514  | Test Methods for Water Penetration and Leakage Through Masonry.                       |
| G 1653 | Moisture Vapor Transmission.  |
| G 154  | Accelerated Weathering.   |

1.3 PERFORMANCE REQUIREMENTS

- A. Concrete: Water absorption values for treated concrete surfaces shall not exceed 0.50 percent moisture after 48 hour submersion in water, when compared to similar untreated concrete surfaces with approximately 3.5 percent moisture after 48 hour submersion in water, according to ASTM C 642
- B. No surface staining, discoloration, darkening, or texture change is allowed as a result of treatment used.
- C. Treatment shall allow treated substrates to retain vapor permeability.
- D. Not detrimental to asphalt based products.
- E. Resistant to staining by automotive fluids and food products.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

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- B. Product Data: Submit manufacturer's specifications, installation instructions, and general recommendations for water repellents. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.
    - 1. Certified test reports indicating compliance with performance requirements specified.
  - C. Maintenance Instructions: Written instructions on cleaning automotive and food spills including recommended time limits. Include recommendations, time periods, and procedures for re-treatment.
  - D. Sample Warranty: Submit with product data in accordance with Section 01 33 25.
  - E. Closeout Submittals:
    - 1. Warranty: Upon completion of work under this section, submit an executed copy of the warranty
    - 2. Records: Submit material records and installation log specified in Part 3.

### 1.5 QUALITY ASSURANCE

- A. Manufacturer: Not less than 5 years' experience in the actual production of specified products
- B. Installer: Firm with at least three years of successful experience in application of water repellents of types required on substrates similar to those of this project; authorized by manufacturer and approved by Architect.
- C. Product Qualifications:
  - 1. Surface Appearance - No change in the surface appearance or texture.
  - 2. ASTM E514 "Water Permeance of Masonry"
    - a. 100% reduction in the leakage rate over the control
    - b. Control wall must have a leakage rate of at least 2.0 liters/hour
  - 3. ASTM G154 "Accelerated Weathering" for 2000 hours
    - a. Maximum 5% loss of effectiveness over initial water repellency
  - 4. ASTM C642 "Water Absorption of Hardened Concrete" 48 hour water soak.
    - a. Less than 0.50% absorption.
    - b. Control (untreated) concrete absorbs more than 3.5%.
  - 5. ASTM C672 "Deicer Scaling of Concrete"
    - a. Rating of treated sample 0+ after 60 cycles
    - b. Rating of untreated sample 5 after 40 to 50 cycles
  - 6. ASTM D1653 Water Vapor Transmission
    - a. 76.2 g/ft<sup>2</sup>/24 hours, 100% Breathable
  - 7. Penetration – 0.20 inches average
- D. The water and stain repellent shall conform to the following characteristics:
  - 1. Color: clear
  - 2. Density: 8.3 lbs/gallon
  - 3. Volatile Organic Compound (VOC) content: less than 25 grams per liter
  - 4. Resistance to Stains before and after accelerated weathering (ASTM G85 & D4587 2000 hours)
    - Motor Oil – excellent
    - Transmission fluid – excellent
    - Engine coolant – excellent
    - Ketchup – excellent
    - Alcoholic Beverages-excellent
    - Mustard – excellent

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- Wine – excellent
  - Vegetable oil – excellent
  - 5. Slip Resistance – UK Slip Resistance Standards
    - a. Dry conditions > 60 Four S Pendulum Units
    - b. Wet conditions > 45 Four S Pendulum Units
  - 6. Toxic Fume Emission During Fire – ISO 5659-2: None.
  - 7. Fire Propagation – UK BS 479 Part 6
    - a. Fire Propagation Index less than 4.0
  - E. Field Sample:
    - 1. Where directed by Architect, apply water repellent to test area of each type of material required to receive water repellent, including specified sample panels and mock-ups. Comply with installation requirements of this Section. Application to test effectiveness, confirm application rate and visual appearance of surfaces after treatment, and be representative of product's effect. Obtain Architect's approval before proceeding with installation.
    - 2. Test for effectiveness of water repellent treatment minimum 5 days after application by flooding with fresh water or using suitable water absorption measuring device.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in sealed containers clearly marked with manufacturer's identification including type of materials, numbered seal intact, and date of manufacture.
- B. Store materials in area protected from rain or standing water, where temperatures are not less than 0 degrees F or over 100 degrees F, with adequate ventilation, unless otherwise authorized by manufacturer.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Do not apply water repellent if any or all of the following conditions exist:
  - 1. If ambient temperature is below 35 degrees F or if ice or frost are covering substrate.
  - 2. If ambient temperature or surface temperature exceeds 100 degrees F.
  - 3. In rainy conditions or if rain is anticipated within 4 hours after application.
  - 4. If substrate is wet or damp to the eye.
  - 5. If substrate surfaces have not achieved cure period of one month.
- B. Protection:
  - 1. Protect plants and vegetation from overspray.
  - 2. Protect asphalt based materials.
  - 3. Verify compatibility with all adjacent materials. Obtain letters from the respective manufacturers indicating no objection to contact between water repellent and their product. Advise Architect of conflicts and provide suitable protection to susceptible materials. Investigate the following:
    - a. Asphalt paving.
    - b. Sealants.

#### 1.8 WARRANTY

- A. The system manufacturer shall furnish the Owner a written single source performance warranty that the Concrete Penetrating Sealer System will be free of defects related to workmanship or

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material deficiency for a ten (10) year period from the date of completion of the work provided under this section of the specification. The following performance standards shall be specifically covered under the warranty:

1. Loss of water repellency:
  - a. Concrete: 1.0 mil/20 minutes or greater(80 mph wind driven rain equivalent)
- B. All defective areas shall be retreated by the system manufacture as determined by the site survey.
- C. The Sealer Manufacturer shall be responsible for providing labor and material to reseal areas where sealer effectiveness does not meet the specified limits

## PART 2 - PRODUCTS

### 2.1 PENETRATING WATER REPELLENTS MATERIALS

- A. Silane, Penetrating Water Repellent: Clear, containing 40 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BHN Plus by Evonik.
    - b. BASF Construction Chemicals, LLC; Hydrozo Clear 40 VOC
    - c. PROSOCO, Inc.; SLX100 Water & Oil Repellent.
    - d. Aqua AG Sealer distributed by M & F Surface Solutions
  2. Basis of Design: "Aqua-Trete SG" by Evonik.
- B.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate and conditions under which water repellent is to be applied and advise Architect in writing of unsatisfactory conditions. Proceed with work only after unsatisfactory conditions have been corrected in a manner acceptable to installer.
- B. Verify that new concrete and masonry have reached required 28 day cure strength.

### 3.2 PREPARATION

- A. Perform test applications in approved areas to verify suitability of product and application rate. See Field Sample under Part 1, above.
- B. Clean surfaces to remove dust, dirt, oil, wax, other coatings, efflorescence, and other foreign materials using non-damaging high pressure water, sandblasting, or other suitable methods. Clean by hand brushing near adjacent materials.

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- C. Protect adjoining work from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of susceptible materials where there is a possibility of water repellent being deposited on surfaces. Cover plant materials with drop cloths. Clean water repellent from adjoining surfaces immediately after spillage. Comply with manufacturer's recommendations for cleaning.

### 3.3 APPLICATION

- A. Apply water repellent in accordance with manufacturer's recommendations.
- B. Apply water repellent with low pressure airless fan spray, coarse nozzle, flooding surface to obtain uniform coverage according to manufacturer's recommendation.
- C. Apply water repellent materials at a coverage rate according to manufacturer's recommendation.
- D. Use water repellent promptly once sealed containers opened; remove from site and dispose of unused water repellent remaining from containers opened more than 3 hours.
- E. Follow manufacturer's recommendations for cleanup of overspray on adjacent materials.

### 3.4 FIELD QUALITY CONTROL

- A. Spray Test: After water repellent has dried, spray coated surfaces with water.
  - 1. After surfaces have adequately dried, recoat surfaces that show water absorption.
- B. Manufacturer's Field Services:
  - 1. Furnish written certification that surface preparation method and final condition has manufacturer's approval and comply with the warranty.
  - 2. Test Area: Furnish results of test area absorption on each type of substrate. Test results shall determine application rate.
  - 3. Acceptable minimum results are as stated in the warranty provisions. Coverage rate used to pass this test section must be used on entire project.

### 3.5 RECORDS

- A. Maintain accurate records of water repellent materials delivered and removed to and from job according to batch numbers and date of manufacture.
- B. Provide log of water repellent installation, listing the following information:
  - 1. Location (i.e. vehicular paving at main entrance) and quantity expressed in gallons.
  - 2. Date of application.
  - 3. Manufacturer's batch number or other identification.
  - 4. Date water repellent was produced.

END OF SECTION

SECTION 07 21 13  
THERMAL INSULATION

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This section specifies thermal insulation.
- B. Insulation specified in this Section is not part of a firestopping assembly.

## 1.2 RELATED WORK (Items not included in this Project Manual are available through Construction Manager upon request)

- A. Lightweight Concrete Roof Insulation: Section 03 52 00.
- B. Rigid cavity wall insulation: Section 04 05 23, Masonry Accessories.
- C. SPF Insulation: Section 07 21 29.
- D. Mineral-wool board insulation: Section 07 46 15, Metal Siding.

## 1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Insulation, each type used.
  - 2. Adhesive, each type used.
- C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

## 1.4 STORAGE AND HANDLING

- A. Store insulation materials in weathertight enclosure.
- B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

## 1.5 APPLICABLE PUBLICATIONS (Latest edition unless otherwise noted)

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

- B. American Society for Testing and Materials (ASTM):
  - 1. C578 Rigid, Cellular Polystyrene Thermal Insulation

PART 2 - PRODUCTS

2.1 DESIGN / PERFORMANCE REQUIREMENTS

- A. Provide complete thermal separation between exterior and interior heated spaces with R-values of not less than the following if not provided elsewhere:
  - 1. Walls:
    - a. Above Grade: The R-values stated below are the requirements for continuous insulation. Increase the insulation in locations where insulation is not continuous, such as SPF between metal studs at the CEP Building, to obtain thermal efficiency equivalent of required continuous R-value:
      - 1) Typical: R = 13 continuous Insulation in conformance with ASHRAE 90.1-2007.
      - 2) Mass Wall Construction: R= 5.7 continuous Insulation in conformance with ASHRAE 90.1-2007.

2.2 INSULATION – GENERAL

- A. Insulation Products shall comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Rigid foam	9 percent recovered material

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

2.3 PERIMETER INSULATION IN CONTACT WITH SOIL

- A. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX where covered by soil or concrete.

2.4 RIGID INSULATION

- A. Extruded polystyrene foam: ASTM C 578, Type X, with compressive strength not less than 15 psi:
  - 1. Water Absorption: Not to exceed 0.3%.
  - 2. Fire characteristics per ASTM E 84:
    - a. Flame spread: 75 maximum.
    - b. Smoke developed: 450 maximum.

PER RFI 5227

## 2.5 SPRAY FOAM

- A. Spray Foam: Provide as specified in Section 07 21 29 - Sprayed Polyurethane Foam Insulation & Air/Vapor Barrier System.
- B. Mineral Fiber Insulation Shown on the Drawings at Parapets: Provide mineral-wool board insulation as specified in Section 07 46 15 - Metal Siding.

## 2.6 ADHESIVE

- A. As recommended by the manufacturer of the insulation.

## PART 3 - EXECUTION

## 3.1 INSTALLATION - GENERAL

- A. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.
- B. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

## 3.2 RIGID INSULATION ON SURFACE OF WALLS

- A. On the interior face of concrete walls and beams, where shown.
- B. Bond to solid vertical surfaces with adhesive as recommended by insulation manufacturer

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## SECTION 07 21 29

## SPRAYED POLYURETHANE FOAM INSULATION &amp; AIR/VAPOR BARRIER SYSTEM

## PART 1 - GENERAL

SEE RFI 04286:

Q: The existing masonry walls are to be insulated with spray foam insulation on the interior face. It should be noted that this will increase the potential for trapped moisture since the walls will no longer be able to dry to the interior. This can result in a higher potential for efflorescence in the masonry on the exterior face. 1.) Please confirm that the existing masonry walls are to be insulated with spray foam insulation on the interior face.

A: This is Confirmed.

## 1.1 SUMMARY

- A. Bid Requirements: At bid submission, provide evidence to the Contracting Officer of licensing and certification under the Air Barrier Association of America's (ABAA's) Quality Assurance Program.
- B. SPF Thermal insulation where shown.
- C. Section Includes: Spray polyurethane foam (SPF) insulation and air/vapor barrier system located in non-accessible part of the wall. Including but not limited to:
1. Connections of the walls to the roof air barrier.
  2. Underside of building structure between conditioned and unconditioned space. Thermal barrier required at this location.
  3. Connections of the walls to the foundations.
  4. Interior of masonry walls at Dixie Building.
  5. Steel supports for glazed framing systems.
  6. Frames of exterior cladding including doors, windows, curtain wall, and metal panels.
  7. Piping, conduit, duct and similar penetrations
  8. Masonry ties, screws, bolts and similar penetrations.
  9. All other air leakage pathways in the building envelope.
  10. SPF Insulation is identified by the words "Spray Foam" on the drawings.
- D. Coordinate with wall cladding trades for proper sequence and termination details of air/vapor barrier system.
- E. Definitions
1. Sprayed Polyurethane Foam (SPF).
  2. Air Barrier Association of America (ABAA).
  3. The term "vapor barrier" shall have the same meaning as "vapor retarder" unless specifically stated otherwise.
- 1.2 RELATED WORK (Items not included in this Project Manual are available through Construction Manager upon request)
- A. Positive and negative wind loads: Section 01 83 16.13 - Exterior Wind Enclosure Requirements.
- B. Insulated precast architectural concrete, wall type series "PC": Section 03 45 00 - Precast Architectural Concrete.
- C. Lightweight Concrete Roof Insulation: Section 03 52 00.
- D. Insulated masonry construction: Division 4.

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- E. Thermal Insulation: Section 07 21 13.
  - F. Exterior Insulation and Finish System (EIFS): Section 07 24 00.
  - G. Manufactured Metal Siding, wall type "MP-1": Section 07 46 15.
  - H. Fireproofing:
    - 1. Section: 07 81 00 - Cementitious Fireproofing.
    - 2. Section: 07 81 23 - Intumescent Fireproofing
  - I. Firestopping: Section 07 84 00.
  - J. Joint Sealants: Section 07 92 00.
  - K. Steel Doors and Frames: Section 08 11 13.
  - L. Glazed Aluminum Curtain Walls: Section 08 44 13.
  - M. Glazed Aluminum Curtain Walls for Dixie: Section 08 44 13.3.

### 1.3 APPLICABLE PUBLICATIONS (Latest edition unless otherwise noted)

- A. American Society for Testing and Materials (ASTM):
  - C1305-05 Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane
  - C 1338-08 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
  - C518-04 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - D1621-04a Standard Test Method for Compressive Properties of Rigid Cellular Plastics
  - D1622-03 Standard Test Method for Apparent Density of Rigid Cellular Plastics
  - D 1623-03 Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
  - D2126-04 Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
  - D2842-01 Standard Test Method for Water Absorption of Rigid Cellular Plastics
  - D2856-94 Standard Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer
  - D4541-02 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
  - D4263-83(2005) Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
  - E84-05 Test Method for Surface Burning Characteristics of Building Materials.
  - E96-05 Test Methods for Water Vapor Transmission of Materials.
  - E119-09c Methods of Fire Tests of Building Construction and Materials.

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- E2178-03 Test Method for Air Permeance of Building Materials.
  - G21-02 Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
  - B. Air Barrier Association of America (ABAA )
  - C. Underwriters' Laboratories (UL)
    - 1715-09 Fire Test of Interior Finish Material
  - D. Underwriters' Laboratories of Canada (ULC):
    - S102-07 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
    - S705.1-01 Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification, Includes Amendments 1, 2.
    - S705.2-05 Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density – Application.
    - S710.1-05 Standard for Thermal Insulation - Bead - Applied One Component Polyurethane Air Sealant Foam, Part 1: Material Specification.
    - S710.2-05 Standard for Thermal Insulation - Bead-Applied One Component Polyurethane Air Sealant Foam - Part 2: Installation.
    - S711.1-05 Standard for Thermal Insulation - Bead-Applied Two Component Polyurethane Air Sealant Foam Part 1: Material Specification.
    - S711.2 Standard for Thermal Insulation - Bead-Applied Two Component Polyurethane Air Sealant Foam - Part 2: Installation
    - S744-03 Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Submit manufacturer's product data, material specifications and installation instructions fully describing spray insulation and air barrier products and application.
- C. Shop Drawings: Submit shop drawings showing locations and extent of air/vapor barrier and details of all typical conditions, intersections with other envelope systems and materials, and membrane transition strips, Show and detail the following at not less than 3" = 1'-0":
  1. All joints in substrate.
  2. Changes in substrate.
  3. Terminations of air/vapor barrier system to adjacent substrate including frames.
  4. Penetrations through air/vapor barrier and at protrusions such as conduits, pipes electric boxes and how they are sealed.
  5. How gaps in the construction will be bridged.
  6. How inside and outside corners are negotiated.

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- D. Thermal Modeling and Calculations: Provide thermal modeling and a calculation demonstrating the insulation to be installed provides the required continuous R-Value for locations where the insulation is not installed continuous, such as SPF insulation between metal studs at the CEP building, and the insulation installed provides the thermal efficiency requirements of ASHRAE 90.1-2007 for Climate Zone 2(A, B). Thermal Modeling and Calculations, may or may not be returned, and will not bear stamp of approval. Calculations and thermal modeling shall be based on HVAC DESIGN DATA specified in Section 01 11 10 - Summary of Work
- E. Test Reports:
1. Submit copies of fire test reports of sprayed insulation application to substrate materials required.
  2. Submit certified test reports of acceptable testing agencies which perform testing in accordance with ASTM E119 and E84.
  3. Submit test results of Water Vapor Transmission of Materials, in accordance with ASTM E96.
  4. Thermal Barrier:
    - a. Fire Testing:
      - 1) Submit evidence that the cementitious thermal barrier has been subjected to foam plastic wall covering room test UL 1715/UBC 26-3 fire testing at Underwriters Laboratories Inc. by the manufacturer.
      - 2) Submit evidence that the cementitious thermal barrier has been subjected to the time-temperature exposure per ASTM E119/UBC 26-2 fire testing at Underwriters Laboratories Inc. by the manufacturer.
    - b. Test Data: Independent laboratory test results for thermal barrier shall be submitted for the following performance criteria:
      - 1) Bond Strength per ASTM E736.
      - 2) Surface Burning Characteristics per ASTM E84.
      - 3) Mold Resistance per ASTM G21.
- F. Affidavits: Furnish with initial shop drawings for this Section.
1. Furnish manufacturer's certification that materials meet or exceed specification requirements.
  2. Furnish manufacturer's certification regarding compatibility of SPF insulation and transition membrane material, per QUALITY ASSURANCE below.
  3. Furnish applicator's certification that an ABAA Lead Certifier will supervise a maximum of five ABAA registered installers. See Quality Assurance below.
- G. Affidavits: Furnish within 2 weeks after work of this Section is complete.
1. Furnish applicator's certification that material has been completed as specified to meet thickness requirements and application requirements.
- H. Warranty Submittals:
1. Sample Warranty: Submit with shop drawings in accordance with Section 01 3325.
  2. Warranty: Upon completion of work under this section, submit an executed copy of the warranty in accordance with Section 01 3325.
- I. VOC data:
1. Adhesives:
    - a. Product Data for Credit IEQ 4.1: For adhesives and chemical-bonding compounds, documentation including printed statement of VOC content.

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## 1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide all materials and products supplied and tested by a single manufacturer as a total system.
- B. Manufacturer: Regularly engaged in the production of spray insulation materials of the type required by this Section.
- C. Applicator:
1. Licensed and trained by Sprayed Polyurethane Foam (SPF) manufacturer of spray insulation materials.
  2. Licensed and certified under the Air Barrier Association of America's (ABAA's) Quality Assurance Program.
  3. Experienced in performing application of SPF materials on not less than three (3) projects with similar quantities of sprayed insulation materials.
  4. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA.
  5. Each Lead Certified Applicator can supervise a maximum of five registered installers. The Certified Applicator shall be thoroughly trained and experienced in the installation of air barriers of the types being applied. Lead Certified Applicators shall perform or directly supervise all air/vapor barrier work on the project.
  6. Air/vapor barrier installers must be trained and certified by ABAA/NECA (National Energy Conservation Association) and PSDI (Professional Skills Development Institute for energy conservation) in accordance with the training requirements outlined in the ULC S705.2 Installation Standard.
- D. SPF insulation manufacturer shall certify in writing that transition membrane is compatible with the SPF insulation, and meets requirements of ABAA for the specified system.
- E. Sample Panel: A representative surface of not less than 100 sq. ft. shall be sprayed and approved before proceeding with spray insulation work. Include joint treatment between precast panels and precast panel and curtain wall frame. Sample panel to show to details under shop drawing submittals and to demonstrate joints between exterior wall systems, firestopping at edge of slab, corner condition, termination at window openings, tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution.
- F. Testing:
1. Field Testing: On-site testing of work of this Section combined with substrate is required. Such testing is specified under Section 01 45 29 and shall be included in the contractor's bid.
  2. Field Testing: See SPRAYED-ON FIREPROOFING in Section 01 45 29 for field testing by Construction Manager.
- G. Materials utilized in the insulation and air barrier system shall comply with State and Local regulations controlling the used of volatile organic compounds (VOC's).

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages bearing name of manufacturer, product identification and reference to UL or ULC testing, or an IAS certified listing agency.
1. Reject damaged packages found unsuitable for use and remove from job site.

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- B. Store materials off ground, under cover, and away from damp surfaces. Keep materials dry at all times.
    - 1. Protect liquid adhesive from freezing.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not apply sprayed insulation when temperature of substrate material is below 40 degrees F. and surrounding air temperature is below 40 degrees F.
- B. Protection:
  - 1. Provide temporary enclosures to prevent spray from contaminating air.
  - 2. Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dust-off of sprayed insulation materials.
  - 3. Provide ventilation at interior area to receive SPF system, introducing fresh air and exhausting air continuously during and after application until foam and thermal barrier materials are dry to maintain non-toxic, unpolluted, safe working area, and as directed by the Construction Manager.

#### 1.8 SEQUENCING/SCHEDULING

- A. All trades making connections to members receiving spray insulation to install clips, hangers, and devices as required prior to installation of spray insulation.
- B. Edge of slab firestopping shall be complete and inspected prior to the installation of SPF at the interior side of exterior walls.
- C. Steel in the vicinity of the sprayed insulation application must be complete before the installation of the spray insulation can occur.
- D. All trades making connections to members receiving spray insulation to install clips, hangers, and devices as required prior to installation of spray insulation.
- E. Other trades to delay installing work which would prohibit application of spray insulation material until insulation application is completed.

#### 1.9 WARRANTY

- A. Submit written warranty, executed by Contractor and cosigned by Installer, agreeing to repair/replace insulation work of this section, which has cracked, flaked, dusted, peeled or fallen from substrate, or otherwise deteriorated to a condition where it would not perform effectively as intended for thermal insulation and air barrier purposes; due substantially to defective materials or workmanship and not to abuse by occupants, maintenance, non-foreseeable ambient exposures, or other causes beyond anticipated conditions and Contractor's/Installer's control.
- B. Warranty period is 2 years.

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**PART 2 - PRODUCTS****2.1 DESIGN / PERFORMANCE REQUIREMENTS**

- A. Provide complete thermal separation between exterior and interior heated spaces with R-values of not less than the following:
1. Walls:
    - a. Above Grade:
      - 1) Typical:
        - a) Minimum R value = 13.
        - b) Maximum U-value of Wall Assemble = 0.113.
      - 2) Between Under Side of Structure at Unconditioned Spaces and Conditioned Space above Structure: Minimum R value = 5.7 of continuous insulation in conformance with ASHRAE 90.1-2007; and the maximum U-value of the wall assemble is "0.151".
    2. Requirements for glazed areas, roofs, and other areas of construction not controllable under this Section are specified elsewhere.
- B. Provide air/vapor barrier system constructed to perform as a continuous air/vapor barrier system, as building thermal insulation, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. System shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.
1. Water vapor Permeance: less than 1 perms per ASTM E 96.
  2. Exception: Where AWB provides a continuous air/vapor barrier transition to adjacent wall construction the Sprayed Polyurethane Foam Insulation & Air/Vapor Barrier System is not required to provide an air/vapor barrier transition to adjacent wall construction.
- C. Air/vapor barrier system shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
1. Cold formed metal framed exterior walls and windows or doors.
  2. Different wall systems.
  3. Wall and roof.
  4. Wall and roof over unconditioned space.
  5. Walls and roof across construction, control and expansion joints.
  6. Walls and roof to utility, pipe and duct penetrations.
  7. Walls and bottom of floor slabs and supporting structure, where there is conditioned space above floor slab and unconditioned space below the floor slab.
- D. SPF System Characteristics:
- Moisture Permeability: 1.82 perm per inch or less, per ASTM E96 requirements, when installed on the winter warm side of building envelope enclosing conditioned space. SPF insulation shall create a vapor retarder on the warm side of the wall construction, regardless of interior and exterior temperature.
1. Air permeability: Not to exceed 0.004 cf/min/sf under a pressure differential of 0.3 in. water (1.56 psf). ASTM E2178.

2. Air Barrier Penetrations: All penetrations of air barrier and paths of air infiltration/exfiltration shall be made air-tight and tested with air leakage not to exceed 0.01 cfm/sf @ 1.57 psf.
3. Design R-Value: R= 6.0 per inch.
  - a. Aged R-Value shall exceed 6.2 per inch, ASTM C518.
4. Fire Performance Characteristics: ASTM E84.
  - a. Flame Spread: 0-25.
  - b. Smoke Developed: 0-450.
5. Density: Not less than 1.9 lbs/cu. ft., ASTM D1622.
6. Compressive strength: Not less than 15 lbs/in<sup>2</sup>(104kPa), ASTM D1621.
7. Open Cell Content: Not more than 10%, ASTM D2856.
8. Tensile Strength: Not less than 20 psi, ASTM D1623.
9. Dimensional Stability: Per ASTM D2126:
  - a. -20 Degrees Centigrade: -4 percent or less.
  - b. +80 Degrees Centigrade: +8 percent or less.
  - c. +70 Degrees Centigrade, 97 percent relative Humidity (plus or Minus 3 percent): +15 percent or less
10. Water Absorption: Not more than 4 percent; ASTM D2842.
11. Pull Adhesion: Not less than 16 pounds per square inch (110kPa) with concrete and Densglass substrates; ASTM D4541.
12. Tested and listed by the Environmental Protection Agency.
13. VOC: Comply with requirements of Section 01 81 13 - Sustainable Design Requirements.
14. Blowing Agent: Non-flammable and zero ozone-depleting product:
15. Fungi Resistance: No growth, ASTM C1338.
16. Statement: Furnish manufacturer's statement that the spray fireproofing, specified elsewhere, is an acceptable substrate for spray insulation when applied as an overcoat. Spray insulation manufacturer to verify the fireproofing manufacturer and exact type spray fireproofing proposed for the work with the Construction Manager.

## 2.2 MATERIALS

- A. Spray Polyurethane Foam (SPF) Sprayed polyurethane foam material, meeting DESIGN/PERFORMANCE REQUIREMENTS.
- B. Flashing:
  1. Exposed: Provide anodized aluminum in conformance with Section 07 60 00 - Flashing and Sheet Metal.
  2. Concealed: Provide Zinc-tin alloy-coated stainless steel in conformance with Section 07 60 00 - Flashing and Sheet Metal.
- C. Counterflashing:
  1. Metal: Through-wall flashing membrane and dampproof course (Self-Adhering) shall be a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, having the following physical properties
    - a. High Temperature Stability: 110 degrees C min. to ASTM D5147 (resistance to flow),
    - b. Thickness: 1.0 mm (40 mils) min.,
    - c. Air leakage: <0.005 L/s.m<sup>2</sup> @ 75 Pa to ASTM E283-91,
    - d. Water Vapour Permeance: 1.6 ng/Pa.m<sup>2</sup>.s (0.03 perms) to ASTM E96,
    - e. Low Temperature Flexibility: -30 degrees C to CGSB 37-GP-56M,

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- D. Primer: Provide primer recommended by manufacturer of counterflashing membrane.
  - E. Mastic, Adhesives and Tape: As recommended by air/vapor barrier manufacturer.
  - F. Membrane Transition Strip: Self-adhering sheet membrane complete with a cross-laminated polyethylene film, smooth surfaced SBS modified bitumen membrane, nominal 40 mil thickness, width as required and having the following properties:
    - 1. Film Thickness: 9.0 mils (0.225mm).
    - 2. Elongation: 200%, ASTM D417.
    - 3. Tensile Strength of Film: 4000 psi, ASTM D882.
  - G. Membrane Transition Strip Primer: Synthetic rubber based adhesive type, quick setting.
    - 1. Provide primer recommended by Membrane Transition Strip manufacturer.
  - H. Membrane Transition Strip Termination Sealant:
    - 1. Provide termination sealant recommended by membrane transition strip manufacturer.
  - I. Sheet Membrane Air Barrier Perimeter Seal:
    - 1. Neoprene: 50 to 65 mil thick, non-reinforced, cured. ASTM D 2000.
    - 2. Low modulus silicone sheet: Pre-cured low-modulus silicone extrusions.
  - J. Sealants:
    - 1. Low modulus silicone sealant; provide in accordance with Section 07 92 00 – Joint Sealants and as recommended by SPF manufacturer.
    - 2. SPF Sealant: Provide one- or two-component, foamed-in-place, polyurethane foam sealant conforming to ULC S710.1 or ULC S711.1 with the following characteristics:
      - 1) Density: 1.5 to 2.0 PCF.
      - 2) Flame Spread (ASTM E84): 25 or less.
      - 3) Initial R-Value (at 1 inch): Not less than 7.
  - K. Accessories: As needed for complete installation and as recommended by air/vapor barrier manufacturer.

## 2.3 SPRAY EQUIPMENT

- A. Equipment used for SPF: In accordance with ULC S705 and the equipment manufacturer's recommendations for specific type of application.
  - 1. Record equipment settings on the Daily Work Record.
  - 2. Not more than one spray gun permitted for each proportioner unit.

## 2.4 THERMAL BARRIER

- A. For interior use only.
- B. Provide where gypsum board does not provide a thermal barrier for plastic insulation. Thermal barrier shall meeting requirements of 2006 International Building Code.
- C. A thermal barrier shall be provided over the plastic insulation, by contractor designated by the Construction Manager. The Thermal barrier shall be gypsum board, in conformance with Section 09 29 00 - Gypsum Board; or Portland cement based material installed to meets or

exceeds the requirements of Code for separation of foam plastic from the building interior. Product must be acceptable by the sprayed polyurethane foam manufacturer as suitable protective cover for the SPF. Thermal barrier shall include Antifungal admixture factory blended into packaged thermal barrier materials.

1. The thermal performance of the thermal barrier shall not be used in obtaining the required thermal resistance of the SPF.
2. Fire Resistance Classification: The spray applied thermal barrier material shall have been tested and reported by Underwriters Laboratories Inc. fire exposure in accordance with the procedures of ANSI/ASTM E119 and UL 1715 and shall be listed in the Underwriters Laboratories Fire Resistance Directory.
  - a. Meet or exceed requirements for Thermal Barrier in paragraph 2603.4 of the 2006 International Building Code.
3. Physical Properties:
  - a. Bond Strength: 225 pounds per square foot, ASTM E736.
  - b. Fungicide:
    - 1) Portland Cement: Rating of "0" (no growth) when tested in accordance with ASTM G 21 for 120 days.
  - c. Flame Spread: 10, per ASTM E84.
  - d. Smoke Developed: 0, per ASTM E84.
4. Accessories:
  - a. Provide accessories to comply with manufacturer's recommendations and to meet fire resistance design and code requirements. Such accessories include, but are not limited to, any required or optional items such as bonding agents, mechanical attachments; and application aids such as metal lath.
5. Water: Mixing water shall be clean, fresh, and suitable for domestic consumption and free from such amounts of mineral or organic substances as would affect the set of the thermal barrier material. Provide water with sufficient pressure and volume to meet the thermal barrier application schedule

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which air/vapor barrier systems will be applied, with Installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
  1. Do not proceed with installation until after minimum concrete curing period recommended by air/vapor barrier manufacturer.
- B. Ensure that:
  1. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
  2. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
  3. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
  4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263. Cost of testing to be borne by Contractor.

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5. Notify Resident Engineer in writing of anticipated problems using air/vapor barrier over substrate.
  - C. Do not proceed with installation work until unsatisfactory conditions are corrected.
  - D. Installation of insulation is understood as acceptance of the substrates as satisfactory.

### 3.2 PRE-APPLICATION TESTING

- A. Before beginning work, test areas designated below receiving work of this Section for bond strength in accordance with ASTM E736.
  1. All substrates receiving work of this Section including painted surfaces and clay tile.
  2. Areas which have received asbestos encapsulation under WP-9A.

### 3.3 MEMBRANE INSTALLATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.
- B. Priming:
  1. Prime masonry, concrete substrates with conditioning primer when installing modified asphalt membrane transition membranes.
  2. Prime sheathing an adequate number of coats to achieve required bond to transition membranes, with adequate drying time between coats.
  3. Prime, metal and painted substrates with primer recommended by membrane manufacturer.
- C. Prepare, treat, and seal vertical and horizontal surfaces according to air/vapor barrier manufacturer's written instructions at the following locations:
  1. All joints in substrate.
  2. Changes in substrate.
  3. Terminations of air/vapor barrier to adjacent substrate.
  4. Penetrations through air/vapor barrier and at protrusions.
- D. Install membrane transition strip so as to provide continuity of the air/vapor barrier throughout the exterior walls and roof.
  1. Install in accordance with approved shop drawings based on ABAA standard details.
  2. Install transition membranes to all applicable surfaces and ensure proper adhesion of the transition membranes to the substrate, capable of having spray polyurethane foam insulation.
  3. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll into place with roller.
  4. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll seams with roller.
  5. Seal around all penetrations with a transition strip or other procedure in accordance with manufacturer's recommendations.
  6. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers,

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- exterior doors, penetrations, and other intersection conditions using transition membranes and in accordance with the manufacturer's recommendations.
  7. At changes in substrate plane, provide transition material recommended by manufacturer to make a smooth transition from one plane to another.
  8. Provide mechanically fastened metal flashing to span gaps in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate.
  9. At through-wall flashings, provide an additional 6 inch wide strip of manufacturer's recommended membrane counterflashing to seal top of through-wall flashing to membrane. Seal exposed top edge of strip with bead of mastic as recommended by manufacturer.
  10. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
  11. Examine joints before sealing to ensure configurations, surfaces and widths are suitable for spray polyurethane foam. Report in writing all defects stating the locations of joints deemed unacceptable for the application of the spray polyurethane foam.
  12. At end of each working day, seal top edge of self-adhered membrane to substrate with termination mastic if exposed.
  13. Do not allow materials to come in contact with chemically incompatible materials.
  14. Do not expose transition membrane to sunlight longer than as recommended by the manufacturer.
- E. Termination Sealant: Provide at edges of membrane transition strip which will not be covered by spray insulation.

### 3.4 SPRAY FOAM INSTALLATION

#### A. Preparation:

1. Surface Preparation
  - a. Surfaces to receive foam insulation shall be clean, dry and properly fastened to ensure adhesion of the polyurethane foam to the substrate.
  - b. Ensure that all work by other trades that may penetrate through the air barrier system is in place and complete.
  - c. Ensure that surface preparation and any primers required conform to the manufacturer's instructions.
2. Prepare surfaces by brushing, scrubbing. Scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion and integrity of the spray polyurethane foam. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam. Ensure surfaces are dry before proceeding.
3. Ensure the following items in place:
  - a. Membrane transition strips.

#### B. Protection:

1. There are odors, particulates, and vapors related to the curing and processing of various air barrier systems, sealants, and urethane foams. Contractor must follow the manufacturer's recommendations for each product during the installation. Provide the recommended levels of ventilation and alert anyone with respiratory sensitivities to evacuate the premises while the work is being done. Contractor must restrict access to

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- areas where work is proceeding with signage, and require personnel in the work area to wear proper breathing protection.
2. Mask and cover adjacent areas to protect from over spray.
  3. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
  4. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
  5. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
- C. Installation: Install Spray-application of polyurethane foam in accordance with ULC S705.2 and the manufacturer's instructions.
1. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the ULC S705.2 Installation standard.
  2. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings and as needed to meet the specified R value. Passes shall be not less than ½ inch and not greater than 2 inches.
  3. Do not install spray polyurethane foam within 3 inches of heat emitting devices such as light fixtures and chimneys.
  4. Finished surface of foam insulation to be free of voids and embedded foreign objects.
  5. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other trades.
  6. Trim, as needed, any excess thickness that would interfere with the application of cladding/covering system by other trades.
  7. Clean and restore surfaces soiled or damaged by work of the section. Consult with section of work soiled before cleaning to ensure methods used will not damage the work.
  8. Do not permit adjacent work to be damaged by work of this section. Damage to work of this section caused by other sections shall be repaired by this section at the expense of the subcontractor causing the damage.
  9. Complete connections to other components or repair any gaps, holes or other damage using one or two part polyurethane "SPF Sealant" foam material. Install in accordance with ULC S710.2 or ULC S711.2, whichever is appropriate.
- D. Tolerances: Maximum variation from indicated thickness: Minus (-) 0 inch; plus (+) ½ inch.

### 3.5 FIELD QUALITY CONTROL

- A. Site Tests: The Licensed Installer shall:
1. Perform bond test in accordance with ASTM E736 where SPF insulation is applied over existing surfaces possibly treated with encapsulate. Test for each type of substrate encountered.
  2. Conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by the ULC S705.2.
  3. Complete the Daily Work Record and record all information required including the results of the testing. Keep the Daily Work Record on site for routine inspection.
  4. Pull test transition membranes in accordance with the ABAA Quality Assurance Program requirements before installing the spray polyurethane air barrier material.
  5. Bear all costs incurred for daily testing and inspection and the completion of the Daily Work Record.

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6. Cost of the "Site Tests" to be borne by Contractor.

B. Third Party Inspections:

1. Perform inspections and testing at 5%, 50% and 95% of completion. Forward a written inspection report to the Resident Engineer and Construction Manager.
2. If the inspection reveals any defects, the Installing Contractor shall immediately rectify all such defects at his cost.

3.6 PROTECTION

- A. Protect the spray polyurethane foam from ultraviolet radiation when installed on the exterior of a building.
- B. Thermal Barrier: Cover the spray polyurethane foam with a thermal barrier when installed on the interior of the building.
1. Install in thickness as required meeting or exceeding Code requirement for thermal barrier. Where ½" thick gypsum board is properly installed as a complete envelop over the SPF insulation to meet the requirements of Chapter 26 of the 2006 International Building Code (IBC) the thermal barrier may be deleted.
  2. Provide thermal barrier system in accordance with manufacturer's instructions, approved shop drawings, and in accordance with the procedures of UL 1715, ASTM E119, and ASTM E84 and as reported by testing agency of approved thermal barrier system to meet building code requirements.

3.7 ADJUST AND CLEAN

- A. Patching: Patch damage to this work caused by:
1. Other trades before insulation is covered up, or if exposed, before final inspection. Cost of repairs for damage due to work of other trades to be borne by trades responsible for damage.
  2. Failure to provide adequate protection. Repair at no additional cost to Owner.
- B. Clean-Up: Remove all excess material, droppings, equipment and debris normal to this operation upon completion of work.

END OF SECTION

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SECTION 07 24 00  
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Exterior Finish Systems (EFS) specified in this section consist of Direct Exterior Finish Systems (DEFS) applied over substrates shown including, but not necessarily limited to, cement board sheathing.
1. Type: "Miami-Dade County Product Controlled Approval".
    - a. Soffits: Ultra-High Impact.
  2. Include vents at unconditioned DEFS soffits.

1.2 RELATED WORK

- A. Cold-Formed Metal Framing: Section 05 40 00.
- B. Cement Board Sheathing: Section 06 16 63.
- C. Air Weather Barrier: Section 07 27 30.
- D. EFS Finish Coat Textures and Colors: Section 09 06 00, Schedule for Finishes.

1.3 DESIGN REQUIREMENTS

- A. The Drawings show aesthetic design intent. Products provided must conform to design intent shown and performance levels specified. The drawings and specifications are complimentary regarding the aesthetic design intent.
- B. Source: All DEFS shall be provided by a single manufacturer for the entire project.

1.4 DEFINITION

- A. In this Section, for the purpose of exterior wind load requirements, the word "Soffit":
1. Includes relatively horizontal surfaces below floor or roof structures subject to internal pressure.
  2. Excludes surfaces subject to exterior wind loads on both sides, such as eyebrows, canopies, and other overhangs where net pressure must be considered.
- B. "Direct Exterior Finish Systems", "Direct-Applied Exterior Finish Systems", and "DEFS" are synonymous.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Provide EFS design, including comprehensive engineering analysis, by a qualified Professional Engineer, following performance requirements and design criteria

indicated. This engineered design shall include the sheathing and cold-formed metal framing support system including but not limited to material yield strength, size, thicknesses, spacing, and fastening. System dimensional depth shall not exceed that indicated on the Drawings.

B. Structural Design:

1. Wind Loads: Comply with the following or best Engineering practice, whichever is higher:
  - a. General: Follow Section 01 83 16.13, Exterior Wind Enclosure Requirements.
  - b. Soffits: At least 60 pounds per square foot positive and negative.
2. Seismic Loads: See Structural Drawings.
3. Importance Factor: See Structural Drawings.
4. Exposure Category: See Structural Drawings.
5. Additional Performance Requirements: See "Performance Criteria" Paragraph in PART 2.

C. Fire-Test-Response Characteristics: Provide EFS and system components with the following fire-test-response characteristics as determined by testing identical EFS and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
2. Full-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EFS is a part, complies with UBC Standard 26-4 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
3. Full-Scale Diversified Fire Test: Tested mockup, representative of completed multistory wall assembly of which EFS is a part, showing no significant contribution to vertical or horizontal flame spread per ASTM E 108 modified for testing vertical walls.
4. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EFS is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
5. Radiant Heat Exposure: No ignition of EFS when tested according to NFPA 268.
6. Potential Heat: Acceptable level when tested according to NFPA 259.
7. Surface-Burning Characteristics: Provide insulation board, adhesives, Base Coats, and Finish Coats with flame-spread index of 25 or less and smoke-developed index of 450 or less, per ASTM E 84.

D. Connect EFS systems with Air Weather Barriers specified in Section 07 27 30 as necessary to create integrated, continuous air barrier, vapor retarder, and liquid water drainage plane discharged to the exterior.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

1. Two 300 mm (one-foot) square samples, on cement board, of each different EFS finish required identical to the proposed installation in thicknesses, colors, textures, insulation, and workmanship.

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- C. Test Reports and Manufacturer's Literature:
1. Manufacturer's literature and instructions for installation of the system. Include manufacturer's recommended details for corner treatment, sills, soffits, dentils, quoins, lintels, openings and other special applications.
  2. Summary of test results by the Exterior Finish System manufacturer to substantiate compliance with the specified performance requirements. Furnish complete test reports as required.
  3. Statement by Exterior Finish System manufacturer that all components of the system proposed for use on this project are approved by that manufacturer.
  4. Statement by the Installer of the Exterior Finish System that they are experienced with the installation, having done at least three projects using this system and can furnish names and locations of these projects if required.
- D. Shop Drawings: For EFS. Include plans, elevations, sections, component details, penetration and termination details, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.

#### 1.7 DELIVERY AND STORAGE

- A. Deliver materials in unopened packages with manufacturer's labels intact, legible and grade seals unbroken.
- B. Store and handle in strict compliance with manufacturer's instructions. Protect from damage.
- C. Remove from premises any damaged or deteriorated material.

#### 1.8 ENVIRONMENTAL CONDITIONS

- A. Unless a higher temperature is required by the system manufacturer, the ambient air temperature shall be 7 degrees Celsius (45 degrees F) or greater and rising at the time of installation of the system and shall be predicted to remain at 7 degrees Celsius (45 degrees F) or greater for at least 24 hours after installation.

#### 1.9 WARRANTY

- A. Exterior Finish system shall be warranted against water leakage past the weather resistive barrier and other defects in materials and workmanship, and shall be subject to the terms of Article "Warranty of Construction", FAR clause 52.246-21, except that the warranty period shall be fifteen years.

#### 1.10 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications may be referenced elsewhere by basic designation only. Comply with latest editions unless otherwise indicated.
- B. American Society for Testing and Materials (ASTM):

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1. B117 Operating Salt Spray (Fog) Apparatus
  2. C67 Sampling and Testing Brick and Structural Clay Tile
  3. C177 Steady-State Heat Flux measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
  4. C297 Flatwise Tensile Strength of Sandwich Constructions
  5. C578 Rigid, Cellular Polystyrene Thermal Insulation
  6. C666 Resistance of Concrete to Rapid Freezing and Thawing
  7. C920 Elastomeric Joint Sealants
  8. D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
  9. D638 Standard Test Method for Tensile Properties of Plastics
  10. D648 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
  11. D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
  12. D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  13. D968 Abrasion Resistance of Organic Coatings by Falling Abrasive
  14. D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
  15. D2244 Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
  16. D2247 Water Resistance of Coatings in 100% Relative Humidity.
  17. D2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
  18. D3273 Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
  19. D4216 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly(Vinyl Chloride) (CPVC) Building Products Compounds
  20. E84 Surface Burning Characteristics of Building Materials
  21. E96 Water Vapor Transmission of Materials
  22. E108 Fire Tests of Roof Coverings
  23. E330 Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
  24. E331 Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
  25. E2134 Tensile Adhesion Performance of an Exterior Insulation and Finish System (EIFS)
  26. E2485 Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water Resistive Barrier Coatings
  27. G90 Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight
  28. G154 Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
  29. G155 Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
- C. EIFS Industry Members Association (EIMA):
1. 101.86 Resistance of Exterior Insulation and Finish Systems to the Effects of Rapid Deformation (Impact)
  2. 200.2 Standard Test Method for Determining the Drainage Performance of Exterior Insulation and Finish Systems (EIFS), Class PB
- D. Singapore Standards (SS):

1. SS 345 : 1990 Algae Resistant Emulsion Paint for Decorative Purposes

## PART 2 - PRODUCTS

### 2.1 EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

- A. Description: EIMA-classified PB system consisting of Type I molded rigid polystyrene insulation adhesively adhered to substrate and finished with a glass-fiber-mesh reinforced base coat and a textured finish coat.
- B. Manufacturer: Subject to compliance with the requirements, manufacturers offering EIFS products include, but are not necessarily limited to, the following:
1. Basis of Design: "StoTherm NEXt" by Sto Corp.; [www.stocorp.com](http://www.stocorp.com).
  2. Dryvit Systems; [www.dryvit.com](http://www.dryvit.com).
  3. Parex USA, Inc.; [www.parex.com](http://www.parex.com).
  4. BASF Senergy; [www.senergy.basf.com](http://www.senergy.basf.com).
  5. Others meeting the requirements.
- C. Performance Criteria:

TEST	TEST METHOD	REQUIREMENT
Flame Spread (Test samples shall include base coat, fabric, finish mounted on non-combustible substrate)	ASTM E84	Flame spread of 25 or less; smoke developed rating 450 or less
Full Scale Wall Fire Test	ASTM E108	No significant surface flaming or propagation of vertical or lateral flames
Impact Resistance (Sample shall be cured. Finish, base coat and fabric over 25mm (1 inch) insulation typical of project application)	EIMA 101.86 (Hemispherical Head Test)	Walls: High Impact Resistance: 10.2 to 17J (90-150 inch-lbs.) Soffits: Ultra High Impact Resistance: Over 17.1J (Over 150 inch-lbs.) No broken reinforcing fabric
Water Drainage	EIMA 200.2	Capable of draining water; 90% average minimum true drainage efficiency (75% if justified with compliant cementitious backer units)
Structural Performance (Test panels 1200 mm x 1200 mm (4 feet by 4 feet) typical of project application)	ASTM E330	No permanent deformation, delamination or deterioration for positive and negative pressures as required
Water Penetration	ASTM E331	No Water penetration
Abrasion Resistance	ASTM D968	500 liters of sand; slight Smoothing; No loss of film integrity
Accelerated Weathering	ASTM G90	2000 hours; no deterioration
Accelerated Weathering	ASTM G155 Cycle 1 (Xenon Arc)	5000 hours; no deleterious effects
Salt Spray Resistance	ASTM B117	Withstand 300 hours; no deleterious effects
Water Vapor	ASTM E96	Not more than 18 grains an hour per square foot

Absorption-Freeze-Thaw (Pre-weighed 100 mm x 200 mm (4" by 8") specimens; 25 mm (1") insulation, faced with finish coat cured and stored in air; tested with edges and back open.)	ASTM C67 50 Cycles: 20 hrs. at minus 9 deg C; 4-hr. thaw in water	After 50 cycles, total weight gain of not more than 6.2 grams; no checking splitting, or cracking
Freeze-Thaw Resistance	ASTM E2485 ICC - ES Proc. (AC212)	10 cycles; no deleterious effects
Instrumentally Measured Color Difference Includes yellowing)	ASTM D2244, CIELAB, 10° Observer after ASTM G154 Cycle 1	Maximum 1.05 Delta E after 5000 hours QUV
Tensile Bond	ASTM C297/E2134	>25 psi
Algae Resistance	SS 345 : 1990 (Appendix B)	8 weeks; no algae growth
Weather Resistance	ASTM D224	42 days; no deleterious effects
Mildew Resistance	ASTM D3273	28 days; no growth.

- D. Adhesive: Manufacturers standard product including primer as required compatible with sheathing.
- E. Create a means of drainage between the insulation board and substrate.
  - 1. Unless specifically indicated, drainage plane at horizontal applications, such as soffits, is optional (Contractor's option).
- F. All penetrations and terminations shall be flashed.
- G. Accessories: Conform to the recommendations of the EIFS manufacturer, including trim, edging, anchors, expansion joints, and other items required for proper installation of the EIFS. All metal items and fasteners to be corrosion resistant.
  - 1. Vinyl Accessories: Devices as necessary including corner beads, casing beads, starter strips, drips, control joints, channel reveals, and soffit vents.
    - a. General: Manufacture vinyl accessories using weatherable grade, lead-free, virgin vinyl compounds formulated and tested for exterior use.
      - 1) Comply with ASTM D1784 and D4216 cell class 13244C.
      - 2) Heat Distortion Temperature; ASTM D648 (°F @ 264 psi @ 72°F): 160.
      - 3) Coefficient of Linear Thermal Expansion; ASTM D696 (in./in. °F x 10<sup>-5</sup> at 72°F): 3.45.
      - 4) Durometer "D" Hardness: 78<sup>-3</sup>.
      - 5) Specific Gravity: 1.46.
      - 6) Plasticizers: None.
      - 7) UV resistant.
      - 8) Ignition Resistance: Self-extinguishing.
      - 9) Flanges: Perforated to facilitate EIFS matrix to flow and anchor to substrate.
      - 10) Color: White.
      - 11) Paint Adhesion: Excellent without priming.
      - 12) Other Properties (minimum):

	ASTM	@0°F	@32°F	@72°F
Tensile Strength (psi)	D638	8,100	7,500	5,900

Tensile Modulus (psi)	D638	425,000	400,000	360,000
Flexural Strength (psi)	D790	16,500	14,600	11,200
Flexural Modulus (psi)	D790	497,000	470,000	415,000
Izod Impact (ft.-lbs./in.)	D256	1.1	1.6	3.4

- b. Soffit Vents: Continuous, one-piece, 3 inches wide yielding 15 square inches vent area per linear foot.
- H. Reinforcing Fabric: Balanced, open weave, glass fiber fabric made from twisted multi-end strands specifically treated for compatibility with the other materials of the system. Weight as necessary to meet the requirements, including wind and impact resistance, except at least 4.3 oz/sq. yd.
- I. Base Coat: For PB system, manufacturer's standard product. Minimum thickness of 1-1/2 times reinforcing fabric thickness but not less than 2.4 mm (3/32 inches) wet thickness.
- J. Finish Coat: For PB system, manufacturer's standard product. Minimum thickness 1.6 mm (1/16 inch), complying with PERFORMANCE REQUIREMENTS in PART 1, including "Performance Criteria" in PART 2.
- K. Sealant: ASTM C 920; material having a minimum joint movement of 50% with 100% recovery. Type, grade and use shall be as recommended by the sealant manufacturer. When required, primer, bond breaker and backer rods shall be non-staining as recommended by the sealant manufacturer. Do not use absorptive materials as backer rods.

## 2.2 DIRECT APPLIED FINISH SYSTEM (DEFS)

- A. DEFS: Same as EIFS except as follows:
1. Description: The system consists of substrate finished with a glass-fiber-mesh reinforced base coat and a textured finish coat.
  2. Insulation and Related Adhesive: Not required.
  3. Manufacturer: Basis of Design: "StoQuick Silver" by Sto Corp.; [www.stocorp.com](http://www.stocorp.com).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate, opening supports and conditions under which this work is to be performed. Notify Resident Engineer in writing of conditions detrimental to the proper completion of this work. Proceed with work only after unsatisfactory conditions have been corrected.

### 3.2 CONTROL JOINTS

- A. See drawings for location of building control joints and surface control joints. Install surface control joints as follows except as otherwise shown on approved shop drawings:

- 
- B. Direct Exterior Finish System (DEFS): Install at 6 meters (20 feet) o.c. maximum in either direction, erecting the continuous vertical joints first at building expansion joints, intersection of dissimilar substrates or finishing materials where concentrated stresses or movement may be anticipated. Leave 13 mm (1/2") minimum continuous gap between board panels to receive control joint.

### 3.3 SEALANTS

- A. Direct Exterior Finish System (DEFS): Seal all intersections of substrate with windows, doors, control joints, and other openings and penetrations. Seal locations shown on drawings. Do not seal locations intended for water drainage.

### 3.4 ACCESSORIES

- A. Install according to manufacturer's recommendation.

### 3.5 FINISH

- A. Direct Exterior Finish System (DEFS):
1. Joint Reinforcement: Pre-fill substrate joints and trim with Base Coat mixed according to manufacturer's directions. Immediately embed reinforcing tape into wet Base Coat and tightly trowel to board surface to avoid crowning joints. Cure for a minimum of four hours before application of Base Coat.
  2. Base Coat: Apply Base Coat a minimum of 1.6 mm (1/16") uniformly smooth and flat over entire surface including joints and trim. Dampen board surface as necessary under rapid drying conditions. Embed reinforcing fabric in Base Coat while wet and cover with Base Coat material so pattern of fabric is invisible.
  3. Finish Coat: Examine Base Coat for damage or defects and repair prior to application of Finish Coat. Trowel apply ready-mixed exterior Finish Coat to Base Coat, texturing surface as specified, to a uniform thickness of 1.6 mm to 4.8 mm (1/16" to 3/16"). Provide finish surfaces that are plumb and plane with no greater deviation than 1:500 (1/4 inch in 10 feet). Dampen Base Coat as necessary under rapid drying conditions. Joining between batches shall occur at surface breaks such as corners, control joints, windows, and similar conditions.
- B. Finish Appearance: See Section 09 06 00, Schedule for Finishes, for Finish Coat textures and colors.

### 3.6 CLEAN UP

- A. Upon completion, remove all scaffolding, equipment, materials and debris from site. Remove all temporary protection installed to facilitate installation of system.

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SECTION 07 26 10  
VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Slab Vapor Retarder between new structural slab and topping slab at Level 1.
  - a. Sheet vapor retarder.
  - b. Seam tape.
  - c. Mastic.

1.2 RELATED WORK

- A. Division 03 Cast-in-Place Concrete Section(s).
- B. Division 07 Section, "Topical Vapor Retarder".

1.3 APPLICABLE PUBLICATIONS (LATEST EDITION UNLESS OTHERWISE NOTED):

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by basic designation only.
- B. American Society for Testing and Materials (ASTM)
  1. ASTM E 1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
  2. ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
  3. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
  4. ASTM F 1249 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
  5. ASTM E 1643 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Provide manufacturer's product data and installation instructions for sheet vapor retarder and related accessories.
- C. Shop drawings: Include the following:
  1. Extent of vapor retarder installation
  2. Termination and penetration details
- D. Submit for approval four samples of each type of material proposed for use.
- E. Summary of test results as per paragraph 8.3 of ASTM E 1745

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### 1.5 QUALITY ASSURANCE:

- A. Pre-Installation Conference: Conduct conference at Project site.
  - 1. Include all parties responsible for work of this section including Contractor, Manufacturer's representative, Architect, and relevant Subcontractors.
  - 2. Review methods and procedures related to the installation of the vapor retarder, and coordination between trades.

### 1.6 DELIVERY, STORAGE AND MARKING

- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer or seller.
- B. Protect from damage from handling, weather and construction operations before, during, and after installation in accordance with manufacturer's instructions.

## PART 2 - PRODUCTS

### 2.1 SHEET VAPOR RETARDER

- A. Slab Vapor Retarder must meet or exceed the following requirements:
  - 1. Permeance of less than 0.01 Perms [grains/(ft<sup>2</sup> · hr · inHg)] as tested in accordance with ASTM E 1745 Section 7
  - 2. Strength: ASTM E 1745 Class A
  - 3. Thickness: 15 mils (min)
  - 4. Puncture Resistance: 2,200 grams; ASTM D 1709.

### 2.2 ACCESSORIES

- A. Tapes:
  - 1. Joint Tape: Pressure sensitive tape produced by vapor retarder manufacturer and specifically designed for sealing joints of above and below grade vapor retarder sheets and terminations to steel and concrete substrates. Perm rating of tape shall not be less than the membrane being sealed.
  - 2. Mounting Tape: Double-faced pressure sensitive tape produced or approved by vapor retarder manufacturer and suitable for mounting vapor retarder to steel framing.
- B. Mastic: Manufacturers standard mastic recommend for use with vapor retarder sheet.
- C. Silicone Sealant: Provide in conformance with Section 07 92 00 – Joint Sealants.
- D. Pipe Boots: Premoulded devices of same material as slab vapor retarder to facilitate sealing vapor retarder to penetrations. Sizes as needed for penetrations.

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**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine substrate to ensure it is ready and suitable for installation of vapor retarder. Correct any conditions found not in accordance with manufacturers recommendations for approved substrate conditions.
- B. Beginning of installation signifies acceptance of substrate conditions.

**3.2 SLAB VAPOR RETARDER INSTALLATION**

- A. Install vapor retarder in accordance with manufacturer's instructions and ASTM E 1643
  1. Unroll vapor retarder with the longest dimension parallel with the direction of the concrete placement
  2. Lap vapor retarder over footings and/or seal to foundation walls.
  3. 1<sup>st</sup> Floor vapor retarder to lap and seal to perimeter exterior wall.
  4. Where wall vapor retarder is required to terminate with slab vapor retarder or air barrier, extend slab vapor retarder approximately 6 inches above slab to allow lapped seal.
  5. Overlap joints 6 inches and seal with manufacturer's tape
  6. Seal all penetrations (including pipes) per manufacturer's instructions
  7. Provide sealed connection with piping and penetrating features including grade stakes; use premoulded pipe seals where possible.
  8. No penetration of the vapor retarder is allowed except permanent utilities.
  9. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all sides with tape. *It is acceptable to install Bentonite granules at damaged vapor barrier around pipe penetrations (RFI 07319)*

**3.3 INSPECTION**

- A. Immediately before placing concrete slab above, conduct final review of vapor retarder installation and condition to ensure any damage occurring during subsequent work is corrected prior to the vapor retarder being concealed.

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SECTION 07 26 14  
TOPICAL FLOOR VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Topical Floor Vapor Retarder (TFVR)
1. Surface-applied vapor retarder for reducing moisture level to specified limit to prevent floor covering adhesion failure.
    - a. New concrete slabs: All floor levels.
    - b. Existing concrete slabs with new cast underlayment topping. All floor levels.
    - c. Product contributes to LEED (EQ) Low-Emitting Adhesives and Sealants.
  2. Re-testing costs.
- B. Work of this Section required when test results from Section 01 45 24, Concrete Vapor Emission & Alkalinity Testing do not meet requirements of floor covering manufacturer and is performed by trade contractor designated by Construction Manager
- C. Flooring Trades: Each contractor or subcontractor installing floor coverings whose manufacturer has requirements for maximum allowable slab water vapor emissions is required to include the following provisions in Bid.
1. Include costs for work of this Section for 100% of the total floor area for each type of flooring being bid.
    - a. List separate cost for above work.
    - b. List total amount of floor area for each type of flooring being bid.
  2. Contract cost will be adjusted on a deduct basis from actual amount of topical vapor retarder required and installed.
- D. Related Sections:
1. Concrete Vapor Emission and Alkalinity Testing: Section 01 45 24.
  2. Execution Requirements: Section 01 73 00 – Execution.
  3. Cast in Place Concrete: Section 03 30 09:
  4. Cast Underlayment: Section 03 54 00.
  5. Traffic Coatings: Division 7.
  6. Floor coverings and coatings: Division 9.

1.2 REFERENCES (latest edition unless otherwise noted)

- A. American Society for Testing and Materials (ASTM):
- |        |   |
|--------|---|
| C 109  | Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)                        |
| C 580  | Flexural Strength and Modulus of elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes. |
| D 1308 | Effect of Household Chemicals on Clear and Pigmented Organic Finishes.  |
| D 4541 | Test Method for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.  |
| E 96   | Test Methods for Water Vapor Transmission of Materials and Elements.  |

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- E 648 Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
  - E 662 Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
  - F 710 Practice for Preparing Concrete Floors to Receive Resilient Flooring.
  - F 1869 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  - F 2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

- B. International Concrete Repair Institute (ICRI): Technical Guideline No. 03732, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

### 1.3 SYSTEM DESCRIPTION

- A. Utilizes a two-component epoxy liquid penetrant to stabilize internal humidity by restricting excessive moisture and pH (alkalinity), and to mechanically regulate permeability and suppress the volume of moisture reaching concrete surfaces, for compliance with specifications and subsequent floor covering's written limits . Application methods determined by site conditions, presence of sub-slab vapor barriers for slabs-on-grade, concrete mix design and contaminants, age of concrete substrate, results of ASTM F1869-04 calcium chloride testing, and finish floor covering manufacturer's recommendations.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Moisture Control:
  1. Water Vapor Emission Reduction: System to reduce moisture level to not more than 2.0 pounds per 1,000 sq. ft. in 24 hours; ASTM F 1869.
    - a. Exception: Maximum control limited to 25 pounds per 1,000 sq. ft. in 24 hours of moisture before treatment under this Section.
  2. Relative humidity suppression: Retarder product shall suppress concrete's internal humidity from transferring to concrete floor surface. Retarder to maintain its adhesion and alkaline chemical resistance when exposed to long term 100% relative humidity exposure per ASTM F 2170.
  3. Water Vapor Transmission: Application to concrete shall mechanically restrict water vapor emission transfer by 95% per ASTM E 96 vs. un-coated concrete.
- B. Alkalinity (pH) Control: Retarder shall maintain and reduce pH level on concrete substrates from 14.00 pH to a neutral level less than 9.00 pH per ASTM F 710.
- C. Fire Performance: Materials to meet the following fire-related requirements:
  1. Critical Radiant Flux: 0.45 watts/sq. cm. or greater; ASTM E 648.
- D. Concrete Adhesion: System to have adhesion strength to concrete not less than 530 psi or concrete cohesive failure, independent lab tested; ASTM D 4541.
- E. Alkaline resistance per ASTM D 1308 at 30 day exposure; independent lab tested:
  1. 14 pH alkali solution
  2. 35% potassium hydroxide (6 times the chemical concentration vs. 14pH)

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- F. Chemical Resistance, pH 14: No retarder damage at 1 week, independent lab tested; ASTM D 1308.
  - G. Cementitious Surfacing System: Provide products meeting or exceeding strength requirements listed below
    - 1. Compressive Strength: 5,000 psi at 28 days; ASTM C 109.
    - 2. Tensile Strength: 650 psi at 28 days; ASTM C 109.
    - 3. Flexural Strength: 1,300 psi at 28 days; ASTM C 580.
    - 4. pH acceptable to floor coverings.

#### 1.5 QUALITY ASSURANCE

- A. Perform work of this Section by a single entity with responsibility for field measurements, submittals, field installation and warranty.
- B. Installer: Shall have a minimum five (5) years experience in the installation of floor covering or floor coatings and shall have a minimum of three (3) years experience in the installation of Topical Moisture Vapor Control Systems.
  - 1. Manufacturer's trained personnel.
  - 2. Factory trained and authorized installer.
- C. Manufacturer Qualifications: Manufacturer shall have a minimum five (5) years of producing moisture vapor emission control products and shall have a minimum of five (5) years of product application experience.
  - 1. Provide a minimum of 20 project references of installations completed within the last 12 months.
  - 2. Warranty and Insurance Capability: See WARRANTY below.
- D. Finish Surface: Finished surface of topical floor vapor retarder must be smooth and free of imperfections that would visibly telegraph through finish floor coverings, specified elsewhere. Finish surface must be:
  - 1. Acceptable to floor covering installing trade.
  - 2. Compatible with floor covering materials. Adhesive selection for compatibility is responsibility of floor covering manufacturer to the extent that long term performance is not compromised.
  - 3. Acceptable as a floor finish in spaces not scheduled to receive a finished floor covering.
- E. Mockups: Prior to starting application of topical floor vapor retarder, provide full scale portable Mockup to establish acceptable quality and appearance. Size not less than 2' x 2'.
  - 1. Acceptable Mockup to be standard of quality for installed work.
  - 2. Unacceptable installed work to be removed and replaced until acceptable. Aesthetically unacceptable, but well bonded work may be overlaid or recoated per manufacturer's instructions if, in Architect's opinion, additional thickness for transitions or clearances permit.

#### 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
- B. Product Data: Submit manufacturer's printed data on physical characteristics and methods of installations.

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- C. Laboratory Testing: Provide manufacturer's current year, independent laboratory results for specified ASTM methods. Reports aged over a 24 month period are invalid.
    - 1. Exception: Lab tests must be performed on proposed products which have been re-formulated since previous testing regardless of time limits.
  - D. Warranty Information: Submit a copy of Manufacturer's Warranty, as it will appear when issued upon completion of work and demonstrating compliance with this Section. Include warranty period.
  - E. Insurance Certificate: Submit product liability insurance certificate naming Owner as additionally insured. Issuance of warranty must include insurance certificate.
  - F. Letter: Manufacturer shall certify in writing that topical vapor retarder meets requirements of specifications.
  - G. Certification and Approval:
    - 1. Provide manufacturer's BOND TEST certification in compliance with Section 01 73 00 – Execution.

#### 1.7 PROJECT CONDITIONS

- A. Concrete to be cured and dry.
- B. Space Enclosure and Environmental Limitations: Space shall be:
  - 1. Enclosed, fully weather-tight, wet-work in space shall be complete and nominally dry, work above ceilings finished.
  - 2. At the same temperature and humidity expected during normal use except that in no case shall temperatures be below 65 nor more than 100 degrees F.

#### 1.8 WARRANTY

- A. Emission control system warranty must be a "joint" warranty from the manufacturer and installer, in writing, and cover manufacturing defects, concrete cohesive failure, moisture and pH control as specified under PERFORMANCE REQUIREMENTS above. In addition the warranty must extend to the flooring material, adhesive, cementitious compounds, re-application of system, preparation and installation labor.
  - 1. Warranty Period: Not less than 5 years or the life of the floor covering which ever comes first.
  - 2. Manufacturer's warranty to provide the primary coverage and will be looked to for initial relief from all claims made by the Owner.
  - 3. Contractor's warranty to provide secondary coverage to the extent that the manufacturers warranty does not apply. The Contractor will be looked to for relief from all claims made by the Owner and not provided by the manufacturer.
- B. Insurance Certificate: Manufacturer shall add Owner as additional insured on its standard product liability insurance policy. Policy coverage shall be no less than \$5,000,000 per occurrence.
- C. On-Site Conditions and Limitations of Exclusions: Assuming substrate and lower materials comply with requirements of the Contract Documents, Warranty shall not exclude any attribute of materials or conditions which may be found or discovered from review of applicable

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documents, submittals, and test data. Include concrete cohesive failure, concrete compressive strength, dew point, concrete salts, admixtures, resin and silicate surfaces treatments.

1. Barrier manufacturer is responsible for complete review of concrete mix designs, admixtures, sub slab vapor barrier and curing methods.
2. Warranty may not exclude cracks visible at time of installation, nor "improper installation".
3. Unreacted silicates shall not void warranty.
4. Installation deems acceptance of on site conditions; see EXAMINATION in Part 3 below.

## PART 2 - PRODUCTS

### 2.1 PHYSICAL PROPERTIES

#### A. Retarder Formulation: 100% Synthetic Chemistry:

1. Shall not contain acrylic, latex, silicates, colloidal gel, organic additives or chemistries that may re-emulsify or support the growth of mold, mildew or microbial growth under flooring.
2. Solid Content: 40 - 70% solids or more.

#### B. Environmental:

1. Growth Resistance: Will not support the growth of mold, mildew or microorganisms.
2. Safety: Non-corrosive, non-toxic and non-hazardous to installers.
3. Water Pollution: When exposed to natural water sources, material must not be a marine pollutant.
4. VOC Content: 100 g/l or less.

#### C. Fire Resistance: Non-combustible, non-flammable. See PERFORMANCE REQUIREMENTS in Part 1 above.

### 2.03 ACCESSORIES

#### A. Cementitious Surfacing Systems: Provide manufacturer approved cement, non-gypsum based, resurfacing material at up to 1/8 inch thickness. See "Cementitious Surfacing Systems" under PERFORMANCE REQUIREMENTS in Part 1 above.

1. Primer for non-porous surfaces or sand broad-cast is required to secure cement products to retarder surface.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

#### A. Moisture and pH testing: Specified elsewhere.

#### B. Examine surfaces to receive topical vapor retarder and verify that condition is satisfactory for the installation; notify Resident Engineer of any conditions deemed unsatisfactory for the installation; installation of vapor retarder materials is understood as installer's acceptance of the substrates as satisfactory.

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### 3.2 PREPARATION

- A. Prior to installation of vapor retarder system all walls and previously installed floor coverings shall be masked or otherwise protected from the effects of scarification and / or application.
- B. Shot blast, sand or scarify concrete surface to ensure bonding of vapor retarder system to concrete to an ICRI #3 or #4 profile in accordance with TFVR manufacturer's written instructions.
- C. Prepare and treat all cracks, control joints and cold joints per system requirements.
- D. Application of vapor retarder treatment by manufacturers trained personnel only.

### 3.3 INSTALLATION

- A. Install all products according to manufacturer's recommendations to suppress water vapor emission levels up to 25 lbs. per 1,000 square feet in 24 hours.
- B. Allow retarder to cure a minimum of 12 hours.
- C. Apply a primer for non-porous surfaces or sand-broadcast directly to retarders surface and install a final cementitious coat to facilitate floor-covering adhesive.
- D. Installer shall provide all components needed for a warranted system.

### 3.4 RE-TEST

- A. Re-test slab areas with completed topical work of this Section in accordance with Section 01 45 24. ASTM F 1869 re-test results shall be 2.0 pounds per 1,000 square feet per 24 hours. Apply additional retarder materials at no charge Owner and retest.
- B. Perform ASTM D 4541 concrete pull off adhesion test of 500 psi or concrete cohesive failure at five different locations for each separate area plus minimum 1 test per 3,000 sq. ft. or a minimum of 10 tests per project.
- C. Upon successful re-testing results, leave ready for installation of finish floor covering specified elsewhere. Advise Construction Manager, and floor covering trade when installation of their work may begin.

END OF SECTION

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SECTION 07 27 30  
AIR WEATHER BARRIER (AWB)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes:

1. This Section outlines the requirements for the installation of the air barrier/vapor retarder and related flashings. The fluid applied air barrier/vapor retarder system shall be installed behind the exterior cladding and where indicated in the drawings, to act as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. The fluid applied membrane will also act as a vapor retarder.

B. Materials installed elsewhere, and furnished under this Section:

1. AWB products to maintain the watertight integrity of AWB within the wall system, and accessories or transitioning between components provide by this Section to the AWB system at:
  - a. Composite Wall Panels: Furnished materials to Section 07 42 43 - Composite Wall Panels.
  - b. Manufactured Metal Siding: Furnished materials to Section 07 46 15 - Manufactured Metal Siding.

1.2 RELATED WORK

- A. Testing: Section 01 45 29 - Testing Laboratory Services.
- B. Division 03 Section "Cast-in-Place Concrete"
- C. Masonry cavity walls: Division 4.
- D. Cementitious Sheathing: Section 06 16 63.
- E. Facility Exterior Enclosure Commissioning: Section 07 08 00.
- F. Metal Panel Wall Cladding Sections:
  1. MP-1 metal panel wall cladding system: Section 07 46 15 - Manufactured Metal Siding.
- G. Roofing Systems:
  1. Section 07 52 16 - Styrene-Butadiene-Styrene Modified Bituminous Membrane Roofing.
- H. Sheet Metal Flashing and Trim: Section 07 60 00.
- I. Division 07 Section "Joint Sealants"
- J. Expansion Joint Cover Assemblies: Section 07 95 13.
- K. Glazed aluminum curtain wall: Section 08 44 13 and 08 44 13.3.

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### 1.3 DEFINITIONS

- A. The terms extruded silicone transition system and preformed joint sealant with aluminum adaptor, are interchangeable terms for purposes of this Section.

### 1.4 SYSTEM DESCRIPTION

- A. Design and provide a continuous AWB floor-to-floor and floor to roof covering concealed within the exterior enclosure systems of the buildings.
1. AWB to provide a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration.
  2. AWB is applied to exterior face of CMU, cast in place concrete and other concealed substrates as a continuous air barrier.
  3. Provide zinc-tin alloy-coated stainless-steel flashing or other material acceptable to Architect and compatible with silicone sealants where AWB is in contact with sealant joints exposed to view. Materials that change the color of the sealant are not acceptable. Material other than metal shall match color of sealant.
  4. AWB: Functions as an air barrier, vapor retarder, and water shedding membrane. Provide materials to maintain performance requirements where mechanical fasteners and other elements penetrate the AWB.
    - a. Exception: Where this Section specifies furnishing materials to "maintain the watertight integrity of AWB within the wall system" the installation of the furnished material shall be by the Section designated to receive said material.
  5. Provide transitions between different exterior enclosure systems.
    - a. See Glazed Aluminum Curtain Walls, Section 08 44 13 for exceptions.
    - b. Construction Manager shall designate the air weather barrier contractor responsible for transitions between exterior enclosure systems.
  6. Water-Managed Assembly: System includes a drainage plane formed over sheathing and protected by AWB installed on sheathing. Drainage plane is weeped to exterior by horizontal drainage flashing which is independent of other metal trim and accessories.
    - a. AWB laps shingle style with drainage flashing.
    - b. Drainage flashing and counter flashing specified elsewhere.
    - c. Metal Panel Wall Cladding: The AWB acts as a part of the Water-Managed Assembly specified in Metal Panel Wall Cladding Sections. The Metal Panel Wall Cladding Sections will design and provide flashing to weep water on the AWB to the exterior of the building; and counter flash to AWB in conformance with this Section.
  7. The following wall cladding system and the roofing systems are considered to have an AWB within the specified system:
    - a. Insulated precast architectural concrete panels: Section 03 45 00.
    - b. Doors and Door frames.
    - c. Glazed Aluminum Curtain Walls.
    - d. Glazing.

### 1.5 PERFORMANCE REQUIREMENTS

- A. The fluid applied air barrier/vapor retarder system shall be installed to resist rainwater penetration.
- B. The fluid applied air barrier/vapor retarder system shall resist air leakage and shall be installed such that the overall leakage of the assembly does not exceed 0.04 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft. according to ASTM E 2357

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- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference: 20 lbf/sq. ft. (718 Pa). Test panel shall be a minimum of a 10 foot by 10 foot and include horizontal and vertical joints.
  - D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference: 6.24 lbf/sq. ft. (300 Pa).
  - E. The fluid applied air barrier/vapor retarder system provided shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
  - F. Exposure: AWB must be capable of exposure to weather and ultraviolet light for not less than 30 days without detrimental effect on its properties or performance capabilities.
  - G. Nail Seal Ability: No water penetration at galvanized roof nail penetration under 5 inch head of water after 3 days at 40 degrees Fahrenheit, ASTM D1970.
  - H. Do not allow materials to come in contact with chemically incompatible materials.
  - I. AWB shall be compatible with silicone sealants.
  - J. Provide AWB transition material to EXTRUDED SILICONE TRANSITION SYSTEM specified in Section 08 44 13 - Glazed Aluminum Curtain Walls, and Preformed Extruded Silicone Joint Sealant specified in Section 07 92 00 – Joint Sealants. Provide AWB flexible membrane to wall flashing specified elsewhere. Counter flash transitions to provide a shingle style transition to shed water and maintain watertight construction.
  - K. Comply with requirements of Section 01 43 39 – Mockups. If requirements conflict with requirements stated in this Section, comply with the more stringent condition.

#### 1.6 SUBMITTALS

- A. Submit in accordance with Division 01 33 23 – “Shop drawings, Product data, and Samples”.
- B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier/vapor retarder.
- C. Shop Drawings:
  - 1. Show locations and extent of air barrier.
  - 2. Include details for substrate joints and cracks, counter flashing strip, penetrations, inside and outside corners, terminations, expansion joints, and tie-ins with adjoining construction.
  - 3. Detail transitions at changes in material substrates; and designate the name of the Contractor responsible for transition work if work is not by Contractor submitting detail.
  - 4. Detail AWB, bellows, at building expansion joints.
  - 5. Details of AWB requirements where a fastener securing a cladding system penetrates the AWB to maintain the watertight integrity of the system.
  - 6. Detail transition of typical metal flashing, with end dams, to AWB. Note any deviation to detail requirements of metal flashing is installed by Metal Siding Section.
  - 7. Detail AWB at Relief angles supporting face brick and detail transition from masonry flashing to AWB.

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8. Include connection details to glazing systems. Detail transition of AWB to EXTRUDED SILICONE TRANSITION SYSTEM provided by Section 08 44 13.
  9. Include details of interfaces with other components that form part of air barrier.
- D. Product Certificates:
1. Submit document certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the air barrier/vapor retarder; signed by product manufacturer.
  2. Submit certification by air barrier/ vapor retarder manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).
- E. Installer Certificates: Submit document stating the applicator of the air/weather barrier membranes specified in this Section is qualified by the manufacturer as suitable for the execution of the Work.
- F. Product Test Reports: Submit documentation from an approved independent testing laboratory certifying the air/weather barrier meets air leakage performance requirements in accordance with ASTM E 2357.
- G. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.

#### 1.7 QUALITY CONTROL

- A. Installer's Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Manufacturer's Qualifications: Must have a minimum of 10 years experience manufacturing air barrier/vapor retarder system specified in this Section.
- C. Source Limitations: Obtain each product for the weather/air barrier system through one source from a single manufacturer.
- D. Pre-installation Testing: Make tests determining compatibility of air barrier/vapor retarder system with substrates and other adjacent flashings as necessary to conform to manufacturer's Warranty provisions and project requirements.
1. Sealants: Comply with testing requirements in Section 07 92 00 - Joint Sealants.
- E. Pre-installation Conference: Conduct conference at Project site.
1. Include installers of other construction connecting to or coming in contact with the air barrier, including roofing, waterproofing, sealants, glazed curtain walls, and door frames.
  2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, transition details testing and inspecting procedures, and protection and repairs.
- F. Mockups: Before beginning installation of air barrier/vapor retarder, build a mockup of typical exterior wall section in accordance with Section 01 43 39 - Mockups and as follows:
1. The Mockup shall incorporate backup wall construction and typical wall details to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, tie-ins to interfaces, penetrations of air barrier/vapor retarder system and transition detail to extruded silicone joint sealant.

2. Typical detailing at openings including head jamb and sill conditions.
3. Hollow Metal doors: Provide AWB mockup indicated from mockup in Section 08 11 13 - Hollow Metal Doors and Frames.

#### 1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver and store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier/vapor retarder manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store and protect materials in compliance with manufacturer's instructions.

#### 1.9 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive the air barrier/ vapor retarder membrane.

#### 1.10 WARRANTY

- A. Air Weather Barrier work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend warranty period to 5 years from acceptance of facility by the Government.

#### 1.11 APPLICABLE PUBLICATIONS (Latest edition unless otherwise noted)

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM) Standards:
  1. E 2178 Standard Test Method for Air Permeance of Building Materials
  2. E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
  3. E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
  4. E 1677 Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls
  5. E 330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
  6. E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
  7. E 96 Water Vapor Transmission of Materials
  8. E 779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
  9. E 2112 Standard Practice for Installation of Exterior Windows, Doors and Skylights
  10. C 836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
  11. D 412 Standard Test Methods for Rubber Properties in Tension

- |     |       |  |
|-----|-------|--|
| 12. | D 903 | Standard Test Method for Peel or Stripping Strength of Adhesive Bonds  |
| 13. | D1970 | Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection |
| 14. | E84   | Surface Burning Characteristics of Building Materials  |

## PART 2 - PRODUCTS

### 2.1 AIR BARRIER/VAPOR RETARDER MEMBRANE

- A. Fluid-applied weather/air barrier membrane shall be a synthetic trowel or spray grade material with the following physical properties:

1. Nominal dry film thickness: 60 mils
2. Air permeability: 0.0002 CFM/ft<sup>2</sup> @ 75Pa per ASTM E 2178
3. Water vapor Permeance: less than 1 perms per ASTM E 96
4. Pull Adhesion Strength: 18 psi per ASTM 4541
5. Elongation: minimum 500% per ASTM D412
6. Chemical resistance: shall resist mild acids, alkalis and salt.
7. Solid Content: minimum 62%

WR Meadows peel and stick is an approved equal product per RFI 08049

### 2.2 FLEXIBLE TRANSITION FLASHING

- A. Description: 36 mils of self-adhesive butyl or rubberized asphalt integrally bonded to 4 mil of cross-laminated, high-density polyethylene film to provide a min. 40 mil thick membrane.
- B. The transition flashing shall have the following physical properties:
1. Water Vapor Transmission: 0.05 perms (max) per .ASTM E 96, Method B.
  2. Air Permeance: 0.0002 cfm/ft<sup>2</sup> max at 75Pa per ASTM E 2178
  3. Puncture Resistance: min. 40 lbs per ASTM E 154
  4. Tensile Strength: min. 400 psi per ASTM D 412, Die C Modified
  5. Elongation: min 200% per ASTM D 412 Die C.

### 2.3 FLEXIBLE MEMBRANE FLASHING

- A. Description: 32 mils of self-adhesive butyl based or rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a min. 40 mil thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed.
- B. Membrane shall have the following physical properties:
1. Water Vapor Transmission: 0.05 perm per ASTM E 96, Method B
  2. Water Absorption: max 0.1% by weight per ASTM D 570
  3. Puncture Resistance: min. 80 lbs per ASTM E 154
  4. Tear Resistance: 13lbs M.D per ASTM D 1004
  5. Tensile Strength: min. 800 psi per ASTM D 412, Die C Modified
  6. Elongation: min 200% per ASTM D412, Die C

### 2.4 PRIMER

- A. Primer for Flexible Membrane Flashing and Transition Flashing: Product recommended by manufacturer of AWB for substrate.

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## 2.5 JOINT REINFORCING STRIP:

- A. Air barrier/vapor retarder manufacturer's approved and integral glass-fiber-mesh.

## 2.6 SUBSTRATE PATCHING:

- A. Manufacturer's standard trowel-grade substrate filler.

## 2.7 SEALANTS

- A. For use to seal air barrier/vapor retarder termination mastic
  - 1. Manufacturer's recommended silicone sealants compatible with air barrier/vapor retarder membrane product.
    - a. Sealant shall be in conformance with Section 07 92 00 Joint Sealants.
- B. For use as joint sealant at interfaces with other components
  - 1. Refer to Division 07 Section "Joint Sealant"
    - a. Complies with ASTM C 920, Type S, Grade NS, Class 25
    - b. Elongation: 450 – 550%
    - c. Remains flexible with aging
  - 2. Provide sealant compatible with all materials that it comes in contact with.
    - a. Sealant changing color is not acceptable.

## 2.8 BUILDING EXPANSION JOINT MEMBRANE

- A. Provide Extruded Silicone Transition System as specified in Section 08 44 13 - Glazed Aluminum Curtain Walls with aluminum attachment bar as the AWB membrane at expansion joints.
  - 1. Membrane Width: Not less than 150% of expansion joint width.

## 2.9 AUXILIARY MATERIALS

- A. Transition Membrane between Air Barrier/Vapor Retarder and Roofing and Other Adjacent Materials: Comply with both air barrier/vapor retarder manufacturer's recommendations and roofing material manufacturer's recommendations.
- B. Others: As required for a complete installation.
- C. Zinc-Tin Alloy-Coated Stainless-Steel Flashing: Provide as specified in Section 07 60 00.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Inspect areas to receive air/barrier membrane to establish extent of work, access and need for protection of surrounding construction.

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- B. Verify compatibility with and suitability of substrates, including compatibility with existing finishes.
    - 1. Test for contaminants in substrate, as recommended by membrane manufacturer.
    - 2. Test substrates for moisture content or water vapor transmission in accordance with membrane manufacturer's recommendations.
  
  - C. Examine substrate conditions with installer and manufacturer's representative present for compliance with requirements for maximum moisture content, acceptable surface texture and other conditions affecting performance of work.
    - 1. Applicator shall examine the areas and conditions under which work of this Section will be performed.
    - 2. Verify conformance with manufacturer's requirements.
    - 3. Report unsatisfactory conditions in writing to Resident Engineer.
    - 4. Do not proceed until unsatisfactory conditions are corrected.
    - 5. Begin air barrier/vapor retarder membrane application only after unsatisfactory conditions have been corrected and surfaces are dry. Application of air barrier/vapor retarder membrane indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
  
- B. Mask off adjoining surfaces not covered by air barrier/vapor retarder to prevent spillage and overspray affecting other construction.
  
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
  
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
  
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
  
- F. Prepare, treat, rout, and fill joints and cracks in substrate according to air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks before coating surfaces.
  
- G. For large gaps exceeding manufacturer's tolerance, cover with stainless-steel sheet to provide continuous support for air barrier and to form a smooth transition from one substrate plane to another

### 3.3 APPLICATION

- A. General:
  - 1. Joints in Sheathing: Seal all joints with sealant except expansion/control joints. Joints larger than ¼" in between sheathing requires a flexible transition membrane.
  - 2. Install strips, transition strips, and auxiliary materials according to air barrier/vapor retarder manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

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- a. Coordinate the installation of air barrier/vapor retarder with installation of other building components to ensure continuity of air barrier.
  - b. Install flexible membrane strip so that a minimum of 3 inches of coverage is achieved over both substrates. 2" is acceptable at base of wall Per RFI 05925
3. Apply primer to substrates at required rate and adequate number of coats, and allow to dry in strict compliance with manufacturer's instructions.
  4. Apply air barrier/vapor retarder membrane to form a seal with strips and transition strips and to achieve a continuous air barrier/vapor retarder.
  5. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
  6. Apply joint sealants forming part of air barrier/vapor retarder assembly within manufacturer's recommended application temperature ranges.
  7. Connect and seal exterior wall air barrier membrane continuously to the air barrier plane of other building components with flexible flashing or as shown in the drawings.
  8. Maintain positive shingling effect in the laps between air barrier/vapor retarder membrane and flexible flashing, unless otherwise approved..
  9. Do not cover air barrier/vapor retarder until it has been reviewed and approved by Resident Engineer.
  10. Correct deficiencies or remove air barrier/vapor retarder that does not comply with requirements; repair substrates and reapply air barrier components.
- B. Inside and Outside Corners:
1. Seal inside and outside corners of sheathing boards with a strip of transition flashing membrane extending a minimum of 3 inches on either side of the corner detail.
  2. Apply air barrier/vapor retarder membrane over continuously over the transition flashing membrane.
- C. Transition Areas:
1. At the details where the air barrier/vapor retarder transitions from the wall to other components such as roofing, soffit, foundation walls, horizontal waterproofing, apply a strip of flexible transition membrane as follows to tie-in the air barrier, unless otherwise approved and indicated in the drawings.
  2. At the wall-to roof transition:
    - a. Apply and extend the air barrier/vapor retarder to the top of the wall.
    - b. Apply flexible transition membrane over air barrier/vapor retarder and extend to connect to roofing air barrier curb. Apply termination bar at top of membrane and seal top edge of termination bar with sealant. .
  3. At the wall-to-soffit transition:
    - a. Apply and extend the air barrier/vapor retarder up to the top of the wall.
    - b. Apply flexible transition membrane from the air barrier/vapor retarder and lap onto to the soffit air barrier plane. Apply termination bar at top of membrane and seal top edge of termination bar with sealant. .
  4. At concrete wall base transition:
    - a. Apply flexible transition membrane strip on concrete wall and extend onto the wall minimum 6 inches.
    - b. Apply air barrier/vapor retarder membrane and lap over the flexible transition membrane.
  5. At transition to horizontal waterproofing at plaza or canopy:
    - a. Apply compatible flexible membrane strip onto the plaza or canopy membrane and upturn onto the wall minimum 6 inches.
    - b. Lap air barrier/vapor retarder membrane over the flexible transition membrane.
  6. At wall to window sill and window jamb flashings and wall to louver sill and louver jamb flashings:
    - a. Apply and extend the air barrier/vapor retarder to the top of the wall and side of walls to receive metal flashing.

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- b. Apply flexible transition membrane over air barrier/vapor retarder and extend to the top of the wall and side of walls to receive metal flashing.
      - c. Exposed face of flexible transition membrane shall be compatible with Butyl Sealant specified in Section 07 60 00.
    7. Flashing at Veneer Wall:
      - a. Apply compatible flexible flashing strip at transition from cavity wall to masonry flashing.
      - b. Lap air barrier/vapor retarder membrane over the flexible flashing.
    8. Expansion/Control Joints (movement joints): Apply and extend the air barrier/vapor retarder flexible flashing membrane over control joints, extending a minimum of 3 inches on either side of joint. Create bellows in flexible flashing membrane to allow joint width to double in width. At joints wider than one inch conform to requirements of Building Expansion Joints below.
    9. Building Expansion Joints: Provide concealed transition at joint assemble with **Building Expansion Joint Membrane** (silicone) secured to substrate with stainless steel screws and continuous aluminum attachment bar. Install as a bellows to allow full movement of expansion joint. Transition from expansion joint membrane to adjacent AWB with a transition membrane compatible with both materials. Install Building Expansion Joint Membrane to provide a silicone membrane substrate for the full width of the expansion joint cover aluminum bases specified in Section 07 95 13 - Expansion Joint Cover Assemblies and Section 07 72 00 - Roof Accessories. Install Building Expansion Joint Membrane and Joint Bonding Sealant in conformance with Extruded Silicone Transition System specified in Section 08 44 13 - Glazed Aluminum Curtain Walls.
    10. Spanning Gaps: Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. AWB transition and flashing membrane shall be continuously supported by substrate or as recommended by the manufacturer.
      - a. Non-Corrosive Metal: Provide zinc-tin alloy-coated stainless-steel sheet as specified in Section 07 60 00 - Flashing and Sheet Metal
      - b. "Spanning Gaps" does not apply to building expansion joints.
  - D. Glazing Systems
    1. Wrap rough openings with self-adhering membrane as detailed.
    2. Apply flexible membrane to tie to the glazing system air barrier plane as detailed.
      - a. Exception: Preformed silicone sheet flash to AWB by Section 08 44 13.
    3. Apply air/barrier membrane over flexible membrane; and ensure 3 inches minimum lap. Seal leading edges with termination mastic.
  - E. Penetrations:
    1. Seal joint around the penetrations of air barrier membrane with compatible sealant.
    2. Apply flexible membrane to wrap onto the penetrating feature. Seal edges with termination mastic.
    3. Apply air barrier/vapor retarder membrane over the flexible membrane and ensure a minimum of 3 inches overlap.
  - F. Through-Wall Flashing: Flexible through-wall flashing at brick and cast stone provided by Section 04 05 23 - Masonry Accessories. Install AWB continuous over shelf angles, relief angles, and similar structures and as required to maintain continuous AWB prior to the installation of flashing provided by Section 04 05 23 - Masonry Accessories.

### 3.4 FIELD QUALITY CONTROL AND TESTING

- A. Thickness Gage Test: Test to be conducted by contractor

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1. Perform thickness gage tests for every 100 sq-ft. For each testing session, verify thickness of the membrane at a minimum of three (3) locations.
  2. Maintain test log and submit report to Resident Engineer indicating tests, locations, dates, results, and remedial actions.
- B. Air Leakage Testing:
1. Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.
  2. Testing to be performed will be determined by Owner's testing agency from among the following tests:
    - a. Qualitative Testing: Air barrier/vapor retarder assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
    - b. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E 783.
    - c. Quantitative Water Leakage Testing:
- C. Building:
1. Owner may engage a qualified testing agency to conducting quantitative air leakage testing for the building assemblies per ASTM E 779-03.
  2. Extent of testing to be performed will be determined by Owner's testing agency:
    - a. Whole building, floors, or suites.
- D. Manufacturers Field Review:
1. Coordinate with the manufacturer's technical representative to conduct periodic in-progress inspections to verify installation is in compliance with manufacturer's recommendations and meets all warranty requirements. The number of site attendance shall be no less than four times including at the start of the installation, and at intervals approximately 25%, 50% and 90% completion. The manufacturer shall provide a written report of their observations.
  2. Final Inspection: Arrange for manufacturer's technical personnel to inspect air barrier/vapor retarder system installation on completion. A final inspection report from the Technical Representative, certifying that the fluid applied air barrier/vapor retarder system has been satisfactorily installed in according with the manufacturer's warranty requirements shall be provided.

### 3.5 PROTECTION AND CLEAN UP

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
  2. Protect air barrier from contact with non-compatible materials such as creosote, uncured coal-tar products, flexible PVC membranes, and sealants not approved by air barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

--- E N D ---

SECTION 07 42 15  
INSULATED-CORE METAL WALL PANELS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. The Insulated-Core Metal Wall Panels shall be blast resistant, and meet or exceed blast resistant requirements specified.
2. Metal panel systems specified in this Section apply to wall type "MP-2", ~~"MP-2A", and "MP-4"~~. See drawings for locations of wall types designated as MP-2 ~~and MP-4~~.
3. Wall Type "MP-2" ~~and "MP-2A"~~: Foamed-insulation-core vertical metal wall panel assembly with integral reveals and profiled panels, with related metal trim and accessories, structural steel backup, cold-formed metal framing, exterior sheathing, and air weather barrier. ~~System includes some wall panels installed in horizontal direction and soffit panels.~~
- ~~4. Wall Type "MP-4": Foamed-insulation-core horizontal metal wall panel assembly with integral reveals and profiled panels, with related metal trim and accessories, structural steel backup, cold-formed metal framing, exterior sheathing, and air weather barrier.~~
5. Insulated metal panel where indicated on drawings.
6. Insulated metal panel soffits at Building 06, Transitional Living shall be designed to be blast resistant.
7. Downspout covers through metal panel system.
8. Maintaining watertight integrity of AWB within the wall system.
9. Delegated design.
10. Contractors Option: Specifications are based on factory foamed-in-place insulated-core metal wall panels. Factor laminated-insulation-core metal wall panels meeting requirements of this Section may be provided in place of factory foamed-in-place insulated-core metal wall panels, at Contractors option.

## B. Work Specified Elsewhere, but Provided Under this Section:

- ~~1. Steel for Wall Type MP-3: Provide as specified in Section 05 50 00 - Metal Fabrications. Exception: Through-Tube Support System provided in EWP-5.~~
1. Work of this Section shall comply with Section 07 42 15.30 - Blast Resistant Requirements for Metal Wall Panel Systems, Life Safety Structures. Work of this Section shall comply with Section 07 42 15.50 - Blast Resistant Requirements for Metal Wall Panel Systems, Mission Critical Structures. ~~Composite metal system for wall type MP-4: Provide as specified in Section 07 42 43 - Composite Panels.~~

## C. Materials furnished elsewhere, and installed under this Section:

1. AWB products to maintain the watertight integrity of AWB at back-up wall system for MP-2, ~~MP-2A, and MP-4~~, and accessories or transitioning between components provide by this Section to the AWB system at this back-up wall system: Products furnished by Section 07 27 30 - Air Weather Barrier (AWB).

## D. Products Supplied but not Installed Under this Section:

1. Prefinished steel face sheet for MP-2 panels. ~~Supply to Section 10 14 01, Exterior Building Signage for fabrication into signage panels. Obtain required quantity from Division 10 signage trade. Supply 1 quart of air-dry PVDF touch-up paint in color matching face sheet.~~

## 1.2 RELATED WORK

- A. Exterior Wind Enclosure Requirements: Section 01 83 16.13.
- B. Self-drilling Metal structural Fasteners: Section 05 05 23 - Metal Fastening.
- C. Facility Exterior Enclosure Commissioning: Section 07 08 00.
- D. Division 07 Section "Joint Sealants".
- ~~E. Metal Panel Type MP-3: Section 07 42 43, Composite Wall Panels.~~
- E. Metal Panel Type MP-1, **MP-1a, and MP-1b**: Section 07 46 15, Manufactured Metal Siding.
- F. Back-up wall system for metal panel wall types: Section 07 43 20.
- G. Expansion Joints: Section 07 95 13 - Expansion Joint Cover Assemblies.
- H. Metal panel color, finish, and gloss level: Section 09 06 00, Schedule for Finishes.
- I. Glazed Aluminum Curtain Wall: Section 08 44 13.
- J. Division 26: Lightning protection and grounding.

## 1.3 DEFINITIONS

- A. Factor Laminated-Insulation-Core Metal Wall Panels: Factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and core material laminated or otherwise securely bonded to facing sheets during fabrication without use of contact adhesives, and with joints between panels designed to form weathertight seals. Includes accessories required for weathertight installation; and must achieve or exceed all other requirements of this Section.

## 1.4 DESIGN REQUIREMENTS

- A. The Drawings show aesthetic design intent. Products provided must conform to design intent shown and performance levels specified. The drawings and specifications are complementary regarding the aesthetic design intent.
- B. Design components provided by this Section to meet or exceed requirements of this Section, and applicable building Codes.
  1. Applicable Building Codes:
    - a. International Building Code (IBC), 2006 Edition.
    - b. Life Safety Code 2006.
- C. Provide end dams with all flashing.

- D. Coping: Design and coordinate transition from top of wall system with work of Section 07 72 00 - Roof Accessories, Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types, and adjacent roofing system.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis by a qualified Professional Engineer, using performance requirements, blast requirements, and design criteria indicated.
- B. Structural Performance: Metal wall panel assemblies shall withstand the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330.
1. Wind loads in accordance with Section 01 83 16.13 - Exterior Wind Enclosure Requirements.
  2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.
- C. Air Infiltration: Maximum 0.06 cfm/sq. ft. per ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa), using minimum 10-by-10 foot test panel that includes horizontal and vertical joints.
- D. Water Penetration, Static Pressure: No uncontrolled water penetration per ASTM E 331 at a minimum static differential pressure of 15 lbf/sq. ft. (positive wind load), using minimum 10-by-10 foot test panel that includes horizontal and vertical joints.
- E. Water Penetration, Dynamic Pressure: No uncontrolled water penetration per AAMA 501.1 at a minimum static differential pressure of 15 lbf/sq. ft. (positive wind load), using minimum 10-by-10 foot (3050-by-3050 mm) test panel that includes horizontal and vertical joints.
- F. System Performance: Except at locations otherwise indicated in drawings, assembly shall meet performance requirements in Paragraphs above utilizing separate air and water barrier membrane on rigid backup.
- G. Metal wall panel system shall meet AAMA 508-07 pressure-equalization requirements with an imperfect air barrier.
- H. Water Absorption: Maximum 1.0 percent absorption rate by volume when tested according to ASTM C 209.
- I. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests per ASTM E 1886 and ASTM E 1996 for Wind Zone indicated on Drawings, with "Enhanced Protection".
1. Large-Missile Test: For metal panel wall located within 30 feet (9.1 m) of grade.
    - a. Required Missile Level: "E".
  2. Small-Missile Test: For metal panel wall located more than 30 feet (9.1 m) above grade.
    - a. Metal panel system meeting requirements for Large-Missile Test, above, maybe used to meet Small-Missile Test.

~~J. Seismic Performance: Comply with ASCE 7 Section 9, "Earthquake Loads".~~

- ~~3. System Depth: As indicated on drawings. Support system shall be concealed within the exterior wall system unless approved by Architect.~~
- ~~a. Support System maybe exposed in mechanical room.~~
- ~~b. Support structure at vertical window mullions shall be concealed with in extruded aluminum enclosure, matching window framing.~~

**J.** Self-drilling Metal structural Fasteners: Comply with requirements of Section 05 05 23 - Metal Fastening.

**K.** Comply with requirements of Section 01 43 39 – Mockups. If requirements conflict with requirements stated in this Section, comply with the more stringent condition.

1. Performance requirements specified in Section 01 43 39 – Mockups is for the combined work of this section and the Back-up wall specified in Section 07 43 20- Back-Up Wall System for Metal Panel Wall Types.

**L.** Panel Performance:

1. Flatwise Tensile Strength: Not less than 27 psi (207 kPa) when tested according to ASTM C 297/C 297M.
2. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F (60 deg C) and 100 percent relative humidity according to ASTM D 2126.
3. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at 200 deg F (93 deg C) according to ASTM D 2126.
4. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus 20 deg F (29 deg C) according to ASTM D 2126.
5. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. (958-kPa) positive and negative wind load and with deflection of L/180 for 2 million cycles.
6. Autoclave: No delamination when exposed to 2-psi (13.8-kPa) pressure at a temperature of 212 deg F (100 deg C) for 2-1/2 hours.

## 1.6 BLAST REQUIREMENTS

**A.** Blast Requirements:

1. Life Safety Structures: As specified in Section 07 42 15.30 - Blast Resistant Requirements for Metal Wall Panel Systems, Life Safety Structures
2. Mission Critical Structures: As specified in Section 07 42 15.50 - Blast Resistant Requirements for Metal Wall Panel Systems, Mission Critical Structures.

## 1.7 SUBMITTALS

**A.** Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**B.** Product Data: For each type of product indicated.

- C. Engineer's Seal/Signature: Shop drawings and associated calculations required for structural design shall bear seal and signature of Professional Engineer. See Professional Engineer under QUALITY ASSURANCE below, and "Delegated-Design Submittal" below.
- D. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop-, and field-assembled work. Include project-specific details clearly depicting interface with adjacent construction.
- E. Samples: Samples for Verification: Provide 24-inch section of wall panel showing finishes, horizontal joinery, vertical joint return, injected core material, panel stiffener and anchoring details. Provide 12-inch long pieces of each extruded aluminum trim.
- F. Delegated-Design Submittal: Provide analysis data and calculations for the metal wall panel support system signed and sealed by the qualified professional engineer responsible for their preparation. Submittals may or may not be returned, and will not bear stamp of approval.
- G. Coordination Drawings: Exterior elevations, drawn to scale, and coordinating penetrations and wall-mounted items.
- H. Product test reports.
- I. Maintenance data.
- J. Warranties: Sample of special warranties.
- K. SUBMITTALS required for this Sections shall be submitted complete and concurrently with Blast Submittals. Partial submittals are not acceptable.
1. Blast Submittals: SUBMITTALS as specified in:
    - a. Section 07 42 15.30 - Blast Resistant Requirements for Metal Wall Panel Systems, Life Safety Structures.
    - b. Section 07 42 15.50 - Blast Resistant Requirements for Metal Wall Panel Systems, Mission Critical Structures.
  2. Include work provided by this Section and specified elsewhere.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum 10 years experience in manufacture of similar products in successful use in similar applications. When requested, Manufacturer shall furnish information on previous projects utilizing specified product. Information shall include contact information for Owner of previous project. Approved manufacturers must meet separate requirements of Submittals Article.
- B. Wall Systems Installer Qualifications: Experienced Installer with minimum of 10 years experience with successfully completed projects of a similar nature and scope, and employing workers trained by manufacturer to install products of this Section.
- C. Adhesion Test: Prior to delivery of composite wall panel system, perform test on adhesives and sealants per ASTM D 3359. Test each adhesive and sealant utilizing specified panel finish.

1. Preconstruction Field-Adhesion Testing: Before installing sealants, field test its adhesion to Project joint substrates as specified in Division 07 Section "Joint Sealants."
  2. Cost of testing to be borne by Contractor.
- D. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Characteristics: Per ASTM E 119.
  2. Intermediate-Scale Multistory Fire Test: Per NFPA 285.
  3. Radiant Heat Exposure: No ignition per NFPA 268.
  4. Potential Heat: Acceptable level per NFPA 259.
  5. Surface-Burning Characteristics: Flame-spread index of 25 or less and smoke-developed index of 450 or less, per ASTM E 84.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Louisiana and who has a minimum of 10 years experience in providing engineering services of the kind indicated.
- F. Mockup: Before production or installation of insulated-core metal panel wall systems, provide mockups for aesthetic review and determination of final design and to confirm performance. Build mockups as directed, using all components as shown and specified in accordance with final SUBMITTALS. The mockup is as an Aesthetic Mockup and Testing Mockup.
1. Aesthetic Mockup: See Section 01 43 39, Mockups. Approval of aesthetic mockup required before design of testing mockup can proceed.
  2. Testing Mockup: See Section 01 43 39, Mockups. Test aesthetic Mockup.
- G. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to Insulated-core Metal Panel Work, including but not limited to the following:
    - a. Methods and sequence of installation, including construction scheduling.
    - b. Quality control requirements.
    - c. Evaluation of suitability of specified materials and sealants for anticipated weather conditions.
    - d. Coordination with other trades.
    - e. Field testing, inspecting and certifying procedures.
- 1.9 REFERENCES (LATEST EDITION UNLESS OTHERWISE NOTED)
- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
1. A 653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
  2. C209 Standard Test Methods for Cellulosic Fiber Insulating Board.
  3. C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
  4. C920 Standard Specification for Elastomeric Joint Sealants.

5. C1311 Standard Specification for Solvent Release Sealants.
6. D3359 Standard Test Methods for Measuring Adhesion by Tape Test.
7. D6226 Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
8. E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
9. E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
10. E 283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
11. E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
12. E 331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
13. 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.
14. E1886 Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
15. E1996 Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

C. American Architectural Manufacturers Association (AAMA):

1. 501 Methods of Test for Exterior Walls.
2. 508 Test method to verify pressure-equalization of horizontal joinery.

D. American Society of Civil Engineers (ASCE):

1. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures

E. American Welding Society (AWS):

1. D1.1 Structural Welding Code.

F. National Fire Protection Association (NFPA):

1. 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
2. 268 Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source.
3. 259 Standard Test Method for Potential Heat of Building Materials.

## 1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.
2. Warranty specified shall be extended so that the start of the warranty period does not begin until the project is substantially complete and ready for occupancy by the owner.

- B. High Performance Fluoropolymer Finish: Provide a 20 year warranty as specified in Section 05 05 13 - Shop Applied Coatings for Metal.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. System consists of factory foamed-in-place vertical ~~(MP-2) and horizontal (MP-4)~~ wall panel system consisting of an exterior metal face sheet with interior metal liner panel bonded to factory foamed-in-place core in thermally separated profile. Metal panels are installed over sheathing with a liquid applied air/weather barrier, supported by steel through-tube support system and cold-formed metal framing, and fire stopped at edge of slab.
- B. System to meet project blast resistance requirements. Lateral load connections to be designed to carry system dead loads in the event of failure of dead load anchors as a result of a blast event.

### 2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. Foamed-Insulation-Core Metal Wall Panels: Factory-foamed-in-place ~~horizontal (MP-4) and vertical (MP-2 and MP-2A)~~ wall panel systems consisting of an exterior metal face sheet with interior metal liner panel, bonded to panel core insulation in thermally-separated profile, and with factory-sealed tongue-and-groove joint. Individual panels to have continuous length to cover the entire length of any unbroken wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system. Mechanically attach panels to supports using concealed clips and fasteners. Exposed fasteners not permitted unless detailed otherwise on Architectural drawing.
1. Wall Type "MP-2" ~~and MP-2A~~:
    - a. Vertical Joint: Provide factory-sealed tongue-and-groove joint. Comply with details on drawings.
    - b. Horizontal joints for insulated metal panels shall be gasketed, exposed wet seals are not permitted. Outer wings of gasket shall compress against the metal return flange (trimless end) of the panel face. The horizontal joint shall be designed to allow moisture to be drained from the panel's vertical joint. No end dam sealant is to be applied to the ends of the horizontal joint at the vertical joint location. Seal flashings to back of metal wall panels and as required for weather tight construction. Comply with details on drawings.
  - ~~2. Wall Type "MP-4": Horizontal Ribs at Building 07, CEP Building:
    - a. Horizontal Joint: Provide factory-sealed tongue-and-groove joint. Comply with details on drawings.
    - b. Vertical joints for insulated metal panels shall be gasketed, exposed wet seals are not permitted. Outer wings of gasket shall compress against the metal return flange (trimless end) of the panel face. Comply with details on drawings.~~
  3. Panel Coverage: As indicated on the drawings
  4. Panel Thickness: 3.0 inches
  5. Thermal-Resistance Value (R-Value):
    - a. MP-2 ~~& mp-2A~~ Panels: R-20 min. (at full panel thickness, including joints, per ASTM C-1363).

- 1) U-Value: Panel wall system to achieve overall assembly thermal transmission of not more than U-0.113.
  - ~~b. MP-4 Panels: R-16 (at full panel thickness, including joints, per ASTM C-1363).~~
  - ~~1) U-Value: Panel wall system to achieve overall assembly thermal transmission of not more than U-0.113.~~

## 2.3 PANEL MATERIALS

- A. Metallic-Coated Steel Face Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; 0.030 inch / 22 gage minimum nominal sheet thickness.
  1. Surface:
    - a. Exterior Face: ~~Smooth, flat~~ **Embossed** finish for faces exposed to view.
    - b. Interior Face: Embossed.
  2. Exposed Finish Coating: Fluoropolymer baked enamel as specified under Section 05 0513 - Shop-Applied Coatings for Metal.
    - a. 2-coat PVDF finish containing mica pearlescent flake pigments.
    - b. Color: In conformance with Section 09 06 00, Schedule for Finishes.
- C. Metallic-Coated Steel Liner Sheet: Coil-coated, 0.030 inch / 22 gage Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90.
  1. Surface: Embossed planked.
  2. Concealed Finish: Provide in conformance with Section 05 05 13 - Shop Applied Coatings for Metal.
- D. Panel Sealants:
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing.
  2. Joint Sealant: ASTM C 920.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.4 INSULATION FOR PANEL CORES

- A. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, foamed-in-place type, with maximum flame-spread index of 25 and smoke-developed index of 450.
  1. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
  2. Density: 2.1 lbs./cu. ft. minimum.

## 2.5 EXTERIOR SHEATHING

- A. Exterior Sheathing: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.

## 2.6 METAL DECKING

- A. Metal Decking: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.

## 2.7 AIR WEATHER BARRIER

- A. Air Weather Barrier: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.

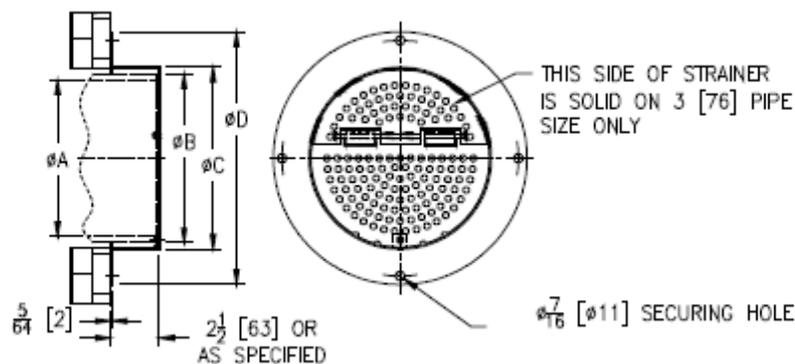
## 2.8 COLD-FORMED METAL FRAMING

- A. Cold-Formed Metal Framing: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.

## 2.9 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws; bolts and nuts; self-locking rivets and bolts; end-welded studs; and other suitable fasteners designed to withstand design loads. Fasteners shall be concealed, except where expressly permitted by the Architect.
  - 1. Exposed Fasteners: Where expressly permitted by the Architect provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.
  - 2. Provide EPDM, PVC, or neoprene sealing washers.
- B. Metal Wall Panel Accessories, General: Provide complete metal wall panel assembly incorporating trim, fasciae, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap tapes, closure strips, and caps for a complete installation. Fabricate accessories in accordance with SMACNA Manual.
  - 1. Copings: Provided by Section 07 72 00 - Roof Accessories.
- C. Formed Flashing and Trim: Exposed sheet metal trim shall only be permitted where shown on the drawings or expressly approved by the Architect. Match material, thickness, and color of metal wall panel face sheets as indicated on the drawings. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, fasciae, parapet caps, soffits, reveals, fillers, and as shown on drawings. Finish flashing and trim with same finish system as adjacent metal wall panels.
- D. Extrusion Trim: Provide manufacturer-provided extruded trim as required for complete installation and as indicated on Drawings. Where indicated on the drawings, provide thermally-broken extruded shapes to prevent condensation within the wall cavity.
- E. Sub-Framing:
  - 1. Furring, additional girts, depth, gage, and configuration as required for span and application, 16 gage minimum; G 90 galvanized steel.

- F. Sealants: Type recommended by metal wall panel system manufacturer for application, meeting requirements of Section 07 92 00 - Joint Sealants.
- G. Flashing Tape: 4-inch wide self-adhering butyl flashing tape.
- H. Panel Attachment Clips: Concealed stainless steel clip configured to prevent overdriving of fastener and crushing of foam core, with panel fasteners engaging both face and liner elements and mechanically attaching to panel supports.
- I. Fasteners: Stainless Steel, self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Exposed fasteners will not be allowed, except where expressly permitted by the Architect.
- J. AWB Materials: Furnished by Section 07 27 30 - Air Weather Barrier (AWB).
- K. Structural Steel: Provide as specified in Section 05 50 00.
- L. Downspout Cover:
1. Coordination:
    - a. Provide factory cut round opening in exterior wall system for installation of piping by Division 22. Opening to approximately 1/2" larger than outside diameter of downspout cover inlet (Dimension "C" below).
    - b. Provide concealed blocking for support of scupper and securing scupper fasteners through wall system to blocking. Pipe provided Division 22 shall be supported by Division 22.
    - c. The sealing of pipe to Air Weather Barrier and the scupper to the Composite Panels shall be provided under this section.
  2. Downspout Cover will be provided by WP-8. The information below regarding the downspout cover is for information only.
  3. Basis of Design: Model Number "Z199-DC" Downspout Cover.
    - a. Manufacturer: Zurn Plumbing Products.
  4. Exposed Material: Stainless steel.
  5. Fasteners: Stainless steel fastener with Robertson type head finish.
  6. Size: Match to pipe size provided by Division 22 for piping to the scupper.
    - a. Default: If not indicated in EWP-6, Construction Manager shall base bid on nominal 6" inside diameter pipe and verify required size with Resident Engineer prior to submitting "SUBMITTALS" for this specification Section.
  7. Appearance and Profile: As shown below.



- M. Miscellaneous: All materials, tools, equipment, hardware, and devices required for complete installation.

## 2.10 FABRICATION

- A. Insert unique general fabrication requirements, if any, to suit Project.
- B. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- C. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with interlocking joints between panels designed to form weathertight seals.
- D. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- E. Retain first paragraph below if gaskets or sealants are factory installed.
- F. Fabricate metal wall panel joints with factory-installed captive gaskets, separator strips, or laser-monitored non-skinning butyl that provides a tight seal and prevents metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- G. Folded Corners: Factory-formed, with no visible seams or trim on panel face.
- H. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify back-up wall systems are complete and AWB is continuous over back-up wall construction and sealed at penetrations in the wall system; and free of tears or openings.
1. Check stud framing, for accurate spacing and alignment.
- B. Do not proceed with installation until deficiencies are corrected.

### 3.2 GENERAL:

- A. Install materials in conformance with Approved shop drawings and comply with manufacturer's instructions and details, except where more stringent requirements are shown or specified, and where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- B. Install weather seals recommended by AWB manufacturer (provided by Section 07 27 30 - Air Weather Barrier (AWB)) and provide flash metal flashings as required to maintain a continuous

air barrier and as a liquid-water drainage plane. Install weather seals recommended by AWB manufacturer to properly seal fastener penetrations through AWB, and maintain PERFORMANCE REQUIREMENTS specified for AWB.

1. Fastener Penetrations of AWB: Seal/gasket penetration in conformance with AWB manufacturer's recommendations.
2. Fastener Penetration where Fastener is Removed: Seal penetration with AWB as specified in Section 07 27 30.
3. Flashing: Apply AWB transition membrane over flashing and seal to AWB as specified in Section 07 27 30.

### 3.3 INSULATED-CORE METAL WALL PANEL INSTALLATION

- A. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

### 3.4 ACCESSORY INSTALLATION

- A. Revise first paragraph below to suit Project. Delete items not required.

1. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
2. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

- B. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

### 3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION 07 42 15



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**SECTION 07 42 43**  
**COMPOSITE PANELS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Factory-formed and assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated; and aluminum plate panels formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, extruded aluminum furring, and accessories required for weathertight system.
2. Delegated Design.

**B. Materials furnished elsewhere, and installed under this Section:**

1. AWB products to maintain the watertight integrity of AWB and accessories or transitioning between components provide by this Section to the AWB system at this back-up wall system: Products furnished by Section 07 27 30 - Air Weather Barrier (AWB).

**1.2 RELATED WORK**

- A. Exterior Wind Enclosure Requirements: Section 01 83 16.13.
- B. Precast Architectural Concrete: Section 03 45 00.
- C. Shop Applied Coatings for Metal: 05 05 13.
- D. Self-drilling fasteners: Section 05 05 23 - Metal Fastening.
- E. Miscellaneous metal framing: Section 05 50 00.
- F. Metal Coping: Section 07 72 00 - Roof Accessories.
- G. Sealants: Section 07 92 00.
- H. Glazed Aluminum Curtain Walls: Division 8.
- I. Color and coating type: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 REFERENCES (LATEST EDITION UNLESS OTHERWISE NOTED)**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Architectural Manufacturers Association (AAMA):

1. 508 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.

C. American Society for Testing and Materials (ASTM):

1. B 209 Aluminum and Aluminum-Alloy Sheet and Plate.
2. B 221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes, and Tubes.
3. E 330 Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads
4. E 331 Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure.
5. E 283 Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
6. D 1781 Climbing Drum Peel Test for Adhesives
7. E 84 Surface Burning Characteristics of Building Materials
8. D 1929 Standard Test for Ignition Properties of Plastics
9. D 3363 Method for Film Hardness by Pencil Test
10. D 2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
11. D 3359 Methods for Measuring Adhesion by Tape Test
12. D 2247 Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
13. B 117 Method of Salt Spray (Fog) Testing
14. D 2244 Calculation of Color Differences from Instrumentally Measured Color Coordinates
15. D 4214 Evaluating the Degree of Chalking of Exterior Paint Films
16. D 822 Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
17. D 1308 Effect of Household Chemicals on Clear and Pigmented Organic Finishes

1.4 DESIGN REQUIREMENTS

- A. The Drawings show aesthetic design intent. Products provided must conform to design intent shown and performance levels specified. The drawings and specifications are complementary regarding the aesthetic design intent.
- B. Design components provided by this Section to meet or exceed requirements of this Section, and applicable building Codes.
  1. Applicable Building Codes:
    - a. International Building Code (IBC), 2006 Edition
    - b. Life Safety Code 2006.
- C. System to be self weeping and fully weathertight.
  1. Composite Metal panel system shall be a pressure equalized rain screen design.
    - a. Comply with AAMA 508-05 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.
  2. Rear Ventilated Rain Screen: Provide a reveal joints, as detailed on drawings
  3. Do not allow compressive skin stresses.
  4. Panel system with back-up wall system shall remain flat and water tight.
- D. Water-Managed Assembly: The wall is a cavity wall/rain screen wall construction with AWB over the back-up wall system behind the metal panel system. Design and provide metal flashing to weep water on the back-up wall system to the exterior of the building; and counter flash to AWB in conformance with Section 07 27 30 to maintain a continuous water drainage path to the exterior of the building. Water-Managed Assembly shall not allow water to enter into

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the interior of the building or adjacent exterior wall systems. See Section 07 43 20 for back-up wall system.

- E. Exposed fasteners shall be located on approved shop drawings and be a consistent location from edge of panel, spaced evenly, and align vertically and horizontally between adjacent panels. Holes for fasteners shall be drilled before installation.
- F. Provide end dams with all flashing.
- G. Panel Reveals: Reveals shall be metal on all faces and designed to protect the AWB behind the reveal from exposure to ultra violet light.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis by a qualified Professional Engineer, using performance requirements, and design criteria indicated.
- B. Structural: Panel system and supports to withstand wind load with deflection limited to L/175, 3/4", or manufacturer's recommendation; whichever is less.
  - 1. Wind Loads: As specified in Section 01 83 16.13 - Exterior Wind Enclosure Requirements.
- C. Panels to permit expansion and contraction through a 180 degree temperature range without overstressing fasteners or panel face.
- D. Composite Panel System: The performance criteria below are for the Air Infiltration and Water Penetration of the composite panel system; with the AWB installed at back-up wall system.
  - 1. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference: 20 lbf/sq. ft. Test panel shall be a minimum of a 10 foot by 10 foot and include horizontal and vertical joints.
  - 2. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** when tested according to ASTM E 283 at the following test-pressure difference: 6.24 lbf/sq. ft.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- F. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- G. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- H. Self-drilling Metal structural Fasteners: Comply with requirements of Section 05 05 23 - Metal Fastening.
- I. Comply with requirements of Section 01 43 39 – Mockups. If requirements conflict with requirements stated in this Section, comply with the more stringent condition.

1. Performance requirements specified in Section 01 43 39 – Mockups is for the combined work of this section and the AWB, over CMU or exterior sheathing, specified in Section 07 27 30 - Air Weather Barrier (AWB).

#### 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Engineer's Seal/Signature: Shop drawings and associated calculations required for structural design shall bear seal and signature of Professional Engineer. See Professional Engineer under QUALITY ASSURANCE below, and "Delegated-Design Submittal" below.
- C. Shop drawings: Show panel sizes, location and types of all joints, sealants, and gaskets including joints to accommodate thermal movement; fastening and anchorage methods; detail joints; note materials and finishes.
  1. Perforated Panels: Show layout of exposed fasteners.
- D. Affidavit: Certify material meets specified requirements.
- E. Samples:
  1. Paint Finish: Provide in conformance with Section 05 05 13 - Shop Applied Coatings for Metal.
  2. Panel Assembly: Two samples of each type of assembly required for project.
    - a. Samples of shall be minimum 24 inches square.
      - 1) Typical Panels: Show rain screen assemble of four panels with horizontal and vertical joints.
      - 2) Perforated Panel: Include installed fasteners with sample.
    - b. Materials installed shall match approved samples.
- F. Delegated-Design Submittal: Provide analysis data and calculations for the composite panel system signed and sealed by the qualified professional engineer responsible for their preparation. Submittals may or may not be returned, and will not bear stamp of approval.
- G. Test Reports:
  1. Submit test reports certifying proposed product complies with PERFORMANCE REQUIREMENTS above.
  2. Submit certified test reports of acceptable testing agencies which perform testing in accordance with ASTM E 119 and E 84.
- H. Finish Information: Submit data for finishes as required for "Operation and Maintenance Manual" specified under Section 01 11 10 Summary of Work - - General.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum 10 years experience in manufacture of similar products in successful use in similar applications. When requested, Manufacturer shall furnish information on previous projects utilizing specified product. Information shall include contact information for Owner of previous project. Approved manufacturers must meet separate requirements of Submittals Article.

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- B. Source Limitations: Obtain each type, color, texture, and pattern of siding and soffit, including related accessories, from single source from single manufacturer.
- C. Fabricator/Installer: See companies listed under "Fabricators" in Part 2. Other fabricators wishing to bid shall obtain written approval from the Architect not less than 10 days prior to bid date. The following data to be submitted:
1. Company history showing a minimum of 10 consecutive years, engineering and fabricating composite aluminum panels.
  2. List of completed projects with project contact person.
  3. Detailed shop drawings indicating expertise in fabrication of complex panel configurations.
  4. Confirmation from composite panel manufacturer that proposed fabricator/installer is acceptable and recommended by manufacturer to perform the required work on this particular Project.
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Louisiana and who has a minimum of 10 years experience in providing engineering services of the kind indicated.
- E. Mockup: Before production or installation of curtain wall systems, provide mockups for aesthetic review and determination of final design and to confirm performance. Build mockups as directed, using all components as shown and specified in accordance with final SUBMITTALS. The mockup is an Aesthetic Mockup and Testing Mockup.
1. Aesthetic Mockup: See Section 01 43 39, Mockups. Approval of aesthetic mockup required before design of testing mockup can proceed.
  2. Testing Mockup: See Section 01 43 39, Mockups. Test aesthetic Mockup.
- F. Preinstallation Conference: Conduct conference at Project site:
1. Review methods and procedures related to work of this Section, including but not limited to the following:
    - a. Methods and sequence of installation, including construction scheduling.
    - b. Quality control requirements.
    - c. Evaluation of suitability of specified materials and sealants for anticipated weather conditions.
    - d. Coordination with other trades.
    - e. Field testing, inspecting and certifying procedures.

#### 1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store crates of panels indoors in clean dry areas and protect from moisture; should panels become wet, uncrate and dry. Store panels flat on continuous support.

#### 1.9 WARRANTY

- A. Manufacturer and Contractor: Warrant manufactured wall panel material and workmanship for a period of two years from date of completion. Warranty shall provide for repair or replacement of material found defective in manufacture, field labor damage, and work not installed in accordance with erection drawings.
- B. High Performance Fluoropolymer Finish: Provide a 20 year warranty as specified in Section 05 05 13 - Shop Applied Coatings for Metal.

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**PART 2 - PRODUCTS****2.1 MANUFACTURERS/FABRICATORS**

- A. Composite Panel Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alcan Composites USA Inc.
  2. Alcoa Architectural Products., Eastman, GA;
  3. Reynobond® [www.alcoa.com](http://www.alcoa.com).
  4. Mitsubishi Chemical America, Inc.
- B. Fabricator/Installers: Subject to compliance with requirements, available fabricator/installers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Architectural Fabricator Co., Inc (918-331-0393)
  2. Sobotec Ltd., Hamilton, Ontario (905-578-1278).
  3. Riverside Group, Windsor, Ontario, Canada (519-645-1321) [www.riversidegroup.net](http://www.riversidegroup.net).
  4. Kanalco Ltd., Bownamville, Ontario (905-623-2303) [www.kanalco.com](http://www.kanalco.com).
  5. Royaltan Architectural Fabrication, Inc., North Royalton, OH (216-582-0400).
  6. Universe Systems, Division of Universe Corporation, St. Louis, MO.
- C. Basis of Design: Rainscreen: "SL-2000", Dry Joint Filler System.

**2.2 MATERIALS**

- A. Aluminum Sheet: Alloy and temper as recommended by manufacturer and processor to comply with the requirements of performance, fabrication and application of finish and control of color.
- B. Aluminum extrusions: Characteristics as specified for aluminum sheet above. Provide aluminum shapes for joining aluminum panels as detailed with finish to match panels if exposed.
- C. Sealant:
1. Sealants within Metal Panel System: As recommended by manufacturer except as follows:
    - a. Backer Rod and Sealant Type Joints: Provide as specified in Section 07 92 00 – Sealants.
- D. Gaskets and bedding tapes: Nonstaining closed cell neoprene, EPDM, or compressible butyl based tape as recommended by panel manufacturer for the conditions of the installation.
- E. Structural Steel: Provide as specified in Section 05 50 00.
- F. Support devices: Corrosion-resistant metal in shapes, and types as indicated on drawings and to meet Performance Requirements; fasteners as made or recommended by panel manufacturer for concealed installation and the conditions for the installation.
1. Expansion anchors into concrete to be stainless steel devices by Wej-it, Hilti, Liebig, or Ramset/Red Head; or approved equal.
  2. Comply with requirements of Section 05 05 23 - Metal Fastening.

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## 2.3 BACK-UP WALL COMPONENTS

### A. Back-Up Wall Components and Support System:

1. CMU: Provided by Division 4 – Masonry.
2. Cold-Formed Metal Framing: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.
3. Exterior Sheathing: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.
4. AWB/Water barrier: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.
5. Edge of Slab Firestopping: Provide by Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.

## 2.4 MANUFACTURED UNITS

### A. Composite Panels: Minimum 4 mm (0.157") thick.

1. Core: Extruded thermoplastic; manufacturer's standard.
2. Faces: 0.51 mm aluminum sheet.
3. Alloy:
  - a. Painted Material: AA3000 Series.
  - b. Anodized Material: AA5000 Series.
4. Fire: Product to be acceptable cladding component to governing authorities for non-combustible construction.
  - a. Panels not to exceed the following; ASTM E 84.
    - 1) Flame Spread: 5.
    - 2) Smoke Developed: 20.
  - b. ASTM E 119.
5. Bond Integrity: When tested for bond integrity, in accordance with ASTM D 1781 (simulating resistance to panel delamination), there shall be no adhesive failure of the bond a) between the core and the skin nor b) cohesive failure of the core itself below the following values:
  - a. Peel Strength:
    - 1) 22.5 in lb/in as manufactured.
    - 2) 22.5 in lb/in after 21 days soaking in water at 70°F (21°C).
6. Perforated Panels: See Plate Metal Panels below.

### B. Plate Metal Panels:

1. Material: Aluminum flat sheet or plate, **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
2. Panels are to be manufactured from single sheets of aluminum selected for surface flatness, smoothness and freedom from surface blemishes where exposed to view in a finished unit. Do not use material where the exposed surface exhibit pitting, seam marks, roller marks, stains, discolorations, or variations in flatness exceeding those permitted by referenced standards for stretcher-leveled aluminum alloy sheets.
3. Thickness: Minimum 0.125".
4. Perforated Panels: Provide perforation pattern indicated on drawings and Section 09 06 00 - Schedule for Finishes.
  - a. Thickness: 18 gage, or thicker.
  - b. Openness: 50%.
  - c. Exposed Fasteners: 302 or 304 Stainless steel, with finish to match panels.
    - 1) Self-drilling Fasteners: Section 05 05 23 - Metal Fastening.

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- C. Finish: Fluoropolymer baked enamel as specified under Section 05 0513 - Shop-Applied Coatings for Metal.
1. 2-coat PVDF finish containing mica pearlescent flake pigments.
  2. Color: In conformance with Section 09 06 00, Schedule for Finishes.

## 2.5 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws; bolts and nuts; self-locking rivets and bolts; end-welded studs; and other suitable fasteners designed to withstand design loads. Fasteners shall be concealed unless approved Architect or indicated as exposed on drawings. Provide exposed fasteners with heads matching color of metal wall panels by means factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
- B. Metal Wall Panel Accessories, General: Provide complete metal wall panel assembly incorporating trim, fasciae, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap tapes, and closure strips for a complete installation. Fabricate accessories in accordance with SMACNA Manual and as required to meet Performance Requirements.
1. Copings: Provided by Section 07 72 00 - Roof Accessories.
- C. Flashing and Trim: Match material, and color of metal wall panel face sheet. Provide flashing and trim formed as required to seal against weather and to provide finished appearance. Provide flashing to meet requirements of Water-Managed Assembly. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, fillers, and flashing to weep cavity. Finish flashing and trim with same finish system as adjacent metal composite material panels.
1. Metal Thickness: Fabricate accessories in accordance with SMACNA Manual and as required to meet Performance Requirements.
- D. Extrusion Trim: Provide extruded trim as required for complete installation and as indicated on Drawings:
- E. Sub-Framing:
1. Furring, additional girts, depth, gage, and configuration as required for span and application, 18 gage minimum; G 90 galvanized steel.
- F. AWB Materials: Furnished by Section 07 27 30 - Air Weather Barrier (AWB).

## 2.6 FABRICATION

- A. Configuration: Custom, as shown on drawings.
- B. Verify proposed panel thickness acceptable where used as component of other wall systems. Modify perimeter depths where required to glaze into curtain wall or window systems where proposed depths cannot be accommodated by glazing products.
- C. Fabricate panels in such a manner as to allow for mechanical reinforcing or stiffening to meet required wind loading and to maintain flatness. Rippling, warping, oil canning, or other visible distortion in panel surface is not acceptable. Increase panel thickness where reinforcing not practical or suitable.

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- D. Joints shall be of a male/female interlocking design to provide both alignment of interlocking units as well as expansion and contraction.
  - E. Curved Panels: Provide radiused panels and not segmented panels for curved areas of cladding.
  - F. Cut panels to accurate sizes as indicated on drawings; finish all exposed surfaces and edges to match. Drill panels as required for installation of fasteners and support devices. Fabricate panels with exposed faces and edges sharp, true to square, and free from tool marks.
  - G. Bends, to be minimum radius, crisp and accurate.
  - H. Clips and anchorage devices attached to panels to be welded; no exposed fasteners permitted unless specifically shown. All welding to be performed prior to finishing.
  - I. Flashing type terminations behind other finish material to be panned up to drain water to exterior. See "Flashing" under Section 01 73 00 – Execution.

## 2.7 FABRICATION TOLERANCES

- A. Panel Bow: Maximum 0.8% of any 72" panel dimension.
- B. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
- C. Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.
- D. Maximum deviation from panel flatness shall be 1/8" in 5'0" on panel in any direction for assembled units. (Non-accumulative - No Oil Canning).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify back-up wall systems are complete and AWB is continuous over back-up wall construction and sealed at penetrations in the wall system; and free of tears or openings.
  - 1. Check stud framing, for accurate spacing and alignment.
- B. Do not proceed with installation until deficiencies are corrected.

### 3.2 GENERAL:

- A. Install materials in conformance with Approved shop drawings and comply with manufacturer's instructions and details, except where more stringent requirements are shown or specified, and where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

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- B. Flashing: Provide end dams on flashing to discharge liquid water to exterior and not into adjacent construction or interior of building.

### 3.3 INSTALLATION

- A. General: Install panels in accordance with approved shop drawings and manufacturer's recommendations.
1. Install level with all abutting edges flush and in same plane.
  2. Take care that all corners and edges are sharp, clean and unbroken. Install panels with concealed fasteners, unless otherwise indicated or approved by Architect.
  3. Install panels to provide weathertight installation; weep/flash water to exterior.
  4. Secure composite metal panel system to metal framing of 16 gage thickness or greater.
- B. Install weather seals recommended by AWB manufacturer (provided by Section 07 27 30 - Air Weather Barrier (AWB)) and provide flash metal flashings as required to maintain a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Install weather seals recommended by AWB manufacturer to properly seal fasteners penetrations through AWB, and maintain PERFORMANCE REQUIREMENTS specified for AWB.
1. Fastener Penetrations of AWB: Seal/gasket penetration in conformance with AWB manufacturer's recommendations.
  2. Fastener Penetration where Fastener is Removed: Seal penetration with AWB as specified in Section 07 27 30.
  3. Flashing: Apply AWB transition membrane over flashing and seal to AWB as specified in Section 07 27 30.
- C. At base of walls and above openings and other penetrating components, provide flashings with end dams and or weeps to allow water from air weather barrier to drain to the exterior of the metal panels.
- D. Install clips and anchorage devices as shown and as required to support attached panels.
- E. Joints:
1. Form joints only where shown or approved by Architect.
  2. Expansion joints: Provide suitable expansion joints spaced not more than 15 feet o.c.
- F. Isolate dissimilar metals to prevent electrolysis.
- G. Sealant:
1. Conform to sealant manufacturer's recommendations for cleaning, priming and installation.
  2. Joints to be Sealed Under this Section: Joints indicated on drawings and joints required to maintain weather tightness of cladding.
  3. Joints to be Sealed Under Section 07 92 00: Perimeter joints between system metal and adjacent substrates.
- H. Tolerances: Maximum deviation from vertical and horizontal alignment of erected panels: 1/4 inch in 20 feet, non-cumulative.

#### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.
- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

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**SECTION 07 46 15**  
**MANUFACTURED METAL SIDING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Preformed steel siding wall panel assembly with, rainscreen insulation behind metal panel, related metal trim and accessories. Panels are installed over masonry backup, and air weather barrier.
2. Metal panel systems specified in this Section apply to wall type designation "MP-1" on the drawings.
3. The masonry back-up wall system, provides the blast requirements for the wall type.
4. Flashing associated with metal siding and flashing noted on drawings. Provide with finish to match Manufactured Metal Siding.
5. Scupper through metal panel system.
6. Maintain watertight integrity of AWB within the wall system.
7. Secondary rain barrier system. The secondary rain barrier system shall be a highly permeable water resistive air barrier provided between the back side of the manufactured metal panels and the exterior face of insulation. It shall be continuous and act as a liquid-water drainage plane designed to discharge to the exterior, and as shown on drawings, and protect insulation from contact with water.
8. Delegated design.

**B. Materials furnished elsewhere, and installed under this Section:**

1. AWB products to maintain the watertight integrity of AWB at back-up wall system for MP-1, and accessories or transitioning between components provide by this Section to the AWB system at this back-up wall system: Products furnished by Section 07 27 30 - Air Weather Barrier (AWB).

**1.2 RELATED WORK (Items not included in this Project Manual are available from the Construction Manager upon request)**

- A. Exterior Wind Enclosure Requirements: Section 01 83 16.13.
- B. Reinforced CMU back-up: Section 04 20 00.
- C. Shop Applied Coatings for Metal: 05 05 13.
- D. Self-drilling Metal Fasteners: Section 05 05 23 - Metal Fastening.
- E. Flashing not included under metal siding: Section 07 60 00.
- F. Metal Coping: Section 07 72 00 - Roof Accessories.
- G. Air Weather Barrier (AWB): Section 07 27 30.
- H. Roofing: Section 07 52 16 - Styrene-Butadiene-Styrene Modified Bituminous Membrane Roofing.
- I. Expansion Joints: Section 07 95 13 Expansion Joint Cover Assemblies.

- J. Color and texture of finish: Section 09 06 00, Schedule for Finishes.
- K. Sealants for perimeter seals: Section 07 92 00.
- L. Division 26: Lightning protection and grounding.

#### 1.3 APPLICABLE PUBLICATIONS (Latest edition unless otherwise noted)

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Spray Coaters Association (ASCA):
  - 96 Voluntary Specification for Superior Performance of Organic Coatings on Architectural Aluminum Curtainwall, Extrusions and Miscellaneous Aluminum
- C. American Society for Testing and Materials (ASTM):
  - A463 Steel Sheet, Cold-Rolled, Aluminum-Coated, by the Hot-Dip Process
  - A 653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
  - A 792 Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
  - A924/A924M7 Steel Sheet, Metallic Coated by the Hot- Dip ProcessA1008/A1008M Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low AlloyC553 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
  - C612 Mineral Fiber Block and Board Thermal Insulation
  - D 226 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
  - D 882 Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  - E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - E 96 Standard Test Methods for Water Vapor Transmission of Materials.
  - E 283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
  - E 331 Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.  
American Association of Textile Chemists and Colorists (AATCC)
  - 127 Water Resistance: Hydrostatic Pressure Test.

#### 1.4 DESIGN REQUIREMENTS

- A. The Drawings show aesthetic design intent. Products provided must conform to design intent shown and performance levels specified. The drawings and specifications are complimentary regarding the aesthetic design intent.
- B. Design components provided by this Section to meet or exceed requirements of this Section, and applicable building Codes.
  - 1. Applicable Building Codes:

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- a. International Building Code (IBC), 2006 Edition
  - b. Life Safety Code 2006.
- C. Wall panel system shall be manufactured and installed to withstand specified design loads and maintain performance requirements without defects, damage, or failure.
  - D. Water-Managed Assembly: The wall is a cavity wall construction with AWB over the back-up wall system behind the metal panel system. Design and provide metal flashing to weep water on the back-up wall system to the exterior of the building; and counter flash to AWB in conformance with Section 07 27 30 to maintain a continuous water drainage path to the exterior of the building. Water-Managed Assembly shall not allow water to enter into the interior of the building or adjacent exterior wall systems.
  - E. Provide complete thermal separation between exterior and interior heated spaces with U- Value not greater than U-0.113 for the MP-1 and MP-1A wall assemble.
  - F. Deflection: Provide horizontal deflection joints in metal panel system to allow for vertical deflection of cold formed metal framing. Live load deflection per structural span is 5/8"plus and 5/8" minus.
  - G. Coordinate elevation of scuppers with roofing in Division 7.
  - H. Provide end dams with all flashing.
  - I. Coping: Design and coordinate transition from top of wall system with work of Section 07 72 00 - Roof Accessories and adjacent roofing system.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis by a qualified Professional Engineer, using performance requirements and design criteria indicated.
- B. Design: Furnish components to resist wind loading inward and outward except gages not to be less than specified. Deflection limit L/180.
  - 1. Wind Loads: As specified in Section 01 83 16.13 - Exterior Wind Enclosure Requirements.
- C. Manufactured Metal Panel System: The performance criteria below are for the Air Infiltration and Water Penetration of the manufactured metal panel.
  - 1. Water Penetration under Static Pressure:
    - a. With AWB at Back-up Wall: No water penetration when tested according to ASTM E 331 at the following test-pressure difference: 15 lbf/sq. ft. positive wind load. Test panel shall be a minimum of a 10 foot by 10 foot and include horizontal and vertical joints.
  - 2. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference: 6.24 lbf/sq. ft. (300 Pa).
- D. Seal all penetrations in the AWB to maintain continuous water tight AWB assemble.
- E. Self-drilling Metal structural Fasteners: Comply with requirements of Section 05 05 23 - Metal Fastening.

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- F. Life expectancy of finish to be minimum 20 years without excessive color change or chalking, blistering, cracking, checking, chipping or failure of any kind under normal conditions.
  - G. Comply with requirements of Section 01 43 39 – Mockups. If requirements conflict with requirements stated in this Section, comply with the more stringent condition.
    - 1. Performance requirements specified in Section 01 43 39 – Mockups is for the combined work of this section and the Back-up wall specified in Section 07 43 20 - Back-Up Wall System for Metal Panel Wall Types.
  - H. Secondary Rain Barrier:
    - 1. Water Vapor Permeance tested to ASTM E 96 Method B: 6 0 perms or higher.
    - 2. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage.
    - 3. Tensile Strength tested to ASTM D 882: 25 lbf/inch (43.8 N/mm), machine direction; 20 lbf/inch (35.0 N/mm), cross-machine direction.
    - 4. Surface Burning Characteristics tested to ASTM E 84:
      - a. Flame-spread: 25 maximum.
      - b. Smoke-development: 450 maximum.
    - 5. Application Temperature: No temperature restrictions
    - 6. Allowable UV Exposure Time: Unlimited.
    - 7. Deflection: Capable of allowing up to ¼" deflection in exterior wall system by forming a bellows in Secondary Rain Barrier.
    - 8. Wind Load: As specified above.

#### 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Engineer's Seal/Signature: Shop drawings and associated calculations required for structural design shall bear seal and signature of Professional Engineer. See Professional Engineer under QUALITY ASSURANCE below, and "Delegated-Design Submittal" below.
- C. Shop Drawings:
  - 1. Submit on drawings with manufacturer's title block indicating authorship by manufacturer or his approved representative.
  - 2. Show locations, sizes, details of fabrication, supplemental framing, materials, joints, splices, fasteners, anchorages, and installation details; indicate connections and fastening to adjacent materials and construction; show provisions for thermal expansion and contraction.
    - a. Include details of flashing and water-managed assembly.
- D. Manufacturer's Literature and Data:
  - 1. Provide complete description for all components.
- E. Delegated-Design Submittal: Provide analysis data and calculations for the metal wall panel support system signed and sealed by the qualified professional engineer responsible for their preparation. Submittals may or may not be returned, and will not bear stamp of approval.
- F. Methods and procedures related to metal wall panel installation, including manufacturer's written instructions for Installation of Type MP-1 wall system, and verification of wall system assembly wind load and fire stopping.
- G. Samples:

1. Metal Siding: Submit samples of metal wall panel and siding showing color, finish, and profile. Sample sizes to be width of unit by 24" high minimum.
  2. Secondary Rain Barrier:
    - a. 8-1/2-x-11-inch sheet of black air barrier membrane.
    - b. Tapes: One of each type in a 12' length x required width.
    - c. Fasteners: 10 of each type.
- H. SUBMITTALS required for this Sections shall be submitted complete and concurrently with Blast Submittals. Partial submittals are not acceptable.
1. Include work provided by this Section and specified elsewhere.
- I. Secondary Air Barrier: Provide manufacturer's instructions showing the recommended procedures and sequence of installation of breathable underlayment. Instructions may or may not be returned by Architect and will not be reviewed or approved by Architect.
- J. Certification: Secondary Air Manufacturer shall certify in writing that the air barrier is in conformance with specifications; and product is suitable as a Secondary Rain Barrier for this project and as detailed on shop drawings.

#### 1.7 QUALITY ASSURANCE

- A. Manufactured Metal Siding shall be products of a single manufacturer regularly engaged in the fabrication and erection of metal panels of the type and design shown and specified.
- B. Installer: Installation of preformed metal siding accessories and supplemental framing shall be performed by one of the following:
1. Authorized dealers or builders of the manufacturer.
  2. Building manufacturer's crews.
  3. Other erectors authorized by the manufacturer as trained and qualified to erect that manufacturer's product. In this case, the manufacturer shall inspect the work and certify its correctness.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Louisiana and who has a minimum of 10 years experience in providing engineering services of the kind indicated.
- D. Mockups: Before production or installation of manufactured metal siding systems, provide mockups for aesthetic review and determination of final design and to confirm performance. Build mockups as directed, using all components as shown and specified in accordance with final shop drawings. The mockup is as an Aesthetic Mockup and Testing Mockup.
1. Aesthetic Mockup: See Section 01 43 39, Mockups. Approval of aesthetic mockup required before design of testing mockup can proceed.
  2. Testing Mockup: See Section See Section 01 43 39, Mockups.
- E. Preinstallation Conference: Conduct conference at Project site:
1. Review methods and procedures related to Manufactured Metal Siding work, including but not limited to the following:
    - a. Methods and sequence of installation, including construction scheduling.
    - b. Quality control requirements.
    - c. Evaluation of suitability of specified materials and sealants for anticipated weather conditions.
    - d. Coordination with other trades.
    - e. Field testing, inspecting and certifying procedures.

- F. Secondary Rain Barrier:

1. Water-resistive weather barrier membrane components and accessories must be obtained as a single- source to ensure total system compatibility and integrity.
2. Comply with Quality Control specified in Section 07 27 30 - Air Weather Barrier (AWB).

## 1.8 WARRANTY

- A. Manufacturer and Contractor: Warrant manufactured wall panel material and workmanship for a period of two years from date of completion. Warranty shall provide for repair or replacement of material found defective in manufacture, field labor damage, and work not installed in accordance with erection drawings.
- B. High Performance Fluoropolymer Finish: Provide a 20 year warranty as specified in Section 05 05 13 - Shop Applied Coatings for Metal.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Specification based on the following model by Centria.
  1. MP-1: #BR5-36. 1-1/2" deep, with 5 flat faces per 36" wide panel.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  1. Centria. .
  2. Metal Sales.
  3. Industrial Building Panels.

### 2.2 MATERIALS

- A. Steel: Aluminum-zinc alloy coated steel; "Galvalume", ASTM A 792 with minimum coating weight of 0.55 ounces per square foot (AZ 55).
- B. Structural Steel: Provide as specified in Section 05 50 00.

### 2.3 BACK-UP WALL COMPONENTS

- A. CMU: Provided by Division 4 – Masonry.
- B. Air Weather Barrier: Provide by Section 07 27 30 - Air Weather Barrier (AWB).
- C. Sheet metal flashing: Provide as specified in 07 60 00 - Flashing and Sheet Metal.
  - a. Exposed flashing shall be painted to match metal siding.
- D. Others: As required for a complete installation.

### 2.4 METAL SIDING COMPONENTS

- A. Metal wall shall be single sheets, of approximate overall depth and configuration shown on drawings. Connections between panels shall be created by a shingle style lap and sealed with sealing as specified in Section 07 92 00, Joint Sealants or manufacturer's standard butyl

sealant tape system. Furnish wall panels in one continuous length for full height or at least one story height with no horizontal joints, except at openings. Provide factory cut-outs as required for scuffers. Construct panels as follows:

1. Gage: 18 gage (0.047 inch) sheet steel.
2. Surface: Smooth, non-embossed.
3. Pattern: Standard profiles and as specified and shown on drawings.
4. Panel Width (nominal): 36 inches.
  - a. Min.: 24 inches.
  - b. Max. 48 inches
5. Panel Depth: 1-1/2 inches

B. Sub-Framing:

1. Z-Furring: Furnished and installed continuous Z-furring horizontal.
  - a. Material: Steel with G-90 galvanized finish.
  - b. Gage: As required to comply with Performance Requirements, but not less than 16 ga. (0.059 inch).
  - c. Depth: As indicated on drawings.
  - d. Vertical Spacing: As required to comply with Performance Requirements.
2. Other Furring, additional girts, depth, gage, and configuration as required for span and application, 16 gage minimum; G 90 galvanized steel.

## 2.5 INSULATION

A. Rainscreen Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. "Roxul Plus" by Roxul.
  - b. "RainBarrier" by Thermafiber.
2. Mineral-Wool Board Insulation: ASTM C612, Type I.
  - a. Moisture Resistance: 0.03%, or less, Moisture Sorption per ASTM C 1104.
  - b. Material: Rock Wool.
    - 1) Fiberglass is not permitted.
  - c. Density: Not less than 4 pounds per cubic foot.
  - d. Thickness: 4 inches.
3. Fire characteristics of Unfaced Mineral Wool Insulation:
  - a. Flame spread: 0, per ASTM E 84.
  - b. Smoke developed: 0, per ASTM E 84.
  - c. Rated Non-combustible per NFPA Standard 220.
4. Color: Dark.

B. Insulation Anchors:

1. Mechanically Secured, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - a. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
  - c. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
2. Contractor's Option: Provided Impasse Hanger in dimension to match insulation thickness and as recommended manufacturer.
  - a. Manufacturer: Thermafiber.

3. Anchor Spacing: Provide anchors at edges of insulation board and within 6 inches from edge of insulation boards. Spacing of anchors shall not exceed 24 inches on center.

## 2.6 SECONDARY RAIN BARRIER

- A. Type: Sheet that is designed to span between the metal framing with specified insulation full depth of metal framing and meets or exceeds PERFORMANCE REQUIREMENTS, and designed to be mechanically attached.
- B. Thickness: Not less than 0.018 inches.
- C. Color at Locations Exposed to View:
  1. Black
- D. Fasteners: 304 stainless steel screws with preformed head caps. Screws shall have head caps with a center throat hole that seals the membrane at the fastener penetration, specifically designed and tested to withstand wind loads and protect against water intrusion at screw penetrations.
  1. Fastener Length: Not less than 3/4".
- E. Transition And Flashing Membranes:
  1. Types: Self Adhered and Mechanically fastened membranes with the following properties:
    - a. Water Vapor Permeance: Not less than 50 perms, tested to ASTM E 96 Method B:
    - b. Water Resistance: No leakage when tested to AATCC 127, 550 mm hydrostatic head for 5 hours.
- F. Accessories:
  1. Water-Resistive Flashing and Penetration Tapes: UV-Resistant Black: 35 mil thick by 4 inches wide penetration seam tape.
  2. Others: As required for a complete installation.

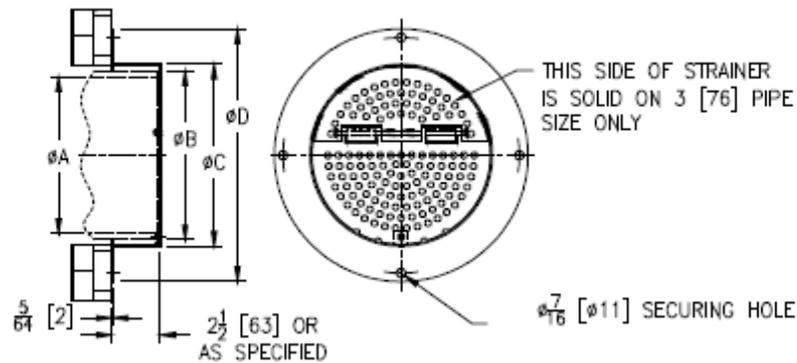
## 2.7 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Stainless steel screws; bolts and nuts; self-locking rivets and bolts; end-welded studs; and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
  1. No explosive charge or power actuated devices permitted.
    - a. Attachment to masonry: Stainless steel expansion devices.
    - b. Attachment to metal: Self-tapping stainless steel screws; size as required.
  2. Siding Fasteners: Manufacturers' standard or custom as required.
    - a. Exposed type with neoprene washers. Provide stainless steel fastener and stainless steel washer painted to match siding.
    - b. Fasteners shall conform to requirements of Section 05 05 23 - Metal Fastening.
  3. Trim: Same as siding fasteners above. Stainless steel pop- rivets permitted where required; field paint exposed heads to match metal siding.
  4. Clips and Other Miscellaneous Types: Manufacturer's standard, noncorrosive.
- B. Metal Wall Panel Accessories, General: Provide complete metal wall panel assembly incorporating trim, fasciae, parapet caps, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets,

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lap tapes, closure strips, and caps for a complete installation. Fabricate accessories in accordance with SMACNA Manual.

1. Formed Flashing and Trim: Match material, and color of metal wall panel face sheets, thickness not less than 20 gage. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, fasciae, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels. Provide metal closers at intersection of horizontal flashing with metal panel to close off visible void between the valley in the metal panel and edge of the flashing.
  2. Extrusion Trim: Provide, extruded trim as required for complete installation and where indicated on Drawings. Provide custom shapes indicated on drawings. Meet or exceed manufacturer's requirements.
    - a. Color: Match metal wall panel face sheets.
- C. Copings at Top of Parapet: Provided by Section 07 72 00 - Roof Accessories.
- D. Joint Sealant:
1. Preformed sealant tape as recommended by siding manufacturer.
  2. Type recommended by metal wall panel system manufacturer for application, and meeting requirements of Section 07 92 00 - Joint Sealants.
    - a. Sealant joints with a backer rod shall be silicone sealant Type S-6.
- E. Sealants: Type recommended by metal wall panel system manufacturer for application, meeting requirements of Section 07 92 00 - Joint Sealants or as approved by Architect.
- F. Flashing Tape: 4-inch wide self-adhering butyl flashing tape.
- G. AWB Materials: Furnished by Section 07 27 30 - Air Weather Barrier (AWB).
- H. Downspout Cover:
1. Coordination:
    - a. Provide factory cut round opening in exterior wall system for installation of piping by Division 22. Opening to approximately 1/2" larger than outside diameter of downspout cover inlet (Dimension "C" below).
    - b. Provide concealed blocking for support of scupper and securing supper fasteners through wall system to blocking. Pipe provided Division 22 shall be supported by Division 22.
    - c. The sealing of pipe to Air Weather Barrier and the scupper to the Composite Panels shall be provided under this section.
  2. Downspout Cover will be provided by Division 22. The information below regarding the downspout cover is for information only.
  3. Basis of Design: Model Number "Z199-DC" Downspout Cover.
    - a. Manufacturer: Zurn Plumbing Products.
  4. Exposed Material: Stainless steel.
  5. Fasteners: Stainless steel fastener with Robertson type head finish.
  6. Size: Match to pipe size provided by Division 22 for piping to the scupper.
    - a. Default: If not indicated in EWP-6, Construction Manager shall base bid on nominal 6" inside diameter pipe and verify required size with Resident Engineer prior to submitting "SUBMITTALS" for this specification Section.
  7. Appearance and Profile: As shown below.



- I. Miscellaneous: All materials, tools, equipment, hardware, and devices required for complete installation.
- 2.8 FINISHES
- A. Surface Preparation: Clean zinc-coated surfaces with an alkaline compound, treat with a zinc phosphate conversion coating, and seal with a chromic acid rinse.
- B. Finishes:
1. Exposed Finish Coating: Fluoropolymer baked enamel as specified under Section 05 05 13 - Shop-Applied Coatings for Metal.
    - a. 2-coat PVDF finish containing mica pearlescent flake pigments.
    - b. Color: In conformance with Section 09 06 00, Schedule for Finishes.
  2. Concealed Surface: As specified under Section 05 05 13 - Shop Applied Coatings for Metal.
- C. Protective Film: Apply strippable plastic film for protection during fabrication, shipping, and storage.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Check stud framing, specified elsewhere, for accurate spacing and alignment.
- B. Verify back-up wall systems are complete and AWB is continuous over back-up wall construction and sealed at penetrations in the wall system; and free of tears or openings.
- C. Do not proceed with installation until deficiencies are corrected.

#### 3.2 GENERAL

- A. Install materials in conformance with Approved shop drawings and comply with manufacturer's instructions and details, except where more stringent requirements are

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shown or specified, and where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

- B. Install weather seals recommended by AWB manufacturer (provided by Section 07 27 30 - Air Weather Barrier (AWB)) and provide flash metal flashings as required to maintain a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Install weather seals recommended by AWB manufacturer to properly seal fasteners penetrations through AWB, and maintain PERFORMANCE REQUIREMENTS specified for AWB.
  - 1. Fastener Penetrations of AWB: Seal/gasket penetration in conformance with AWB manufacturer's recommendations.
  - 2. Fastener Penetration where Fastener is Removed: Seal penetration with AWB as specified in Section 07 27 30.
  - 3. Flashing: Apply AWB transition membrane over flashing and seal to AWB as specified in Section 07 27 30.
- C. At base of walls and above openings and other penetrating components, provide flashings with end dams and or weeps to allow water from air weather barrier to drain to the exterior of the metal panels.

### 3.3 INSTALLATION

- A. General: Install panels in accordance with the manufacturer's approved erection instructions and diagrams, except as specified otherwise, and approved shop drawings. Panels shall be in full and firm contact with supports and with each other at side and end laps. Where panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after the necessary repairs have been made with material of the same type and color as the weather coating, be approved before being installed. All cut ends and edges, including those at openings through the sheets shall be sealed completely. Correct defects or errors in the materials in an approved manner. Replace materials which cannot be corrected in an approved manner with nondefective material. Provide molded closure strips where indicated and whenever sheets terminate with open ends after installation
- B. Provide weather seal recommended by AWB manufacturer to properly seal fasteners penetrations through AWB reveals, and maintain PERFORMANCE REQUIREMENTS specified for AWB.
- C. Flashing: All flashing and related closures and accessories in connection with the preformed metal panels shall be provided as indicated and as necessary to provide a watertight installation. Details of installation, which are not indicated, shall be in accordance with the panel manufacturer's printed instruction and details, or the approved shop drawings. Installation shall allow for expansion and contraction of flashing. . Install metal flashing with end dams and shingle style to weep water to the exterior. Seal all penetrations. See PERFORMANCE REQUIREMENTS in PART 1 above for metal flash and Water-Managed Assembly.
  - 1. Coordinate installation of flashing with AWB, so AWB and flashing are installed shingle style. See additional requirements in Section 07 27 30 - Air Weather Barrier (AWB)
- D. Secure sub-framing horizontally to structure; spacing not to exceed manufacturer's recommendations and shall meet performance requirements. Isolate dissimilar metals.
  - 1. Coordinate installation of roofing provided under another Section.
  - 2. Continuous Z- Shaped Sub-framing may be used as a portion of the insulation support system if depth of "Z-Shape" matches depth of insulation and horizontal leg laps over insulation two or more inches.
- E. Insulation:

1. Provide attachment/support as specified, and not less than as recommended by manufacturer, to assure insulating materials maintain their proper location and perform their intended function; all subject to review and approval of Resident Engineer.
  2. Butt joints between insulation boards tight to provide continuous insulation.
- F. Secondary rain barrier:
1. Ensure all preparatory work is complete prior to applying primary secondary rain barrier membrane.
  2. Inspect areas to receive secondary rain barrier membrane to establish extent of work, access and need for protection of surrounding construction.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes.
    - a. Test for contaminants in substrate, as recommended by secondary rain barrier membrane manufacturer.
    - b. Test substrates for moisture content or water vapor transmission in accordance with secondary rain barrier membrane manufacturer's recommendations.
  4. Install secondary rain weather barrier sheet horizontally directly over insulation and "Z" supports for metal siding.
  5. Complete detail Work around corners, wall openings, building transitions and penetrations prior to field applications.
  6. Starting at lowest point of wall cut first sheet in half length-wise. Place and secure first sheet over wall and allow secondary rain barrier membrane to hang down to lowest point of wall. Allow for excess material at bottom of wall to accommodate tie-ins and connections to adjacent surfaces.
  7. Measure and pre-cut into manageably sized sheets to suit the application conditions.
  8. Hang sheets over wall and extend down to lowest point of wall. Allow for excess material at bottom of wall to accommodate tie-ins and connections to adjacent surfaces.
  9. Seal and secure the mechanically attached secondary rain barrier membrane sheets across the top of the wall edge and bottom of wall edge back to the substrates with specified single sided tape and roll surfaces to ensure adhesion.
  10. Secure sheets with appropriate fasteners based on substrate starting at highest point and working down. Ensure sheets lay smooth and flat to surfaces. Secure the mechanically attached secondary rain barrier membrane to substrate with specified fasteners with preformed head caps. Install fasteners along the top and bottom edge of membrane spaced at not less than 24 inches on center and along the middle spaced at not less than 48 inches on center, and as required to meet wind loads. Fasteners shall be set flush with substrate and fastened into solid backing. Use additional mechanical fasteners in field of sheet and tape joints if membrane will be left exposed for prolonged periods prior to installation of cladding system.
  11. Install subsequent sheets of secondary rain barrier membrane sheets in overlapping weatherboard format and secure as specified above. Do not place vertical laps above openings. Provide 18 inch horizontal lap seams and 12 inch vertical lap seams and do not tape. Horizontal laps shall be shingle style.
  12. At open joints and deflection joints provide specified black flashing membrane open joints of panels over mechanically fastened sheet secondary rain barrier membrane. Secure into position with fasteners and specified screw head caps or black tape. Create bellows in secondary rain barrier membrane to allow deflection joints to open to twice the size shown on drawings.
  13. Do not seal bottom edge of flashing secondary rain barrier membrane.
  14. Penetrations: Penetrating items to be sealed must be secured solid into position prior to installation secondary rain barrier. Seal penetrations with self adhered flexible membrane flashing and as recommended by manufacturer.

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15. Fasteners: Position fasteners to not be at the valley of the manufactured metal panels. There should be no secondary weather barrier fasteners in contact with metal panel, unless approved by Architect.
16. Protection:
- a. Protect wall areas covered with secondary rain barrier membrane from damage due to construction activities, high wind conditions, and extended exposure to inclement weather.
  - b. Review condition of secondary rain barrier membrane prior to installation of cladding. Repair, or remove and replace damaged sections.
  - c. Protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed primary water-resistive weather barrier installations.
  - d. Remove and replace secondary rain barrier membrane that is damaged.
- G. Wall Panels: Install siding with pattern oriented vertically as shown. Provide panels in the longest obtainable lengths, with end laps occurring only at structural members. Seal side and end laps with joint sealing material. Flash and seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Install closure strips, flashings, and sealing material in an approved manner that will assure complete weather tightness. Flashing will not be required where approved "self-flashing" panels are used. Provide flashing with end dams. No sealant to be exposed unless shown as exposed in drawing details. Remove strippable film protection. Use a laser level, or some other type of surveying instrument, and mark module lines on the horizontal supports to maintain vertical module. Fasteners shall be installed centered horizontally in panel reveal and aligned with fasteners at adjacent reveals, and installed at consistent fastener spacing. However fastener spacing shall change when designed for different positive and negative pressures and in conformance with Approved Shop Drawings.
- H. Fasteners: Fastener spacing shall be in accordance with the manufacturer's recommendations, and as necessary to withstand the design loads indicated. Install fasteners in valleys. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface, and to a uniform depth to seat gasketed washers properly, and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered in valleys, or crowns, as applicable. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels. Remove metal shavings and filings from roofs to prevent rusting and discoloration of the panels.
- I. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4" in 20'-0" on level/plum/scope and location/line as indicated, and within 1/8" offset of adjoining faces and of alignment of matching profiles. Workmanship shall conform to standards set forth in the "Architectural Sheet Metal Manual" as published by SMACNA.
- J. Install closers and flashing at all perimeters, corners intersections, and penetrations; except coping specified elsewhere.
- K. Complete installation to meet the requirements of the performance features specified.

### 3.4 PROTECTION AND CLEANING

- A. Protect panels and other components from damage during and after erection, and until project is accepted by the Government.

- B. After completion of work, all exposed finished surfaces of panels shall be cleaned of soil, discoloration and disfiguration. Touch-up abraded surfaces of panels.

END OF SECTION

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**SECTION 07 52 16**  
**STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS ROOFING****PART 1 - GENERAL****1.1 DESCRIPTION**

A. This Section outlines the requirements for the supply and installation of the SBS modified bituminous sheet roofing systems.

1. The membrane will be installed as part of a roof assembly, which consists of: SBS membrane, lightweight concrete roof insulation, vapor retarder (temporary and secondary roof membrane), and concrete deck substrate.
  - a. The vapor retarder shall be installed to provide a temporary roof during construction and a permanent secondary roof.
2. The roofing membrane shall be a two-ply SBS membrane system with white granular top ply (cap) that is heat welded (torch) to an approved prepared primed substrate over insulation.
3. This Section covers the furnishing and installation of the roofing membranes, as well as the flashing and accessories necessary to complete the roofing membrane system. Roof flashing generally extends full height of parapet.
4. Coordinate with the applicable Section for the roof deck insulation product and installation requirements.
5. Walkway.
6. Cants: Provide cants as recommended by manufacturer and in conformance with NRCA.
7. Section includes all roofs, except roof on Dixie dome that is listed as fluid-applied roofing.
8. SBS Roof Types:
  - a. R-MB2: Light colored low glare roofing, not required to meet SRI 78+.
  - b. R-MB3: Designates general roof area requiring chemical resistant roof membrane. Roof color to match adjacent roofing. RFI 7078 CONFIRMED PROGRESSIVE PROPOSED PRODUCT IS CHEMICAL RESISTANT
  - c. R-MB4: Non-torch system at Dixie Building
9. Location of roof types R-MB2", "R-MB3", and "R-MB-4" are indicated on the drawings.

B. Work Specified Elsewhere, but Provided Under this Section:

1. Roof and Deck Insulation at SBS Roofing System: Provide as specified in Section 03 52 00, Lightweight Concrete Roof Insulation.
2. Roof Specialties at SBS Roofing System: Provide as specified in Section 07 71 00.
3. Roof Accessories at SBS Roofing System: Provide as specified in Section 07 72 00.
4. Treated wood subcurbs, nailers, blocking, and cants associated with SBS roofing, and roof penetrations: Provide as specified in Section 06 10 00 - Rough Carpentry with each roof type.

1.2 RELATED WORK (Items not included in this Project Manual are available through Construction Manager upon request):

A. General sustainable design documentation requirements: Section 01 81 13, Sustainable Design Requirements.

B. Removal of embedded wood nailers at gable roof of Dixie building: Section 02 41 10, Selective Demolition.

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- C. Facility Exterior Enclosure Commissioning: Section 07 08 00.
  - D. Air Weather Barrier (AWB): Section 07 27 30.
  - E. Division 07 Section "Flashing and Sheet Metal"
  - F. Division 07 Section "Joint Sealants".
  - G. Roof Membrane Color: Section 09 06 00, SCHEDULE FOR FINISHES.
  - H. Fall Protection Anchors: Section 11 24 24.
  - I. Lightning Protection System: Section 26 41 00 - Facility Lightning Protection.

### 1.3 PERFORMANCE REQUIREMENTS

- A. The roof assembly shall remain watertight and shall not permit the passage of water under ponding or hydrostatic pressure.
- B. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
- C. Roofing Membrane System Load-Strain Properties: Provide a roofing membrane identical to component systems that have been successfully tested by a qualified independent testing and inspecting agency to meet the following minimum load-strain properties at membrane failure when tested according to ASTM D2523:
  - 1. Tensile strain at failure, at 0 deg F (-18 deg C): 600 lbf cross machine direction, minimum; 4.0 to 5.5 percent elongation at break.
- D. FM Approvals Listing: Provide roofing membrane, insulation, backer board, base flashing, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a roofing system and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
  - 1. Fire/Windstorm Classification: Class type 1A-225.
    - a. Basis of Design: The assemble numbers below are for information only, and do not constitute a PERFORMANCE REQUIREMENT.
      - 1) R-MB2: Miami-Dade NOA Number 10-0408.08 System Type F(2).
  - 2. Hail Resistance: SH.
- E. Exterior Fire-Test Exposure, ASTM E108: Class A.
- F. The roof system shall have been tested in compliance with the following codes and test requirements:
  - 1. Metal flashings shall be in compliance with ANSI-SPRI ES-1 Wind Design Standard for Edge Systems (most recent version prevailing).
  - 2. The roof system assembly shall be installed in compliance with all local building and safety requirements adopted by the local building code jurisdiction.
- G. Unless specified otherwise, comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to modified bituminous sheet roofing for storage, handling and application.

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#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Include manufacturer's printed installation instructions on materials proposed for use.
1. Modified bituminous sheet roofing, including vapor retarder (temporary roof) membrane.
  2. Flashing accessories.
  3. Attachment requirements for the backer board.
  4. Application instructions.
  5. Roof walkway.
- C. Shop Drawings:
1. Provide complete installation details of roofing including but not limited to walls, curbs, drains, penetrations, edges, control joints, and all terminations. Show layout of sheets, location of field splices and attachment details showing specific wall and deck construction, entire roof assembly, additional blocking as required, and interfaces with adjacent work. Include lightning protection system and walk way type devices. Indicate and provide method to maintain drainage; and not allow ponding of water.
  2. Show specific detail for vented base sheet termination at vertical surfaces.
  3. Include notation of roof slopes.
- D. Samples:
1. 12-inch square samples of each membrane layer, including base sheet, cap sheet, and flashing plies.
- E. Certificates:
1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.
    - a. Certifications shall include roof plans indicating wind load level for each Class 1A Factory Mutual construction provided.
      - 1) Drawings shall be at a scale of  $1/16" = 1'-0"$  or larger.
  2. Indicating compliance with energy performance requirement.
  3. Installer: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
  4. Product Certificates: Signed by roofing manufacturer certifying that the roofing system complies with specified requirements.
- F. Product Certificates: Signed by roofing manufacturer certifying that the roofing system complies with specified requirements.
- G. Manufacturer's Approval: Submit manufacturer's approval of all components of roof assembly, including insulation, as not being injurious to the membrane or roofing system as located. Include pedestal set roof pavers, specified elsewhere.
- H. Sample Warranty: Submit with shop drawings in accordance with Section 01 33 25 - Warranties.
- I. Test Reports: Provide test reports certifying compliance with the performance requirements referenced under this section.

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- J. Contamination Profile: The manufacturer shall provide the applicator, building owner and/or occupant with a tabular profile of chemicals, solutions, oils, compounds or materials which are injurious to the sheet membrane. This profile shall be established by a generic (or trade name) basis, including those materials normally found to exist in the roof environment or likely to occur on this roof.
- K. Closeout Submittals:
1. Warranty: Upon completion of work under this section, submit an executed copy of the warranty in accordance with Section 01 33 25.
  2. Seam Layout: Provide as-built plan of roof membrane showing location of all seams.
- L. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices for roofing membrane specified. Include recommendations for periodic inspections, cleaning, care, maintenance, and repair of membrane roofing.
- M. LEED Submittals:
1. Product Test Reports for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
  2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in work of this Section with minimum 5 years continuous documented experience for roofing work comparable to Project Scope. Installer must be certified or approved by roofing manufacturer to install specified system.
1. Applicator must have installed at least five roofs of similar materials and methods specified for this project.
  2. Supervision of work by persons that is knowledgeable and experienced in roofing.
- B. Manufacturer's Qualifications: Must have a minimum of 10 years experience manufacturing SBS modified bitumen roofing membranes, minimum 5 years experience manufacturing torch grade systems such as the base system specified in this Section.
1. Provide a factory trained technician to conduct inspections and to ascertain that roofing system has been installed in accordance with the manufacturer's warranty requirements.
- C. Source Limitations: Obtain components for roofing system approved by roofing system manufacturer.
- D. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- E. Roof Mounted Lightning Protection: Coordinate installation with Division 26 9 (WP-8).
- F. Regulatory Requirements:
1. Conform to applicable Federal, State, and Local codes.
- G. Pre-Installation Conference: Conduct conference at Project site.
1. Include all parties responsible for work of this section including manufacturer's representative and other trades whose work interfaces with roofing work.

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2. Review installation procedures and coordination required with related and interfacing work.
  3. Inspect and make notes of project site conditions prior to installation.
- H. Mockups: Before beginning installation, install roofing mock-up, as directed by the Architect, to demonstrate surface preparation, corner treatment, and execution quality.
1. Mock-up shall include typical base and cap ply installation, deck to wall transition, typical penetration flashing, roof edge detailing, and typical drain installation.
- I. Pre-Roofing Meeting:
1. Upon completion of roof deck installation and prior to any roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers Technical Representative, Roofing Applicator, Contractor, Division 26 Contractor responsible for installation lightning protection system at roof level, and Resident Engineer; and any other parties closely associated with work of this section including other trades whose work interfaces with roofing work.
  2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
  3. Examine samples and installation instructions of manufacturer.
  4. Review Flashings, end dams associated with flashings, sill flashings at glazed openings, spring lock flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, transitions to adjacent building enclosure construction, and condition of other construction that will affect roofing system.
  5. Review temporary protection requirements for roofing system during and after installation.
  6. Inspect roof deck at this time to:
    - a. Verify that work of other trades which penetrates roof deck is completed.
    - b. Determine adequacy of deck anchorage, presence of foreign material, moisture and unlevel surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
- 1.6 DELIVERY, STORAGE AND MARKING
- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer or seller.
  - B. Keep materials dry, and store in dry, weather tight facilities, and in strict compliance with manufacturer's instructions.
  - C. Protect from damage from handling, weather and construction operations before, during, and after installation.
- 1.7 PROJECT CONDITIONS
- A. Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

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- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

- A. Roofing work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend warranty period to 10 years from acceptance of facility by the Government.

1.9 APPLICABLE PUBLICATIONS (latest versions unless otherwise indicated)

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. International Building Code 2006.
- C. American Society of Civil Engineers - Reference Document ASCE 7-05, Minimum Design Loads for Buildings and Other Structures.
- D. American Society of Testing and Materials (ASTM):
1. C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  2. D41 Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  3. D2523 Standard Practice for Testing Load-Strain Properties of Roofing Membranes.
  4. D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
  5. D6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
  6. D6164 11 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
  7. E108 Spread of flame.
  8. E1980 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- E. CGSB 37GP56M Classification: Type 2, Class C, Grade 2.
- F. DIN 50018 Testing in a saturated atmosphere in the presence of sulfur dioxide.
- G. Factory Mutual Research Corporation (FMRC):
1. Loss Prevention Data Sheets 1-7; 1-28; 1-28R; 1-29; 1-29R; 1-49.
  2. Approval Guide - Roof Coverings and/or RoofNav assembly database.
  3. Standard 4470 - Approval Standard for Class I Roof Covers.
- H. National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual-current edition.
- I. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.
- J. Underwriters Laboratories (UL) - Roofing Materials and Systems Annual Directory.

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**PART 2 - PRODUCTS****2.1 VAPOR RETARDER (TEMPORARY ROOF) MEMBRANE**

- A. Vapor retarder to provide continuous secondary waterproofing and air barrier system.
- B. Membrane shall have a non-woven polyester reinforcement. Both sides shall have a thermofusible plastic film. This membrane is to be applied by torching.
- C. Vapor Retarder ply shall have the following characteristics:
  - 1. Thickness (min.): 120 mils per ASTM D6164, Type II, Grade S.
  - 2. Weight (min per 100 ft<sup>2</sup> of coverage): 90 lb.
  - 3. Tensile Peak Load (avg) @ 73° F: 145 lb force/inch width per ASTM D6164, Type II, Grade S (Machine Direction).
  - 4. Ultimate Elongation @ 73°F (min.): 45% per ASTM D6164, Type II, Grade S.
  - 5. Tear Strength @ 73°F: 160 lbf/inch per ASTM D6164, Type II, Grade S (Machine Direction).
  - 6. Dimensional Stability (max): 0.7% per ASTM D6164, Type II, Grade S (Machine Direction).
  - 7. Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
  - 8. Reinforcement: Polyester mat.
- D. Basis of Design: Sopralene 250 SP (22B) by Soprema.
- E. Manufacturers: Subject to compliance with requirements, available manufacturers of products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Soprema.
  - 2. Tremco.
  - 3. Garland.

**2.2 MEMBRANE VENTING BASE PLY**

- A. Membrane shall have composite fiberglass/non-woven polyester reinforcement and thermofusible elastomeric asphalt with heat activated ribbon strips bonded to the underside. Top side shall have a thermofusible plastic film. Bottom side has ribbon strips with burn-off film. This membrane is to be applied by torching.
  - 1. Thickness (min.): 120 mils per ASTM D6164, Type II, Grade S.
  - 2. Weight (min per 100 ft<sup>2</sup> of coverage): 84 lb.
  - 3. Tensile Peak Load (avg) @ 73° F: 117 lb force/inch width per ASTM D6164, Type II, Grade S (Machine Direction).
  - 4. Ultimate Elongation @ 73°F (min.): 45 % per ASTM D6164, Type II, Grade S.
  - 5. Tear Strength @ 73°F: 120 lbf/inch per ASTM D6164, Type II, Grade S (Machine Direction).
  - 6. Compound Stability (min): 220°F per ASTM D6164, Type II, Grade S.
  - 7. Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
  - 8. Reinforcement: Polyester mat.
- B. Basis of Design: Colvent Flam 180 TG (78C), by Soprema.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers of products that may be incorporated into the Work include, but are not limited to, the following:

1. Soprema.
2. Tremco.
3. Garland.

### 2.3 MEMBRANE TOP PLY FOR "R-MB2"

- A. The membrane shall have a non-woven polyester reinforcement and thermofusible elastomeric asphalt. The topside shall be self-protected with colored granules. The underside shall be protected by a thermofusible plastic film. This membrane is to be applied by torching only.
- B. The Membrane top ply shall have the following characteristics for the machine direction:
  1. Thickness (avg): 160 mils per ASTM D6164, Type II, Grade G.
  2. Tensile Peak Load (avg) @ 73°F (min.): 70 lbf/inch per ASTM D6164, Type II, Grade G.
  3. Ultimate Elongation @ 73°F: 45 % per ASTM D6164, Type II, Grade G.
  4. Tear Strength @ 73°F: 120 lbf/inch per ASTM D6164, Type II, Grade G.
  5. Dimensional Stability (max): 0.7% per ASTM D6164, Type II, Grade G.
  6. Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
  7. Reinforcement: Polyester mat.
  8. Surfacing: Ceramic granules.
- C. Basis of Design: Sopralene Flam 180 FR GR (48) by Soprema.
- D. Manufacturers: Subject to compliance with requirements, available manufacturers of products that may be incorporated into the Work include, but are not limited to, the following:
  1. Soprema.
  2. Tremco.
  3. Garland.

### 2.4 ASPHALT PRIMER

- A. ASTM D41; composed of asphalt modified bitumen with thermoplastic polymers and volatile solvents.
  1. Basis of Design: Elastocol; 500 (08) by Soprema.

### 2.5 MEMBRANE FLASHING

- A. Manufacturer's approved flashing system installed by heat welding onto primed substrate and consisting of the following:
  1. Base Sheet: The base sheet ply shall have the following characteristics for the machine direction:
    - a. Thickness (avg): 160 mils per ASTM D 6164, Type II, Grade G.
    - b. Tensile Peak Load (avg) @ 73°F (min.): 130 lbf/inch per ASTM D 6164, Type II, Grade G.
    - c. Ultimate Elongation @ 73°F: 50% per ASTM D 6164, Type II, Grade G.
    - d. Tear Strength @ 73°F: 160 lbf/inch per ASTM D 6164, Type II, Grade G.
    - e. Dimensional Stability (max): 0.7% per ASTM D 6164, Type II, Grade G.
    - f. Compound Stability (min): 230°F per ASTM D 6164, Type II, Grade G.
    - g. Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
    - h. Reinforcement: Polyester mat

- i. Surfacing: None.
  - j. Basis of Design: Sopralene Flam 250 (31) by Soprema.
2. Cap Sheet: Same as top ply for "R-MB2.

## 2.6 "R-MB-4" NON-TORCH ROOF SYSTEM

RFI 7699 confirmed that the VA does not wish to deviate from the specified non-torch roof system.

- A. General:
  1. All components installed with adhesive or mechanical fastening only; no open flame torch permitted due to fire concerns with adjacent asbestos encapsulate.
  2. All materials must be suitable for component in specified wind-rated roofing assembly.
  3. System must comply with PERFORMANCE REQUIREMENTS in Part 1 above.
  4. Thermal roof insulation not required for this system. Insulation provided on interior side of deck under Section 07 21 29, SPS Insulation & Air/Vapor Barrier System.
- B. Wood Nailers: As needed for backnailing in compliance with Section 06 10 00, Rough Carpentry; minimum preservative treated 2 x 4's.
- C. Rigid Insulation: As needed to match thickness of wood nailers and suitable for component in wind-rated roofing assembly. R-value not considered.
- D. Deck Board: Non-faced homogeneous board not less than ¼-inch thick. Acceptable products include the following:
  1. SecurRock by USG.
  2. Sopraboard by Soprema.
  3. Cement board by USG or James Hardie.
- E. Sheets:
  1. Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
  2. Reinforcement: Polyester mat.
- F. Base Sheet: See "Sheets" above.
  1. Referenced Tests: ASTM D6164, Type I, Grade S.
  2. Thickness (min.): 120 mils.
  3. Weight (min per 100 ft<sup>2</sup> of coverage): 77 lb.
  4. Tensile Peak Load (avg) @ 73° F: 70 lb force/inch width (Machine Direction).
  5. Ultimate Elongation @ 73°F (min.): 56%.
  6. Tear Strength @ 73°F: 120 lbf/inch (Machine Direction).
  7. Dimensional Stability (max): 0.5% (Machine Direction).
  8. Basis of Design: Sopralene 180 Sanded.
- G. Cap Sheet: Same as MEMBRANE TOP PLY FOR "R-MB2" above.
- H. Flashing: Same as MEMBRANE FLASHING above.
- I. Primer: Same as ASPHALT PRIMER above.
- J. Adhesive: Contractor's option for use of cold or hot adhesive.
  1. Cold Adhesive: As recommended by membrane manufacturer for specific products
  2. Basis of Design: Soprema.
    - a. Board Products: High Velocity Insulation Adhesive or HVIII.
    - b. Sheet Products: FMA VOC Squeegee Adhesive.
    - c. Flashing: FMA VOC Trowel Grade Adhesive.

3. Hot Adhesive: Hot asphalt recommended by manufacturer, and with demonstrated capability to bond backer board and membrane in conformance with structural performance requirements.

- K. Mechanical Fasteners: Provide corrosion-resistant suitable types as needed for wood nailers and deck board. Meet or exceed Factory Mutual corrosion test FM 4470 requirements; not to exceed 15% red rust after 25 cycles in Kesternich cabinet.

## 2.7 ROOF INSULATION

- A. Provide Roof Insulation for SBS roof system in conformance with Section 03 52 00 – Lightweight Concrete Roof Insulation.

## 2.8 METAL FLASHING

- A. Provide flashing for SBS roof system in conformance with Section 07 60 00, Flashing and Sheet Metal.

## 2.9 MISCELLANEOUS ACCESSORIES

- A. Provide other flashings, membranes, protection sheets, or miscellaneous materials as required to resist chemical contact, such as localized grease exposure around kitchen exhaust fans, or other conditions that may impact membrane durability, as noted in the drawings, and roof areas indicated as R-MB3 on drawings.
- B. Cants: Treated wood provided under Division 6 where shown as wood; for cants not shown, but required, provide under this section as follows:
  1. Preservative treated wood conforming to requirements of Section 06 10 00 - Rough Carpentry; typical where suitable nailing substrate is available.
  2. Manufactured fiber type, set in bitumen or adhesive approved by manufacturer, where suitable nailing substrate is not available.

## 2.10 WALKWAYS

- A. Walkway Cap Sheet Strips: Self adhered cap sheet not less than 38 inches wide Type I or II, SBS-modified asphalt sheet with thermoplastic polymers (reinforced with glass fibers) granular surfaced; suitable for application method specified, and as follows:
  1. Granule Color: White.
  2. Thickness: Not less than 135 mils.
  3. Tear Strength: Not less than 80 pound-force at 73.4 degrees Fahrenheit  $\pm$  3.6 degrees.
  4. Tensile Strength - Max Load at 73.4  $\pm$  3.6°F lbf/in.: 55 pound-force/inch.
  5. Product approved by SBS roof manufacturer.
  6. Basis of Specification: Colphene FR GR by Soprema.

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**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine existing substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system. Ensure that:
1. Deck substrates are smooth, clean, dry and free of defects and debris that would adversely effect installation of membrane. Remove sharp projections.
    - a. Test substrates for moisture content or water vapor transmission in accordance with roofing manufacturer's recommendations; however substrate must pass ASTM D4263 as a minimum standard for water vapor transmission. Cost of testing to be borne by Contractor.
  2. Roof drains have been installed at proper elevations relative to finished roof surface.
  3. Damaged or defective deck areas have been repaired prior to commencement of work under this Section.
  4. Embedded wood nailers removed from gable roof of Dixie Building.
- B. Verify substrates to receive roofing have adequate slope throughout (minimum 2%, or as shown in drawings).
1. Verify no build-up of materials can result upon roofing and flashing installation that can impact proper slope to drain.
- C. Begin roofing application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Application of roofing indicates acceptance of surfaces and conditions.

**3.2 VAPOR RETARDER (TEMPORARY ROOFING) INSTALLATION**

- A. Install Vapor retarder (temporary roofing) membrane on clean and dry surfaces, in accordance with the manufacturer's requirements and recommendations.
1. Membrane to be fully adhered to substrate in accordance with manufacturer's recommendations to resist design wind uplift loads.
  2. Prime substrates if recommended by manufacturer to achieve required adhesion.
- B. Seal and flash membrane terminations and penetrations to provide watertight installation and to achieve continuous air barrier, extend vertically so roof flashing overlaps vapor retarder.

**3.3 INSULATION APPLICATION**

- A. Install insulation as specified in Division 7 Section Lightweight Concrete Roof Insulation.

**3.4 PRIMER APPLICATION**

- A. Prime all dissimilar surfaces to which the roofing membrane shall come in contact. Apply at the rate recommended by the manufacturer. Coat with primer all metal flashings and fascia that come in contact with membrane.

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### 3.5 TORCH-APPLIED MEMBRANE APPLICATION

#### A. General:

1. Place and install membrane in accordance with NRCA and manufacturer's recommended procedures, approved shop drawings, and observing manufacturer's cautions and as required to meet or exceed "Wind Rating" specified in Part I. Where NRCA and manufacturer's recommendations conflict, the more stringent provision shall apply.
2. Install roofing membrane on clean and dry surfaces, in accordance with the manufacturer's requirements and recommendations.
3. Perform roofing work on a continuous basis as surface and weather conditions allow.
4. Protect adjoining surfaces against any damage that could result from roofing installation.
5. Install only as much roofing as can be completed in one day. If weather conditions do not permit such completion, exposed areas shall be temporarily weatherproofed to prevent any water or snow infiltration from damaging other materials already installed, in particular, the thermal insulation.

#### B. Base ply installation:

1. Install Base Ply in accordance with manufacturer's recommendations.
2. Beginning at low point of roof, unroll one-half the first roll for positioning and re-roll.
3. Torch weld base ply in accordance with manufacturer's recommendations, to fully adhere membrane to substrate.
4. Each strip shall have minimum 3-inch side laps and 6-inch end laps. End and side laps of successive plies shall be staggered a minimum of 12-inches.
5. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.
6. Turn up at wall perimeters to vent as detailed.

#### C. Base flashing ply installation:

1. Install Base Flashing Ply in accordance with manufacturer's recommendations and as specified below.
2. Prior to application, the vertical surface receiving the base flashing ply shall receive a coat of primer. This primer coating must be dry before application of the base flashing.
3. Base flashing ply shall be laid in strips three (3) feet wide to the vertical surfaces, extending onto the flat surface of the roof a minimum of four (4) inches. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches with the laps of the base ply.

#### D. Top ply installation:

1. Torch weld top ply in accordance with manufacturer's recommendations, onto the base ply membrane.
2. Base ply and top ply seams shall be staggered a minimum of twelve (12) inches.
3. Top ply shall have minimum side laps of three (3) inches and end laps of six (6) inches.
4. Ensure the two membranes are perfectly welded, without air pockets, wrinkles, fishmouths or tears.

#### E. Top ply flashing installation:

1. Install Cap Flashing Ply in accordance with manufacturer's recommendations and as specified below.
2. Top ply flashing shall be laid in strips three (3) feet wide.
3. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches from top ply laps in order to avoid excessive thickness.
4. Top ply flashing shall be extended down the vertical surface and onto the flat roof at a distance of six (6) inches.

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5. Torch weld top ply flashing in accordance with manufacturer's recommendations, directly on its base ply, proceeding from bottom to top followed by the torching of the roof tie-in.
  6. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.
- F. Penetration Details:
1. Apply liquid flashing at penetrations as shown in the drawings and as recommended by the membrane manufacturer.
  2. Liquid flashings shall consist of minimum 2 coats with reinforcing fabric.
  3. Where liquid flashing shall remain exposed, embed granules into liquid flashing to match appearance of finished roofing cap ply.
- G. Roof Drains. Unless otherwise recommended by manufacturer, apply roofing as follows:
1. Provide a smooth transition from drain bowl to deck surface.
    - a. Prime all metal surfaces.
    - b. Using a trowel, set a 6 inches (152 mm) wide layer of mastic around the drain bowl edge as water cut-off.
  2. Install base membrane with lap centered on bowl ensuring a tight seal at drain.
    - a. Install a fully primed, 30 inches (762 mm) square sheet of 4-lb. lead flashing set in mastic.
    - b. Torch into place a reinforcing base sheet membrane three feet (914 mm) square centered on drain.
    - c. Extend membranes 1 inch (25 mm) beyond the inside edge of the drain bowl and temporarily secure with clamping ring.
  3. Install field cap membrane ply.
    - a. Extend membrane 1 inch (25 mm) beyond the inside edge of the drain bowl.
    - b. Position membrane so as to avoid the occurrence of any seams at drains.
    - c. Seal off drain by running a hot trowel along the edge and firmly pressing against the rim.
  4. Install clamping ring and drain covers supplied with drain.
  5. Test all drains for proper flow and water tightness. Correct defects.
- H. Curbs:
1. Inspect and verify that all curbs are properly secured to deck, are level, a minimum 8 inches above finished roof, primed and ready to receive flashings.
  2. Base ply membrane is to run horizontally tight up against the vertical curb or cant as required.
  3. Install roofing membrane as shown in the drawings and in accordance with the manufacturer's instructions.
- I. Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.
- J. Miscellaneous:
1. Install liquid-applied flashing membrane, additional cap sheet, or other protection as may be required to resist any chemical exposure or other conditions that may cause premature deterioration of the roofing products.
- K. Walkway Cap Sheet Strips: Install at locations indicated on drawings and as follows:
1. Entrance Type Door to Roof: Width of door frame opening x width of entrance cap sheet.
  2. Roof Hatch: Continuous around hatch, except not required at side common to roof hatch hinge. Provide walkway path to closest fall protection anchor.
    - a. Width: 24inches, minimum.

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3. Install at locations required by manufacturer to meet warranty requirements.

### 3.6 NON-TORCH-APPLIED MEMBRANE APPLICATION

- A. Same as TORCH-APPLIED MEMBRANE APPLICATION except as follows:
  1. Install all materials as required to comply with PERFORMANCE REQUIREMENTS in Part 1 above.
  2. Nailers: Provide as required by membrane manufacturer, but not less than ridge and eave. Secure to substrate with mechanical fasteners. Countersink nailers for flush surface.
  3. Rigid Insulation: Provide as needed where nailers installed. Secure to substrate with adhesive.
  4. Deck Board: Install over rigid insulation or substrate to provide suitable surface for membrane. Secure to substrate with adhesive. Provide mechanical fasteners where recommended by manufacturer to ensure permanent attachment.
  5. Provide metal drip edge at eave; mechanically attach to nailer.
  6. Membranes and Base Flashing: Install with adhesive. Open flame torch application not permitted for this system.

### 3.7 WATER CUT-OFF

- A. At end of day's work, and when precipitation is eminent, construct a water cut-off at open edges. Construct cut-off with same membrane and asphalt used for roofing system. Allow cut-off to withstand extended periods of wet weather. Completely remove water cut-off prior to resuming installation of roofing system.
- B. Provide for removal of water or drainage of water away from the work.

### 3.8 TEMPORARY PROTECTION

- A. Provide temporary protection over installed roofing by means of duckboard walkways, plywood platforms, or other materials, as approved by Resident Engineer, for roof areas that are to remain intact, and that are subject to foot traffic and damage. Provide notches in sleepers to permit free drainage.

### 3.9 LIGHTNING PROTECTION

- A. Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacture, and complying with requirements of UL's Master Label Certification for lightning protection systems.
  1. Provide roofing pads for lightning protection.

- 3.10 Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

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### 3.11 FIELD QUALITY CONTROL

- A. Manufacturers Field Review:
1. Manufacturer Field Inspection: Coordinate with the manufacturer's technical representative to conduct periodic in-progress inspections to verify installation is in compliance with manufacturer's recommendations and meets all warranty requirements. At a minimum, inspections shall be required at start-up and at intervals of approximately 30%, 60% and 90% completion. The manufacturer shall provide a written report of their observations.
  2. Final Inspection: Arrange for manufacturer's Technical Representative to inspect membrane installation on completion. A final inspection report from the Technical Representative, certifying that the roofing system has been satisfactorily installed in accordance with the manufacturer's warranty requirements shall be provided.
- B. Water ponding/run-off test:
1. Where slope of deck or drainage may be in question, upon request from Architect, apply water to fully cover surface to which roofing has been applied. Areas where accumulation of water occur as a result of inadequate slope or build-up of flashing materials, as determined by the Architect, shall be corrected by methods approved by roofing membrane manufacturer and Architect.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.12 FIRE WATCH

- A. Maintain at least a one (1) hour fire watch at the close of each day after the use of torches has been discontinued.

### 3.13 PROTECTING AND CLEANING

- A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs, structures, vehicles and utilities.
- B. Clean-up and remove daily from site wrappings, empty containers, paper, loose particles and other debris resulting from these operations.
- C. Clean roofing materials from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

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SECTION 07 56 00  
FLUID-APPLIED ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of reinforced dual-coat fluid-applied roofing system to the following exterior substrates where shown on drawings:
1. Dome on Dixie building.

1.2 RELATED WORK

- A. Abatement of asbestos containing dome cladding by encapsulation: "Dixie Demolition and Abatement" under separate contract.
- B. Section 07 52 16 – SBS Modified Bituminous Membrane Roofing.
- C. Sealants: Section 07 92 00 – Joint Sealants.
- D. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
- E. Surface preparation for painting: Section 09 91 00 – Painting.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: For each type of product indicated.
- C. Samples for Initial Selection: For each type of roofing system indicated.
- D. Samples for Verification: For each type of roof coating indicated and in each color and gloss.
1. Submit Samples on same type of substrate as that to receive application, 8 inches square.
  2. Step coats on Samples to show each separate coat, including primers and block fillers as applicable.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.
- E. Product List: For each product indicated, including the following:
1. Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  2. Manufacturer's recommended spreading rate for each separate coat, including primers and block fillers for each type of substrate as applicable.

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#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged for storage in unopened, factory-sealed containers and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent but not less than 1 gallon of each material, color, and texture applied.

#### 1.5 QUALITY ASSURANCE

- A. Material Compatibility:
1. Encapsulate: Obtain product name of encapsulate from Construction Manager. Provide primer as needed for coating encapsulate which is compatible with both encapsulate and elastomeric coating system.
  2. Single-Source Responsibility: Provide primers and undercoat material produced by the same manufacturer as the finish coats for each type of coating. Use only thinners recommended by the manufacturer and only within recommended limits.
  3. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.7 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 90 deg F unless otherwise permitted by manufacturer's written instructions.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
1. Failures include, but are not limited to, the following:

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- a. Water penetration through the roofing system.
  - b. Deterioration of system beyond normal weathering.
  - c. Delamination from substrate.
2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. All products submitted must be breathable type coating allowing water vapor to escape from the interior of all surfaces without loss of adhesion.
- B. General Properties of System:
  1. Minimum 24 percent elongation. ASTM D412.
  2. Tensile Strength: 2,350 psi. ASTM D412.
  3. Tear Strength: 260 pli.
  4. Fire Resistance: Class A, STM E 108.
- C. Wind-Driven Rain, TT-C-555B or ASTM D6904-03: Passed.
- D. Accelerated Weathering at 5,000 Hours: Passes per ASTM G53.
- E. Salt Spray Resistance: Passes per ASTM B117 at 300 hours.

### 2.2 MATERIALS, GENERAL

- A. Material Compatibility:
  1. Provide elastomeric finish coatings and crack fillers, primers, and block fillers as applicable for use within elastomeric finish coatings that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each material or coat, provide products and spreading rates recommended in writing by elastomeric coating manufacturer for use on substrate indicated.

### 2.3 ELASTOMERIC COATINGS

- A. Subject to compliance with requirements, manufacturers of products that may be incorporated into the Work include, but are not limited to, the following:
  1. System Basis of Design: Sikalastic RoofPro15 by Sika.
- B. Base Coat: High performance one component moisture-activated polyurethane coating serving as an embedment coat for reinforcing.
  1. Basis of Design: Sikalstic 601 BC by Sika.
- C. Top Coat: High performance one component moisture-activated polyurethane coating with UV resistance.
  1. Basis of Design: Sikalstic 621 TC by Sika.

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1. Color: See Section 09 06 00, Schedule of Finishes.

#### 2.4 OTHER MATERIALS

- A. Reinforcing: Random glass fiber mat, minimum 225 g/m<sup>2</sup>; rolls not less than 3 feet wide and component of coating system.
  1. Basis of Design: Sika Reemat Premium.
- B. Crack Fillers: Elastomeric Coatings manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated; VOC content complying with limits of authorities having jurisdiction.
- C. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.
- B. Verify:
  1. Existing dome coating has been encapsulated as asbestos abatement work under separate contract.
  2. Patching of holes required for wall reinforcing work under WP-9A is complete.
  3. Suitability of substrates including surface conditions and compatibility with existing finishes and encapsulant.
- C. Begin coating only when moisture content of substrate is acceptable to coating manufacturer when measured with an electronic moisture meter.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

#### 3.2 PREPARATION

- A. General:
  1. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.
- B. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

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2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
  - C. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
  - D. Surface Repair: The Construction Manager shall designate trade contractor to repair plaster surface in conformance with Section 01 73 29 - Cutting, Patching & Sleeves. The finish of the repaired area shall match finish of adjacent surface that is not damaged so repaired area does not telegraph through finish coat provided by this Section.

### 3.3 APPLICATION

- A. Apply roof coatings and reinforcing according to manufacturer's written instructions.
  1. Use equipment and techniques best suited for substrate and type of material being applied.
  2. Coat surfaces behind movable items the same as similar exposed surfaces.
  3. Apply each coat separately according to manufacturer's written instructions.
- B. Primers: Apply at a rate to ensure complete coverage.
- C. Base Coat and Reinforcing: Apply base coat and while still wet, embed reinforcing. Install reinforcing free of bubbles, wrinkles, creases. Lap joint not less than 2 inches.
- D. Top Coat: After base coat is sufficiently cured, install topcoat.
- E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.
- F. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- G. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.
- H. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

### 3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following testing procedures:
  1. Owner will engage the services of a qualified testing agency to sample materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  2. Testing agency will perform tests for compliance of materials with product requirements.
  3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Remove noncomplying materials from Project site, pay for testing, and recoat surfaces that were coated with rejected materials.

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Remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

- B. Field Testing and Inspection: Owner reserves the right to engage the services of a qualified testing agency to verify installed thickness of elastomeric coatings.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

### 3.6 COATING SCHEDULE

- A. Provide for dome and other areas indicated on drawings.
1. Primer: If required by manufacturer.
  2. Elastomeric Base Coat: Minimum 45 WFT (40 sq. ft./gal)
  3. Elastomeric Finish Coat: Minimum 30 WFT (53 sq. ft./gal).
  4. Finish-Coat Color: See Section 09 60 00, Schedule of Finishes.

END OF SECTION

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SECTION 07 08 00  
FACILITY EXTERIOR CLOSURE COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. The requirements of this Section apply to all sections of Division 04, Division 07 and Division 08.
2. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Construction Manager is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Related Specification sections

1. Section 01 00 00 General requirements
2. Section 01 43 39 Mockups
3. Section 01 45 29 Testing laboratory Services
4. Section 01 91 00 General commissioning requirements
5. Section 04 20 00 Unit Masonry
6. Section 04 05 13 Masonry Mortaring
7. Section 04 05 16 Masonry Grouting
8. Section 07 18 13 Fluid-Applied Roofing
9. Section 07 21 29 Sprayed Polyurethane Foam insulation and & Air/ Vapor Barrier
10. Section 07 27 30 Air Weather Barrier (AWB)
11. Section 07 42 15 Insulated-Core Metal Panels
12. Section 07 52 16 Styrene-Butadiene-Styrene Modified Bituminous Membrane Roofing
13. Section 07 54 23 Thermoplastic Polyolefin (TPO) Roofing
14. Section 07 92 00 Joint Sealants
15. Section 08 11 13 Hollow Metal Doors and Frames
16. Section 08 42 29 Automatic Sliding Entrance Doors
17. Section 08 44 13 Glazed Aluminum Curtain Walls
18. Section 08 44 13.13 Glazed Aluminum Curtain Walls for Dixie

B. Pre Functional Checklist (attached as Appendix A)

C. Functional Performance Tests (attached as Appendix B)

D. Contractor and Vendor Field Test Report Documentation (Appendix C)

E. Contractor QA/QC Testing reports.

F. Close-out documentation including O&M Manuals.

G. Reference Codes and Standards

- 
1. AAMA 501.1
  2. AAMA 501.4
  3. AAMA 501.5
  4. AAMA 503.8
  5. AAMA 502-02
  6. AAMA 503-03
  7. AAMA 508-05
  8. ASTM C1193, Appendix X1
  9. ASTM C1521, Method A
  10. ASTM C1601
  11. ASTM E283
  12. ASTM E331
  13. ASTM E783
  14. ASTM E1105
  15. ASTM E1186
  16. ASTM E779
  17. ASTM E2420
  18. ASTM C1153
  19. ASTM C1060
  20. ASTM E2357
  21. ASTM D4263
  22. ASTM D4263
  23. ASTM D3359

### 1.3 DESCRIPTIONS

- A. This Section includes requirements for commissioning the Facility exterior closure, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members

#### 1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions. COMMISSIONED SYSTEMS
- B. Commissioning of a system or systems specified in Division 04, Division 07 and Division 08 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.
- C. The following Facility exterior closure systems will be commissioned:
  - 1. Slabs and Foundations (Waterproofing)
  - 2. Exterior Vertical Surfaces (Masonry, Metal panels, Sealants (Caulking, mechanical seals, and wind and vapor barriers) and EIFS)
  - 3. Wall Openings:
    - a. Exterior Doors (Revolving, glass leaf, emergency exit, and service)
    - b. Curtain Wall Systems (Mullions, glazing, and sealing)
  - 4. Roofs (modified bituminous, fluid-applied, flashing & sheet metal, roof specialties, and roof accessories)
  - 5. Envelope and Room Leakage

#### 1.5 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

## 3.1 FUNCTIONAL PERFORMANCE TESTING EQUIPMENT AND INSTRUMENTS

- A. The VA will hire a third-party testing company to provide all tools, plastic wrap, test chambers, tape, water pumps, hoses, instruments, laptop computers, PDA's, software programs and services required to perform all referenced testing standards listed with in this specification or on the testing matrix. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required. If there is a conflict between this specification and other specifications the greater number of tests shall need to be priced and executed.
- B. Clark McCarthy to provide the following items, as required by the tests listed below, for the third-party testing company use.
  - 1. Scaffolding
  - 2. Water source or tank with in 100' of the testing chamber, sized to provide the specified pressures.
  - 3. Power for the testing agency equipment. Min. 120volt 20 amps dedicated circuit with in 20' of the test chamber.
  - 4. Construction of the testing chambers.

### 3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The installation system contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation are complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent will spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### 3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 03, 04, 07 or Division 08 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS.

### 3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance. The Construction Manager shall review and comment on the tests prior to approval. The VA's Third Party Testing Agency shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document some of the testing. The Construction Manager shall sign the test reports to verify tests were performed.
- B. One test, for each system listed on the Enclosure Testing Matrix, needs to take place after the installation of the first system. Moreover, at least one test needs to be performed, per system, prior to completing 10% of the installation, also at least two tests need to be performed prior to completing 30% and 50% of each systems installation.

- C. The Third Party testing firm hired by the VA shall test the buildings to the performance level as identified below:

I. Exterior Vertical Surfaces

- a. All percentages indicated need to be performed per each exposure of each building.
- b. ASTM E1105 – 5% Insulated Metal wall panels at minimum two areas per building need to be tested, The test area needs to be 15 feet wide by one story in height.
- c. AAMA 501.2 - Test 5% of interfaces with adjacent construction of total length of all metal wall panel joints and perimeters, including interfaces with adjacent construction.
- d. Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521-
  - 1) Perform 5 tests for first 300 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
  - 2) Perform one test for each 600 m (2000 feet) of joint length thereafter or one test.
  - 3) Total test should be 50 tests
  - 4) See specification section 07 92 00 for more information.

II. Wall Openings

- a. Test chambers and spray racks need to be at least 10% larger than the opening being tested.
- b. All percentages indicated need to be performed per each exposure of each building.
- c. ASTM E783, ASTM E1186, ASTM E1105 for Windows, doors, Curtain walls  
Test 5% of total area of each Window/Door/Curtain wall section. The test area needs to be 15 feet wide by one story in height.
- d. Penetrations and Interfaces  
Test 2% of total penetrations
- e. AAMA 501.2 – Curtain wall Joints - Test 5% interfaces with adjacent construction of total length of all I joints and perimeters, including interfaces with adjacent construction.
- f. AAMA 502-02 Method A for Flashing, End Dams, Sills, Sub frames/receptors system and Sill Pans
  - 1)Test 2% Total number of end Dams and sills
  - 2)Test 2% total lineal feet of flashing
  - 3)Test 100% of the first 10% of installed sills
  - 4)Test 100% of the first 10% of flashing lap joints and end dams

III. Roofing

- a. ASTM E 907 and ASTM 2420 - test 1% of total roof area per building
- b. ASTM C1153 test 100% the surface area

## IV. Envelope and Room Leakage test

## a. ASTM E779- full building pressure test.

Testing procedure should include:

- a) One to two days of preparation and testing by a team of individuals, per floor.
- b) On the first evening before the actual test, Infra-red scanning will be performed under pressurized and depressurized building modes. It is preferable that the building be unoccupied during the preparation and test (possibly a weekend), since some exits may be blocked, and mechanical ventilation systems shut down.
- c) The team will start by meeting with building owner, contractor, and commissioning staff to review the building and building drawings, and beginning to prepare the floor. Preparations should include wedging open all interior doors in open position in order to equalize the pressure on the exterior enclosure (pressure boundary) of the building; closing exterior doors, windows and mechanical system vents and openings; and assuming control over the status of mechanical systems. Sealing all opening to other floors (confirm items to be sealed with CxA). The air leakage testing will be done with large blowers and fans, temporarily installed in exit stair doors or exterior doors, to pressurize or depressurize the building. The test procedures will be based on Enclosure Testing Matrix.

b. ASTM C1060, C1153, and E1186 – Test 100% of the Building Envelope: Insulation at wall and roof plus air barrier. Provide thermo-graphic building survey (thermal imaging) of completed wall and roofing systems following.

- 1) Survey to evaluate locations, consistency, and relative state of dryness of insulation, missing insulation, and potential leak sources for water and air, if any. Furnish report of survey which includes photographs, data, and analysis of each area of survey. Verify minimum temperature differential required (normally 40 degrees F). Intervals as follows:
  - d) Exterior Walls: 2 tests, One Prior to Substantial Completion and One after building enclosure with exterior walls completed and permanent HVAC system operating.
  - e) Roof: One test within 2 months of completion of roof including after building enclosure with exterior walls completed.

D. Acceptance criteria will be in accordance with the manufactures, AAMA, ASTM or specified allowances. In the event of any conflict between the other Contract Documents and the Foregoing minimum criteria, the more stringent shall govern.

## 1. Test pressures for the Wall Assemblies

- a. Shall be 6.24 per square foot, 2/3 of the greatest positive test pressure specified for the applicable wall assembly, or that specified in the Contract Documents, whichever is greater.
- b. Leakage rate allowed = .06 cfm/ft sq at 6.24 psf of glazing, roof and wall area.
- c. No water should penetrate the interior side of the air/water barrier plane at 20 psf test pressure.
- d. AAMA 501.4 – 1.5x horizontal design displacement distance.
- e. ASTM E 779- Air leakage rate of the building envelope does not exceed 0.25CFM/sf at a pressure differential of .3 in wag (75 Pa)

## 2. Failure of On-Going Building Enclosure Field Testing -

- Upon failure of a test during on-going building enclosure testing,
- a. Stop testing and find out the cause of the failure.
  - b. Determine if this failure was an isolated incident or effects more than one system area.
  - c. After repairs have been made to all similar systems, then increases the sample rate from the initial sample rate to two and one-half (2-½) times the initial sample rate. Therefore if the initial sample rate is 2%, the new sample rate would be 5%. The new sample rate would continue until three (3) subsequent tests groups pass, and then would revert to the initial sample rate. Upon a failure of a test at the increased sample rate, the sample rate increases to three (3) times the increased sample rate.
    - 1) The new sample rate would continue until three (3) subsequent test groups pass, and then would revert to the previous sample rate.
    - 2) Each additional failure would increase the sample rate three (3) times the previous sample rate, up to a 100% sample rate. Each new sample rate would continue until three (3) subsequent test groups pass, and then would revert to the previous sample rate.
3. All costs associated with increased sample rates will be the responsibility of construction manager. These increased costs will include increased Commission Agent's costs.

#### E. TEST REPORTS

1. Provide copies of all reports required per set forth in the referenced test procedure, for review.
2. Provide the information listed below in addition to the requirement in item 1.
  - a. Report the following information for ASTM E 783: (04 20 00 - Unit Masonry, 08 44 13 - Glazed Aluminum Curtain Wall, 08 44 13.13, Glazed Aluminum Curtain Walls for Dixie, 08 11 13- Hollow Metal Doors, and 08 42 29.23 - Automatic Sliding Entrance Doors)
    - 1) Testing agency, requester of test, date and time of test, date of report, identification, and location of building.
    - 2) Test specimen description.
    - 3) Detailed drawings of the specimen (if available).
    - 4) Sampling procedures.
    - 5) Test parameters.
    - 6) Ambient test conditions.
    - 7) Pressure differences and Leakage.
  - b. Report the following information for ASTM E 1186: (04 20 00 - Unit Masonry, 08 44 13 - Glazed Aluminum Curtain Wall, 08 44 13.13, Glazed Aluminum Curtain Walls for Dixie, 08 11 13 - Hollow Metal Doors, and 08 42 29.23 - Automatic Sliding Entrance Doors and Envelope Air Tightness Test)
    - 1) Testing agency, requester of test, date and time of test, date of report, identification, and location of building.
    - 2) Test specimen description.
    - 3) Detailed drawings of the specimen (if available).
    - 4) Sampling procedures.
    - 5) Test parameters.
    - 6) Ambient test conditions.
    - 7) The direction of movement of the smoke trace.
  - c. Report the following information for ASTM E1105: (04 20 00 - Unit Masonry, 08 44 13 - Glazed Aluminum Curtain Wall, 08 44 13.13, Glazed Aluminum Curtain Walls for Dixie, 08 11 13 - Hollow Metal Doors, and 08 42 29.23 - Automatic Sliding Entrance Doors)

- 
- 1) Testing agency, requester of test, date and time of test, date of report, identification, and location of building.
  - 2) Test specimen description.
  - 3) Detailed drawings of the specimen (if available).
- d. Sampling procedures.
- 1) Test parameters.
  - 2) Test conditions.
  - 3) Test results.
  - 4) Compliance statement.
- e. Report the following information for ASTM E1601: (Water Penetration Test)
- 1) The project name and address of the building;
  - 2) Date, time, and temperature during the test;
  - 3) Dates and results of previous tests of same area, if applicable;
  - 4) Name(s) and address(es) of individual(s) performing the test;
  - 5) Description of the construction of the area tested including surface coatings, masonry type, wall assembly structural system, condition of the masonry surface, chamber location including elevation, floor level and position relative to wall ends or openings in the structure, and repairs performed prior to each test; (NOTE — Examples of masonry surface conditions include presence of cracks, deteriorated units, and so forth.)
  - 6) Description of chamber construction and attachment to wall;
  - 7) Statement of test conditions as applicable;
  - 8) Record of observations
  - 9) facture surface penetration recommendations for the system
  - 10) Results of calculations and graphs
- f. Report the following information for ASTM 779: (Envelope Air Tightness Test)
- 1) Building description, including location, address (street, city, state or province, zip or postal code, country, and elevation above mean sea level in m (ft).
  - 2) Construction, including date built (estimate if unknown), floor areas for conditioned space, attic, basement, and crawl space, and volumes (optional) for conditioned spaces, attic, basement, and crawl space.
  - 3) Condition of openings in building envelope including:
  - 4) Doors, closed, locked or unlocked;
  - 5) Windows, closed, latched or unlatched;
  - 6) Ventilation openings, dampers closed or open;
  - 7) Chimneys, dampers closed or open
  - 8) Statement whether the test zone is interconnected with at least door-sized openings. If not, the results of pressure measurements between portions of the zone.
  - 9) HVAC system, including the location and sizes of ducts that penetrate the test zone envelope.
  - 10) Procedure, including the test equipment used (manufacturer, model, serial number), and calibration records of all measuring equipment.
  - 11) Measurement data, including:
  - 12) Fan pressurization measurements (inside-outside zero flow building pressure differences);
  - 13) Inside and outside temperature (at start and end of test) and the product of the absolute value of the indoor/outdoor air temperature difference multiplied by the building height;
  - 14) Tabular list of all air leakage measurements and calculations:
  - 15) Time, building pressure difference, air density, nominal airflow rate, fan airflow rate, and air leakage rate;

- 
- 16) Deviations from standard procedure.
  - 17) Optional data, including wind speed/direction and whether wind speed is estimated to exceed 0 to 2 m/s (0 to 4 mph).
- g. Calculations, including:
- 1) The leakage coefficient and pressure exponent for both pressurization and de-pressurization;
  - 2) The effective leakage area. Also, report if a reference pressure other than 4 Pa is used; and,
  - 3) An estimate of the confidence limits.
- h. Report the following information for ASTM ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521 (07 92 00 - Joint Sealants)
- 1) Record test conditions and results for each procedure on an appropriate form.
  - 2) Each joint is unique, and as such requires that the procedures described in this method be subjectively applied and/or modified for each test.
  - 3) Retain the sealant samples in a sealed plastic bag, labeled with the location from which sample was taken, date removed, results from the method and project identification. These samples should be stored in a secure location for the duration of the warranty period.
  - 4) Accurate recording of the location, description of the sealant anomalies as they are observed is important.
  - 5) There is no one single procedure that is most appropriate for all projects, therefore an effective method needs to be selected for each project.
  - 6) Use of the shop (submittal) and/or architectural drawing, to notate pertinent data has proven reliable on some projects.
  - 7) When the inspection is complete, a photograph of the joint and associated masking tape can be of value. It is important that the photograph be of good quality so that the markings can be clearly read. This is true for both destructive and non-destructive test.

## B. TRAINING OF VA PERSONNEL

- F. Clark McCarthy shall provided training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 21 Sections for additional Contractor training requirements.

## C. ATTACHMENTS

### 1. APPENDIX

#### A. PRE-FUNCTIONAL CHECKLISTS

- a. 042000-01 Brick Masonry
- b. 071113-01 Bituminous Water Vapor Retarders
- c. 074215-01 Insulated Core Metal Wall Panels
- d. 074615-01 Manufactured Metal Siding
- e. 075216-01 Modified Bituminous Membrane Roof

- f. 075423-01 Thermoplastic Polyolefin (TPO) Roof
- g. 076000-01 Flashing
- h. 081113-01 Metal Doors and Frames
- i. 084413-01 Glazed Aluminum Curtain Walls
- j. 084413.13-01 Glazed Aluminum Curtain Walls for Dixie
- k. 088853-01 Security Glazing

**B. FUNCTIONAL PERFORMANCE TESTS**

- a. ASTM C 1521-09 & C 1193-09 Sealant Joint test
- b. ASTM E1601: Determining Water Penetration
- c. ASTM E779, C1060 & E1186: Determining Air Leakage Rate by Fan Pressure
- d. ASTM E1105, E1186 & E783: Determining Water & Air Leakage
- e. ASTM F2420: Humidity in Concrete

**C. FIELD TEST REPORT**

**END OF DOCUMENT**

**APPENDIX A****CHECKLISTS**

<b>VA – 088853-01</b>	<b>Structural Sealant Glazing Checklist</b>
<b>VA – 042000-01</b>	<b>Brick Masonry</b>
<b>VA – 071113-01</b>	<b>Bituminous Water Vapor Retarders</b>
<b>VA – 074615-01</b>	<b>Manufactured Metal Siding Checklist</b>
<b>VA – 075216-01</b>	<b>Modified Bituminous Membrane Roof Checklist</b>
<b>VA – 076000-01</b>	<b>Flashing</b>
<b>VA – 081113-01</b>	<b>Metal Doors, Hardware and Frames</b>
<b>VA – 084413-01</b>	<b>Glazed Aluminum Curtain Walls Checklist</b>

**PROJECT: VA - SLVHCS Replacement Medical Center Project****PROJECT NUMBER: VA 629HS2401****REPORT ID: VA 088853-01**

EQUIPMENT DESCRIPTION: Structural Sealant Glazing - Aluminum Curtain Wall

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: AREA SERVED: \_\_\_\_\_

This Construction Checklist is used during the Commissioning Process to insure the correct equipment is delivered, installed and properly started in preparation for Functional Testing of related building systems. This checklist does not take the place of the Manufacturer's recommended checkout and startup procedures.

This Checklist is divided into 4 Sections and is to be completed by the Contractor in 4 separate steps. As each Section is completed the Contractor shall post the form to the project FTP site or electronic project management software, also the contractor should mail, fax or e-mail the completed Section(s) to the Commissioning Authority at this address:

**Jacobs Engineering**525 West Monroe, 2<sup>nd</sup> Floor

Chicago, IL 60661

Attn: David Meyers c/o Tina Benitez

Phone: 314.210.2735

Fax: 312.384.6369

E-mail: [david.meyers@jacobs.com](mailto:david.meyers@jacobs.com)

When completing each Section, be sure to check and initial EACH line item as being completed. Immediately notify the Commissioning Authority and VA Resident Engineer any item be checked incomplete or there be any question regarding the level of completeness. Each Section's items must ALL be checked complete and initialed before the form is mailed to the Commissioning Authority.

**SECTION 1 – EQUIPMENT DELIVERY:**

The Contractor shall complete Section 1 of this form when the equipment is delivered to the site. The purpose is to record the actual design parameters listed below along with the checklist items as indicated. Should there be any discrepancy between the Actual and the Submitted information, or any item be checked incomplete, the Contractor shall immediately notify the Commissioning Authority and VA Resident Engineer.

**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Have all calculations etc related to Structural Sealant been provided and sealed by Structural Engineer
_____	Yes / No	Mock up completed and approved
_____	Yes / No	Are all Glazed Aluminum Curtain Wall & Structural Sealants etc clearly selected and locations clearly marked on the drawings
_____	Yes / No	Are the Structural Sealant Glazing/Aluminum Curtain Wall connections clear
_____	Yes / No	Has weather protection been provided as needed

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 2 – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	All openings examined and approved. Curtain Wall framing units installed Plumb and true and proper alignment. All unsatisfactory conditions regarding opening dimensions checked, and installation tolerances have been corrected
_____	Yes / No	All Curtain Wall members and connection locations inspected, and approved by Glazier prior to install.
_____	Yes / No	Installer inspected Glazing Materials for proper edge finishes, defects or damage. Appropriate sealant are provided and are compatible with all components
_____	Yes / No	Glazing surfaces prepared in accordance with GANA-02 Sealant Material.
_____	Yes / No	Required setting blocks/paper shims have been places in the frames per Specifications and Manufacturer’s Recommendations.
_____	Yes / No	Surfaces primed per sealant Manufacturer’s recommendations..
_____	Yes / No	Glazing, Spandrel Panels and structural sealant installed per Manufacturers Recommendations and approved submittals
_____	Yes / No	Install Structural Sealant per Manufacturers Recommendations.
_____	Yes / No	Tool Sealant or wipe surface smooth per Manufacturers Recommendations

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of construction progress
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified to schedule testing per Specifications on completed systems

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project**  
**PROJECT NUMBER: VA 629HS2401**  
**REPORT ID: VA 042000-01**

EQUIPMENT DESCRIPTION: Brick Masonry

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: AREA SERVED: \_\_\_\_\_

This Construction Checklist is used during the Commissioning Process to insure the correct equipment is delivered, installed and properly started in preparation for Functional Testing of related building systems. This checklist does not take the place of the Manufacturer's recommended checkout and startup procedures.

This Checklist is divided into 4 Sections and is to be completed by the Contractor in 4 separate steps. As each Section is completed the Contractor shall post the form to the project FTP site or electronic project management software, also the contractor should mail, fax or e-mail the completed Section(s) to the Commissioning Authority at this address:

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Chicago, IL 60661

Attn: David Meyers c/o Tina Benitez

Phone: 314.210.2735

Fax: 312.384.6369

E-mail: [david.meyers@jacobs.com](mailto:david.meyers@jacobs.com)

When completing each Section, be sure to check and initial EACH line item as being completed. Immediately notify the Commissioning Authority and VA Resident Engineer should any item be checked incomplete or there be any question regarding the level of completeness. Each Section's items must ALL be checked complete and initialed before the form is mailed to the Commissioning Authority.

**SECTION 1 – EQUIPMENT DELIVERY:**

The Contractor shall complete Section 1 of this form when the equipment is delivered to the site. The purpose is to record the actual design parameters listed below along with the checklist items as indicated. Should there be any discrepancy between the Actual and the Submitted information, or any item be checked incomplete, the Contractor shall immediately notify the Commissioning Authority and VA Resident Engineer.

**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Mock up completed and approved
_____	Yes / No	Are all masonry units (sizes, types and colors), mortars and grouts clearly selected and locations clearly marked on the drawings
_____	Yes / No	Are the masonry connections clear
_____	Yes / No	Are movement joints clearly detailed and located
_____	Yes / No	Is everything clear with anchor bolts, rebar, bond beams, grouting, lintels and flashing.
_____	Yes / No	Has the weather protection been provided
_____	Yes / No	Has the joints pointed per specifications

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

## SECTION 2 – EQUIPMENT INSTALLATION:

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

### CHECKLIST ITEMS:

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Supports and openings examined and approved. All unsatisfactory conditions regarding installation tolerances have been corrected
_____	Yes / No	Hollow metal frames are securely braced to specified tolerances.
_____	Yes / No	Frames installed level, plumb, and square. Frames are secured according to specification depending on adjacent wall material.
_____	Yes / No	Has the work been covered every night
_____	Yes / No	Has mortar Smears and Dropping been removed
_____	Yes / No	Has the wall had time to cure
_____	Yes / No	Anchors are properly installed
_____	Yes / No	Flashing and weeps are installed per the Contract Documents. Cavity weep tubes are installed at sills, angles, door and window heads, and imbed joints.
_____	Yes / No	Brick is installed plum (1/4" in 10' or 3/8 per floor, no more than 1/2 from base to roof)
_____	Yes / No	Control Joints are installed per Contract Documents
_____	Yes / No	Weep holes are open and free of debris
_____	Yes / No	Joints are completely filled with sealant
_____	Yes / No	Sealant has cured according to manufacturer’s recommendations

### COMMENTS:

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer.have been notified of construction progress
_____	Yes / No	Cx Authority and VA Resident Engineer.have been notified to schedule air infiltration tests on completed systems

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project**  
**PROJECT NUMBER: VA 629HS2401**  
**REPORT ID: VA 071113-01**

EQUIPMENT DESCRIPTION: Bituminous Water Vapor Retarders

MANUFACTURER: \_\_\_\_\_ MODEL NO: \_\_\_\_\_

TAG NO: \_\_\_\_\_ SERIAL NO: \_\_\_\_\_

LOCATION: Building Exterior AREA SERVED: Building Envelope

This Construction Checklist is used during the Commissioning Process to insure the correct equipment/material is delivered, installed and properly started in preparation for Functional Testing of related building systems. This checklist does not take the place of the Manufacturer's recommended checkout and startup procedures.

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E-mail: [david.meyers@jacobs.com](mailto:david.meyers@jacobs.com)

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**SECTION 1 – EQUIPMENT DELIVERY:**

The Contractor shall complete Section 1 of this form when the equipment is delivered to the site. The purpose is to record the actual design parameters listed below along with the checklist items as indicated. Should there be any discrepancy between the Actual and the Submitted information, or any item be checked incomplete, the Contractor shall immediately notify the Commissioning Authority and VA Resident Engineer.

**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Bituminous Membrane and accessories thoroughly inspected for physical damage
_____	Yes / No	All Bituminous Membrane and accessories stored and protected according to specifications and manufacturer's recommendations

**COMMENTS:**

DRAFT

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 2 – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Substrates examined and approved. Any Proof Rolling documents provided. All unsatisfactory conditions regarding installation tolerances have been corrected
_____	Yes / No	Installation in accordance with the specifications manual and manufacturer’s instructions
_____	Yes / No	Bituminous Membrane was installed when the substrate and ambient temperature were appropriate
_____	Yes / No	Bituminous Membrane was inspected for fishmouths and blisters; these were corrected per manufacturer’s recommendations.
_____	Yes / No	Bituminous Membrane was inspected for any penetrations or irregularities
_____	Yes / No	Joints were installed per manufacturers recommended dimensions.
_____	Yes / No	After installation, appropriate protection was provided to avoid traffic on installed material.

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of Bituminous Membrane waterproofing/vapor retarder construction progress.
_____	Yes / No	Bituminous Membrane field quality control tests have been performed and submitted.
_____	Yes / No	Temporary protective barriers and been in place but have been removed for inspection to take place.
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified to schedule Quality Inspections on completed Bituminous Membrane.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project****PROJECT NUMBER: VA 629HS2401****REPORT ID: VA 074615-01**

EQUIPMENT DESCRIPTION: Manufactured Metal Siding

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: AREA SERVED: \_\_\_\_\_

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E-mail: [david.meyers@jacobs.com](mailto:david.meyers@jacobs.com)

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**SECTION 1 – EQUIPMENT DELIVERY:**

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**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Mock up completed and approved
_____	Yes / No	Are all Manufactured Metal Siding, etc clearly selected and locations clearly marked on the drawings
_____	Yes / No	Are the Manufactured Metal Siding connections clear
_____	Yes / No	Are movement joints clearly detailed and located
_____	Yes / No	Is everything clear with back-up wall, Misc framing, anchorages, and flashing, etc.
_____	Yes / No	Has the weather protection been provided as needed

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

## SECTION 2 – EQUIPMENT INSTALLATION:

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

### CHECKLIST ITEMS:

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Supports and openings examined and approved. All unsatisfactory conditions regarding installation tolerances have been corrected
_____	Yes / No	Back-up wall framing, light gage framing, exterior sheathing and air water barrier (AWB) installed and inspected.
_____	Yes / No	Miscellaneous Framing, including sub girts, base angles, sills, furring etc installed per Manufactures Recommendations, and Specifications.
_____	Yes / No	Insulation attached to framing per Manufactures Recommendations, and Specifications
_____	Yes / No	Manufactured Metal Siding with fully engaged and fastened with fasteners appropriate to back-up materials properly installed, per Manufactures Recommendations, and Specifications.
_____	Yes / No	Remove temporary protective coverings and strippable films, if any, as Manufactured Metal Siding installed per Manufacturers Recommendations
_____	Yes / No	Flashings and closures installed at perimeters, corners, intersections, and penetrations per the Contract Documents.
_____	Yes / No	Control Joints are installed per Contract Documents
_____	Yes / No	Weep holes on sills etc are open and free from debris
_____	Yes / No	Sealant joints between Manufactured Metal Siding and adjacent materials has cured according to manufacturer’s recommendations
_____	Yes / No	Installed Manufactured Metal Siding inspected and any touch up performed to satisfaction of Owners Representative.

### COMMENTS:

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of construction progress
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified to schedule testing per Specifications on completed systems

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project**  
**PROJECT NUMBER: VA 629HS2401**  
**REPORT ID: VA 075216-01**

EQUIPMENT DESCRIPTION: Modified Bituminous Membrane Roofing

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: Building Exterior AREA SERVED: Building Envelope

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Chicago, IL 60661

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Phone: 314.210.2735

Fax: 312.384.6369

E-mail: [david.meyers@jacobs.com](mailto:david.meyers@jacobs.com)

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## SECTION 1 – EQUIPMENT DELIVERY:

The Contractor shall complete Section 1 of this form when the equipment is delivered to the site. The purpose is to record the actual design parameters listed below along with the checklist items as indicated. Should there be any discrepancy between the Actual and the Submitted information, or any item be checked incomplete, the Contractor shall immediately notify the Commissioning Authority and VA Resident Engineer.

### DESIGN PARAMETERS:

Parameter	Designed	Submitted	Actual
XXX			

### CHECKLIST ITEMS:

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Roofing and accessories thoroughly inspected for physical damage
_____	Yes / No	All roofing and accessories stored and protected according to specifications and manufacturer's recommendations
_____	Yes / No	All Modified Bituminous Membrane roofing has met ASTM D2523 and E108
_____	Yes / No	All Modified Bituminous Membrane roofing has met FM 4450 and FM 4470
_____	Yes / No	All roofing as been stored per manufacture recommendations
_____	Yes / No	Mock up has been approved

### COMMENTS:

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 2 – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Roof slab tested for moisture/vapor content and results submitted
_____	Yes / No	Roof slope, Substrates, supports, and openings examined and approved. All unsatisfactory conditions regarding installation tolerances have been corrected
_____	Yes / No	Installation in accordance with NRCA, Specifications manual, and manufacturer’s instructions
_____	Yes / No	Roof drains covered as appropriately to avoid debris entering the drainage system
_____	Yes / No	Vapor Retarder Installed per Specifications and Manufactures’ recommendations
_____	Yes / No	Roof insulation, saddles, etc., installed per Specifications and Manufactures’ recommendations
_____	Yes / No	Substrate backer board installed per Specifications and Manufactures’ recommendations
_____	Yes / No	Primer installed per Specifications and Manufactures’ recommendations
_____	Yes / No	Base ply applied to a dry, clean (free of debris) substrate
_____	Yes / No	Felts installed from low to high point perpendicular to slope of roof, with appropriate laps
_____	Yes / No	All sheet metal flashings installed per Contract documents.
_____	Yes / No	All accessories, lightning protection, and curbs, etc installed per Specifications and Manufactures’ recommendations.
_____	Yes / No	Walkway Cap Sheets installed per contract documents
_____	Yes / No	Roof inspected and any damaged areas replaced per specifications.

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of Roofing System construction progress.
_____	Yes / No	Roofing field quality control tests have been performed and submitted, including water Run-off test
_____	Yes / No	Temporary protective coverings removed from roof drains, etc. according to specifications

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project****PROJECT NUMBER: VA 629HS2401****REPORT ID: VA 042113-01**

EQUIPMENT DESCRIPTION: Flashing and Sheet Metal

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: AREA SERVED: \_\_\_\_\_

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Phone: 314.210.2735

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E-mail: [david.meyers@jacobs.com](mailto:david.meyers@jacobs.com)

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**SECTION 1 – EQUIPMENT DELIVERY:**

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**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Mock up completed and approved
_____	Yes / No	All material has been delivered to the site
_____	Yes / No	All material has been protected
_____	Yes / No	Are flashing locations and types detailed and located
_____	Yes / No	Is everything clear where anchors and clips go and how they are sealed
_____	Yes / No	Are there any dissimilar metals touching each other

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 2 – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Has the substrates and conditions under which sheet metal flashing and trim are to be installed are installed per the contract documents
_____	Yes / No	Is there any oil canning, buckling or tool marks on the flashing or metal?
_____	Yes / No	Lap joint are sealed in accordance with the contract documents
_____	Yes / No	Joints have been filled with sealant and metal formed to conceal sealant
_____	Yes / No	Anchors are properly installed
_____	Yes / No	Control Joints are installed per Contract Documents
_____	Yes / No	Sealant has cured according to manufacturer’s recommendations

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of construction progress
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified to schedule air infiltration tests on completed systems

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project****PROJECT NUMBER: VA 629HS2401****REPORT ID: CC 081113-01**

EQUIPMENT DESCRIPTION: Hollow Metal Doors and Frames

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: AREA SERVED: \_\_\_\_\_

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**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Doors and Frames thoroughly inspected for physical damage
_____	Yes / No	Door and Frames stored and protected according to specifications and manufacturer's recommendations

**COMMENTS:**

DRAFT

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

## **SECTION 2 – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

### **CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Supports and openings examined and approved. All unsatisfactory conditions regarding installation tolerances have been corrected
_____	Yes / No	Hollow metal frames are securely braced to specified tolerances.
_____	Yes / No	Doors and frames tapped at proper locations to receive door hardware.
_____	Yes / No	Frames installed level, plumb, and square. Frames are secured according to specification depending on adjacent wall material.
_____	Yes / No	Door silencers have been installed in frames before being grouted in place.
_____	Yes / No	Doors installed into frame openings with uniform tight clearances around jambs and head
_____	Yes / No	Installed doors swing freely without binding or scraping
_____	Yes / No	Any necessary adjustments to door and hardware have been made to ensure proper operation without binding or scratching
_____	Yes / No	Any necessary paint touch-ups have been made to eliminate evidence of repair
_____	Yes / No	Sill members and other members have been set in a bed of sealant
_____	Yes / No	Joint backing material has been installed per sealant manufacturer’s requirements.
_____	Yes / No	Joints are completely filled with sealant
_____	Yes / No	Sealant has cured according to manufacturer’s recommendations

### **COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of metal doors and frames construction progress
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified to schedule air infiltration tests on completed exterior metal doors and frames

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**PROJECT: VA - SLVHCS Replacement Medical Center Project****PROJECT NUMBER: VA 629HS2401****REPORT ID: VA 084413**

EQUIPMENT DESCRIPTION: Glazed Aluminum Curtain Wall

MANUFACTURER: MODEL NO: \_\_\_\_\_

TAG NO: SERIAL NO: \_\_\_\_\_

LOCATION: AREA SERVED: \_\_\_\_\_

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**SECTION 1 – EQUIPMENT DELIVERY:**

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**DESIGN PARAMETERS:**

Parameter	Designed	Submitted	Actual
XXX			

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All related submittals reviewed by A/E and approved by VA
_____	Yes / No	Mock up completed and approved
_____	Yes / No	Are all Glazed Aluminum Curtain Wall, sealants etc clearly selected and locations clearly marked on the drawings
_____	Yes / No	Are the Glazed Aluminum Curtain Wall connections clear
_____	Yes / No	Are movement joints clearly detailed and located
_____	Yes / No	Is everything clear with back-up wall, Misc framing, anchorages, and flashing, etc.
_____	Yes / No	Has weather protection been provided as needed

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 2 – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer’s recommendations. Immediately notify the Commissioning Authority and VA should any item be checked incomplete.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	O&M and warranty data provided to Cx Authority and VA Resident Engineer.
_____	Yes / No	Supports and openings examined and approved. All unsatisfactory conditions regarding installation tolerances have been corrected
_____	Yes / No	All support and connection locations installed and inspected.
_____	Yes / No	Miscellaneous Framing, including anchorages, and misc steel items per Manufacturer’s submittal. Protection for galvanic or corrosive action with dissimilar materials installed.
_____	Yes / No	Glazed Aluminum Curtain Wall fasteners properly installed, per Manufactures Recommendations, and Specifications.
_____	Yes / No	Curtain Wall framing units installed Plumb and true and proper alignment per Manufacturers Recommendations and Installation requirements
_____	Yes / No	Field Cut ends of units painted (concealed or exposed) per Manufacture’s Recommendations and approval.
_____	Yes / No	Glazing, Spandrel Panels and structural sealant installed per Manufacturers Recommendations and approved submittals
_____	Yes / No	Flashings and installed per the Contract Documents and per Manufacturers Recommendations.
_____	Yes / No	Control Joints are installed per Contract Documents and per Manufacturers Recommendations
_____	Yes / No	Sealant joints between Glazed Aluminum Curtain Wall and adjacent materials has cured according to manufacturer’s recommendations
_____	Yes / No	Remove protective materials applied at factory or after installation and clean curtain wall of any construction related deposits..

**COMMENTS:**

Submitted By: \_\_\_\_\_

Date: \_\_\_\_\_

**SECTION 3 – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

**CHECKLIST ITEMS:**

Initial	Complete	Description
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified of construction progress
_____	Yes / No	Cx Authority and VA Resident Engineer have been notified to schedule testing per Specifications on completed systems

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

**SECTION 4 – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed and is operational and ready for performance testing.

**COMMENTS:**

Submitted By: \_\_\_\_\_ Date: \_\_\_\_\_

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APPENDIX B

FUNCTIONAL TEST PROCEDURES

<b>ASTM F2420</b>	<b>Humidity in Concrete Using Hood</b>
<b>ASTM C1521-09 and C1193-09</b>	<b>Sealant Joint Evaluations</b>
<b>ASTM C1401-09a</b>	<b>Structural Sealant Glazing</b>
<b>ASTM E1601</b>	<b>Existing Brick</b>
<b>ASTM E779, C1060 and E1186</b>	<b>Determining Air Leakage</b>
<b>ASTM E1105, E1186 and E783</b>	<b>Determining Water Penetration</b>
<b>ASTM E907-96</b>	<b>Adhered Membrane</b>

DRAFT

## Determining Relative Humidity on the Surface of Concrete Floor Slabs Using Relative Humidity Probe Measurement and Insulated Hood

**PROJECT:** SLVHCS REPLACEMENT MEDICAL CENTER PROJECT

**PROJECT NUMBER:** VA 629HS2401

**REPORT ID:**

**DESCRIPTION:** ASTM F2420 - 05

Date of Test:

### **DESIGN CRITERIA**

#### ***Related Documents:***

**Specification Sections**

**Drawings**

**Submittal Data**

#### ***Test Equipment Required:***

Humidity Probe and Digital Meter - should have an accuracy level within 63 % from 25 to 98 % relative humidity, and be obtained from a manufacturer having a NIST or equivalent traceable calibration procedure. RH Probes should be calibrated at 90 % relative humidity or higher, in addition to lower humidity levels

Insulated Impermeable Box - The hood's insulated air chamber shall have a minimum area of between 30 and 40 in.<sup>2</sup> (200 and 260 cm<sup>2</sup>) with a minimum depth of 0.25 in. (6.3 mm) positioned and directly above and exposed to the surface.

See Below

***Summary of the ASTM test:***

This test method covers a procedure where a purposely made thermally insulated hood is placed on and sealed to the surface of a concrete floor slab. An entrapped and impervious air pocket or chamber is formed directly above and in contact with the surface of the bare floor slab. Through a lined access hole in the hood, a humidity probe can be inserted to measure the relative humidity (RH), temperature, and dew point within the air pocket.

***Equipment:***

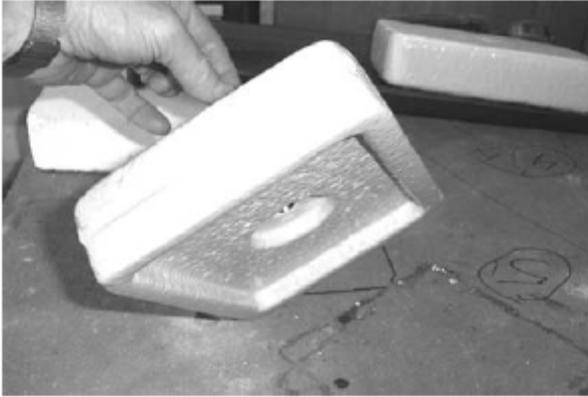


Fig. 1



Fig. 2

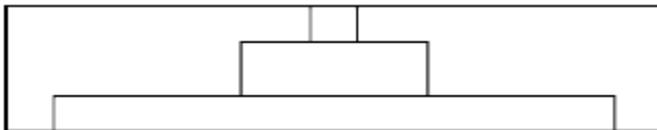


Fig.3

**Functional Performance Test Prerequisites**

Prerequisite	Yes	No	Comments
1. Contractor QA/QC Testing Reports completed & submitted to CxA <u>VA Resident Engineer</u>			
2. Construction Checklist completed & submitted to CxA <u>VA Resident Engineer</u> .			
3. Locations of tests have been verified by the CxA, <u>VA Resident Engineer</u> and Architect			
4.			
5.			

System Identification	
System Identification	Location

Functional Test Procedures:

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>GENERAL SYSTEM READINESS</b>			
	1	Prior to any testing the probe should be checked and calibrated. .	
		<b>Field Notes:</b>	
	2	Conditioning: Concrete floor slabs shall be at service temperature and the occupied air space above the floor slab shall be at service temperature and relative humidity expected under normal use for at least 48 h prior to the hood placements. If this is not possible then the test should be conducted with conditions at 75+/- 10°F (24+/- 5°C) and relative humidity of 50+/- 10 %. All artificial aids used to accelerate drying should be turned off at least 96 h before hoods may be sealed on the concrete surface.	
		<b>Field Notes:</b>	
<b>ASTM F2420</b>			
	3	Perform three tests for the first 1000 ft <sub>2</sub> (93 m <sub>2</sub> ) and at least one additional test for each additional 1000 ft <sub>2</sub> (93 m <sub>2</sub> ). Select test locations to provide information about moisture distribution across the entire concrete floor slab, especially areas of potential high moisture. For slabs on-grade and below-grade, include test locations in the center of the floor and areas close to exterior walls. Choose areas that are susceptible to high moisture when placing hood.	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	4	<p>Prior to placement of the RH hoods the actual test area shall be clean and free of any foreign substances. Only clean bare concrete surfaces shall be exposed to the air chamber underneath the hood.</p> <p><b>Field Notes:</b></p>	
	5	<p>Where covered floor slabs are being tested, all covering materials, adhesive residue, curing compound, sealers, paints, etc., shall be removed to expose an area of clean bare concrete for testing using the RH Hood method. Removal of any existing floor covering or adhesive shall be accomplished using approved OSHA work practices. For removal of any existing flooring or adhesives strictly observe if there are any hazardous materials (Asbestos or Lead etc) and any other appropriate safety and health practices. The cleaned test area should be exposed to conditions specified in for a period of at least 24 h prior to starting the test.</p> <p><b>Field Notes:</b></p>	
	6	<p>Seal the insulated hood firmly to the floor with a suitable preformed butyl/sealant adhesive or similar. The sealant used should be of a type that does not give off any emissions that could affect the relative humidity readings in the hood. Place seal/stopper in probe hole.</p> <p><b>Field Notes:</b></p>	
	7	<p>Allow a period of at least 72 h to elapse after sealing the hood to the floor so as to achieve moisture equilibrium in the air pocket under the hood before taking readings.</p>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		<b>Field Notes:</b>	
	8	<p>This test method is not suitable for areas that have surface applied vapor barriers or curing compounds that cannot be removed or cleaned off sufficiently to allow vapor flow through the surface of the slab.</p> <p>For very thick floor slab construction, (for example, 8 in. and over), and low porosity slabs or slabs with certain types of power floated low emission surface finishes it may take considerably longer than 72 h to reach moisture equilibrium.</p> <p>Should these conditions exist where a considerable amount of additional time may be required for the satisfactory performance of this test because of the low porosity surface or slow vapor movement in the slab, or both, then Test Method <b>F 2170</b> (below surface in situ RH) should be considered as a more suitable test method under these circumstances.</p>	
		<b>Field Notes:</b>	
	9	<p>Readings are taken by removing stopper from probe access hole in hood, this should be done quickly to ensure that no air escapes from, or enters, the air pocket under the hood</p>	
		<b>Field Notes:</b>	
	10	<p>Insert the humidity probe into hole so that its sensor protrudes into the center air chamber, and is sealed in position during acclimation, and taking of readings.</p>	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	11	To avoid leaving the humidity probes on site during the equilibration period, the probe may be removed from the hood and hole sealed with a stopper. Continue the determination of relative humidity reading	
		<b>Field Notes:</b>	
	12	<b>Measurement:</b> Remove the rubber stopper at the top/end of the hole liner sleeve and insert the probe all the way to the bottom/end of the hole liner so that the sensing (filter end) end of the probe is located in the center of the air pocket under the hood. Should the probe be shorter than the liner and its wire protrude from inside the liner this lead wire may need to be sealed in the liner. Connect the probe lead wire to the meter, turn on the meter and allow it to warm up as indicated by the manufacturer's instructions.	
		<b>Field Notes:</b>	
	13	Allow the probe to reach temperature equilibrium before measuring relative humidity. The probe must be at the same temperature as the air pocket before taking readings. Even a small difference in temperature could produce a significant error in relative humidity measurement.	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	14	<p>Check for drift of readings. Meter readings must not drift more than 1 % relative humidity over approximately 20 min. Equilibration may take up to several hours depending on factors such as the initial temperature difference between probe, air chamber and concrete. The meter may be turned off or disconnected. or both, from the probe while the probe equilibrates with the entrapped air pocket above the concrete.</p> <p><b>Field Notes:</b></p>	
	15	<p>Record the relative humidity to the nearest percent, temperature to the nearest °F/°C. Record the location of the hood on the floor slab.</p> <p><b>Field Notes:</b></p>	
	16	<p>Use a relative humidity meter to measure the ambient air temperature and relative humidity above the slab in the vicinity of the hood. Record the relative humidity to nearest percentage, and the temperature and dew point temperature to the nearest °F/°C.</p> <p><b>Field Notes:</b></p>	
	17	<p>If a surface thermometer is used, record this temperature.</p> <p><b>Field Notes:</b></p>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	18	When testing is complete, remove the insulated hood and clean off any adhesive or sealer that may be adhered to the surface of the concrete. After removal of the hood allow sufficient time (at least 24 h) for the area where it was positioned to reach moisture equilibrium with the surrounding area of the floor. This should be completed before proceeding further or applying a covering.	
		<b>Field Notes:</b>	
	19	Once RH values have been determined refer to whatever standard criteria that has been established. Test values that do not meet the agreed upon established criteria generally require more time for the slab to dry before further testing is performed. The equipment and hood should be removed while the floor slab is allowed to continue drying before carrying out further tests per pervious method.	
		<b>Field Notes:</b>	

**Testing company report should be as following:**

**Report the following information for ASTM F2420:**

Report the following information:

- Name and address of the structure,
- Date and time measurements were made,
- Name, title, and affiliation of persons performing the measurements,
- Locations of hoods on the structure, 11.1.5 Relative humidity in each hood to the nearest % RH,
- Temperature in each hood to the nearest °F/°C,
- Ambient air temperature, to the nearest °F/°C, relative humidity (to the nearest % RH) and dew point adjacent to each hood,
- Make, model, and last calibration date of the equipment which is being used to make the measurements, and
- Report any observations that might affect the interpretation of individual measurements such as: age and thickness of slab, standing water on the slab, wet coring operations, evidence of flooding or water damage, area water table, weather, ventilating system operations, vapor check, or artificial drying processes, or combination thereof.

**Date:**

**Summary of Results:**

- 

**Lessons Learned:**

- 

**Corrective Issues:**

- 

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***Acceptance of Test:***

- This test cannot be accepted at this time due to the Corrective Issues noted above.
- This test was witnessed by the Commissioning Authority identified below. Any Corrective Issues noted above do not adversely impact the overall performance of the system.

Witnessed \_\_\_\_\_ Date \_\_\_\_\_  
Commissioning Authority

- This test is accepted by the VA Representative identified below

Accepted \_\_\_\_\_ Date \_\_\_\_\_  
VA Representative

**PROJECT:** SLVHCS REPLACEMENT MEDICAL CENTER PROJECT

**PROJECT NUMBER:** VA 629HS2401

**REPORT ID:**

**DESCRIPTION:** ASTM C1521-09 & C1193-09

Date of Test:

## **DESIGN CRITERIA**

### ***Related Documents:***

Specification Sections 079200

Drawings

Submittal Data

### ***Test Equipment Required:***

### ***Summary of the ASTM test.***

A sealant joint usually fails to perform as a weather seal when the joint experiences a cohesion or adhesive failure. Therefore, sealant bead size and configuration, joint movement, quality of workmanship, the quality of the adhesive bond, and the quality of the sealant material are critical.

There are several tests; three (3) non-destructive and two (2) destructive

The two destructive tests are;

- Tail Test
- Flap Test

The non-destructive test;

- Technique One - Probing the center of the joint
- Technique Two - Probing the edge of the joint
- Nondestructive Continuous Inspection Procedure.

Equipment required;

- Measuring tape/rule with 1/32" divisions
- Probing tool – that is at least 1/8" (3 mm) narrower than width of joint. (see Fig 1 from ASTM)

- Razor Knife
- Knife or other cutting instrument with a min 2" (50 mm) length blade,
- sealable sample bags,
- repair sealant compatible with installed sealant
- tools for installing sealant
- Butyl tape
- Water.
- For the Nondestructive Continuous Method;
  - A wheel roller such as a screen roller or backer rod insertion tool or pressure controlled roller.
  - Masking tape

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*Functional Performance Test Prerequisites*

Prerequisite	Yes	No	Comments
1. Contractor QA/QC Testing Reports completed & submitted to CxA and <u>VA Resident Engineer</u> .			
2. Construction Checklist completed & submitted to CxA and <u>VA Resident Engineer</u> .			
3. O&M Manuals submitted to CxA and <u>VA Resident Engineer</u> for review.			
4.			
5.			

System Identification	
System Identification	Location

**Functional Test Procedures:**

Pas s Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>GENERAL SYSTEM READINESS</b>			
	1	Verify the substrate was inspected prior to installation.  <b>Field Notes:</b>	1. .
	2	Verify the product/system submittal was reviewed and approved by the A/E.  <b>Field Notes:</b>	1. .
	3	Verify the product/system has had the appropriate time for the sealant material to cure per the manufacturers recommendations. (Min. 24 hours)  <b>Field Notes:</b>	1. .
	4	Verify the testing company is utilizing a non-destructive test by using both techniques 1 & 2. Both tests employ using a probe as described earlier. Technique 1; probe the joint at the center of its width to depress and elongate the sealant...note the depth of the depression as a % of the width of the joint. A common percentage to reveal poor adhesion and create reasonable strain is 50% Technique 2; probe the joint at the adjacent to the edge where the sealant abuts the substrate bond line. Depress the sealant bead sufficiently that (visually) it appears the sealant is about to fail cohesively. The tool should not touch or scrape the substrate, nor slide towards the center of the joint  <b>Field Notes:</b>	1. .

5	<p>Verify the Following: non-destructive test by using the Continuous Inspection Procedure;</p> <ul style="list-style-type: none"> <li>• Was the masking tape placed on the exposed substrate adjacent to the sealant joint.</li> <li>• Did the testing company use a roller (that is equal or less than half the width of the joint) to apply pressure to the sealant that represents 50% deflection of the sealant</li> <li>• Did the testing company advance the roller along the centerline of the joint observing conditions as it progresses for conditions such as deflections greater or less than expected, failure of adhesion or cohesive failure, mechanical damage to sealant.</li> <li>• If a failure occurs mark the masking tape; <ul style="list-style-type: none"> <li>○ “A” – Adhesion failure</li> <li>○ “H” – Sealant appears hard</li> <li>○ “S” – Sealant appears soft</li> <li>○ “C” – Cohesive failure</li> </ul> </li> <li>• If there is an extended area of failure mark the tape for the extent and which side failed.</li> </ul>	1. .
	<b>Field Notes:</b>	
6	<p>Upon completion of tests above, determine if destructive testing is required.</p>	1. .
	<b>Field Notes:</b>	

<p><b>7</b></p>	<p>Destructive Test 1:</p> <p>The “tail” procedure consists of cutting through the sealant 6 “ (150 mm) along the bond line at both substrates. The testing company should cut across the sealant bead to release one end of the “tail” that it formed</p> <ul style="list-style-type: none"> <li>• Method A; (testing company should do the following) <ul style="list-style-type: none"> <li>○ Mark the cut portion of sealant 1 “ (25 mm) from the adhesive bond. (see diagram below)</li> <li>○ Grasp and pull the “tail” at 90 degrees to substrate, and extend it to two times the movement capability of the sealant.</li> <li>○ Record any failure and mark distance from adhesive bond when failure occurred.</li> </ul> </li> </ul> <p>.</p>	<p>1. .</p>
<p><b>Field Notes:</b></p>		
<p><b>8</b></p>	<p>Destructive Test 1:</p> <ul style="list-style-type: none"> <li>• Method B; (testing company should do the following) <ul style="list-style-type: none"> <li>○ Mark the cut portion of sealant 1“ (25 mm) from the adhesive bond. (see diagram below)</li> <li>○ Grasp and pull the “tail” at various angles, 30, 90 or 150 degrees to substrate, keeping the “tail” in line with the sealant bed. Monitor the extension to document elongation resulting in failure.</li> </ul> </li> </ul> <p>If the sealant begins to tear cohesively, stop and readjust grasp and restart. Pull tail that best avoids cohesive failure</p>	<p>2. .</p>
<p><b>Field Notes:</b></p>		

<p><b>9</b></p>	<p>Destructive Test 2:</p> <p>The “Flap” procedure consists of cutting through the sealant 3 “ (75 mm) along the bond line on the substrate opposite the substrate to be tested. Pry the flap out by the three cuts through the sealant bead. (see diagram below from ASTM) The testing company should do the following)</p> <ul style="list-style-type: none"> <li>• Grasp the flap near the edge opposite the bond line to be evaluated.</li> <li>• Pull the flap in the tensile mode until adhesive or cohesive failure.</li> <li>• Stop pulling and grasp flap near other end.</li> <li>• Pull the flap in a shear mode until the onset of adhesive or cohesive failure.</li> <li>• Trim away the portions of the flap that have failed.</li> <li>• Bend twist and/or rotate the flap until adhesive or cohesive failure.</li> <li>• Test should be performed on both sides especially if the same type of substrate is present on both sides of joint..</li> </ul>	<p>3. .</p>
<p><b>Field Notes:</b></p>		

<b>10</b>	<p>Number and type of tests will depend upon the reasons for testing. i.e. Quality Control, water or air infiltration.</p> <ul style="list-style-type: none"> <li>• <i>Nondestructive Spot Procedure;</i> For each area inspect, perform every 12' (300 mm) for first 100 lineal ft (3m). If not test failure loss in first 10 lineal ft (3m) of joint, test every 24 " (600 mm) thereafter.</li> <li>• <i>Nondestructive Continuous Inspection Procedure:</i> The amount and location of these inspections is dependent upon the purpose of the inspections. For Quality Control up to 100% may be designated based on the spot procedure or potential quality issues.</li> <li>• <i>Destructive Procedure:</i> For each area inspected, perform this procedure every 100 linear ft in the first 1,000 linear ft. If no failures are observed in the first 1,000 linear ft, perform procedure every 1,000 linear ft thereafter.  Testing at non-typical areas such as joint intersections and complex configurations is recommended.</li> </ul>	1. .
<b>Field Notes:</b>		

**Reporting:**

- Record test conditions and results for each procedure on an appropriate form.
- Each joint is unique, and as such requires that the procedures described in this method be subjectively applied and/or modified for each test.
- It is recommended that the owner retain the sealant samples in a sealed plastic bag, labeled with the location from which sample was taken, date removed, results for the method and project identification. These samples should be stored in a secure location for the duration of the warranty period.
- Data Collection;
  - Accurate recording of the location, description of the sealant anomalies as they are observed is important.
  - There is no one single procedure that is most appropriate for all projects, therefore an effective method needs to be selected for each project.

## Commissioning Functional Performance Test

- Use of the shop (submittal) and/or architectural drawing, to notate pertinent data has proven reliable on some projects.
- Photography is another useful method. When the inspection is complete, a photograph of the joint and associated masking tape can be of value. It is important that the photograph be of good quality so that the markings can be clearly read. This is true for both destructive and non-destructive test.

### Repair:

The general contractor should contact the sealant manufacturer for specific recommendations for the repair of sealant damaged during field adhesion testing.

### Date:

### Summary of Results:

- 

### Lessons Learned:

- 

### Corrective Issues:

- 

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### ***Acceptance of Test:***

- This test cannot be accepted at this time due to the Corrective Issues noted above.
- This test was witnessed by the Commissioning Authority identified below. Any Corrective Issues noted above do not adversely impact the overall performance of the system.

Witnessed \_\_\_\_\_

Commissioning Authority

Date \_\_\_\_\_

- This test is accepted by the VA Representative identified below

Accepted \_\_\_\_\_

VA Representative

Date \_\_\_\_\_

**PROJECT:** SLVHCS REPLACEMENT MEDICAL CENTER PROJECT

**PROJECT NUMBER:** VA 629HS2401

**REPORT ID:**

**DESCRIPTION:** ASTM E1601

**Date of Test:**

## **DESIGN CRITERIA**

### ***Related Documents:***

**Specification Sections** 040120, 042113, and 044200.

**Drawings**

**Submittal Data**

***Test Equipment Required:*** per ASTM E1601

### ***Summary of the ASTM test:***

The test method describes the field determination of water penetration of a masonry wall surface under specific water flow rate and air pressure conditions. This test is intended for use on any masonry wall surface that can be properly instrumented and tested within the requirements of ASTM E 1601.

Due to the nature of the test and equipment used safety of operators and observers will be important. All applicable OSHA safety requirements as well as the fan equipment manufacturer's safety guidelines and specific requirements shall be enforced for all testers and observers. Safety equipment will be required and will, at a minimum, consist of;

1. *Eye Protection* — Glass should not break at the building pressure differences normally applied to the test structure: however, for added safety, adequate precautions, such as the use of eye protection should be taken to protect the personnel.
2. *Safety Clothing* — Use safety equipment required for general field work, including safety shoes, and hard hats.
3. *Equipment Guards* — The air-moving equipment shall have a proper guard or cage to house the fan or blower and to prevent accidental access to any moving parts of the equipment.
4. *Noise Protection* — Make hearing protection available for personnel who must be close to the noise that may be generated by the fan.

**Functional Performance Test Prerequisites**

Prerequisite	Yes	No	Comments
1. Contractor QA/QC Testing Reports completed & submitted to CxA and <u>VA Resident Engineer</u> .			
2. Construction Checklist completed & submitted to CxA and <u>VA Resident Engineer</u> .			
3. O&M Manuals submitted to CxA and <u>VA Resident Engineer</u> for review.			
4.			
5.			

System Identification	
System Identification	Location

**Functional Test Procedures:**

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>GENERAL SYSTEM READINESS</b>			
	1	Verify system has been inspected. All test pre-requisites have been satisfied.	1.
		<b>Field Notes:</b>	
	2	Verify adequate access is provided to the portion of the site and area for test(s) is free and clear of any and all obstructions.	2.
		<b>Field Notes:</b>	
	3	Verify Test Equipment is of a similar configuration to that shown below.	1.
		<b>Field Notes:</b>	
	4	Test opening should be rectangular with a minimum area of 12 ft <sup>2</sup> (1.08 m <sup>2</sup> ) with a minimum dimension of 24 in. (0.6 m) for each side of the opening.	1.
		<b>Field Notes:</b>	
	5	Seal the contact surface between the frame of the chamber and the test area to prevent loss of water and maintain air pressure. Cover the face of the chamber with a tough, transparent material capable of withstanding the test pressure.	1.
		<b>Field Notes:</b>	
X	6	Provide a 3/4-in. (19-mm) diameter, corrosion-resistant, water spray pipe with a single line of 0.04-in. (1.0-mm) diameter holes spaced 1 in. (25 mm) apart, starting within 1 in. (25 mm) of each end.	1.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		<b>Field Notes:</b>	
X	7	Position the water spray pipe within the chamber so that the water impinges the wall perpendicular to the wall not more than 1.5 in. (40 mm) below the interior top of the test chamber	1.
		<b>Field Notes:</b>	
X	8	Fixtures and appurtenances to the chamber include; <ul style="list-style-type: none"> <li>• an air line with manometer or pressure gauge able to read air pressure to within 0.50 lb/ft<sup>2</sup> (24 Pa),</li> <li>• a water line with valves, a flow meter in the water supply line able to read flow within 0.02 gpm (4.5 L/h), and a water drain pipe at the bottom of the chamber.</li> <li>• The water is stored in a calibrated reservoir with a minimum volume of 3 gal. (13 L), with graduations to allow readings within 0.015 gal (0.055 L).</li> <li>• Pump water from the reservoir to the spray bar. Return water which drains from the bottom of the chamber directly to the reservoir.</li> </ul>	1.
		<b>Field Notes:</b>	
	9	<i>Mounting Chamber—</i> <ul style="list-style-type: none"> <li>• Attach the test chamber with mechanical fasteners using sufficient pressure to form an air- and water-resistant seal. Use of a gasket or sealant at the contact surface is common.</li> </ul>	1.
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
X	10	<p><i>Sealing—</i></p> <ul style="list-style-type: none"> <li>If needed, apply a perimeter sealant between the chamber and wall surface to ensure that leakage does not occur at the interface.</li> <li>Allow the sealant to cure sufficiently to ensure adequate bond and water resistance.</li> </ul>	1.
		<b>Field Notes:</b>	
X	11	<p><i>Standard Test Conditions—</i></p> <ul style="list-style-type: none"> <li>Perform this test using a water flow rate of 3.4 gal/ft<sup>2</sup>/h (138 L/m<sup>2</sup>/h) and an air pressure of 10 lb/ft<sup>2</sup> (500 Pa).</li> <li><b>The test duration shall be not less than 4 h after the preconditioning period.</b></li> </ul>	1.
		<b>Field Notes:</b>	
X	12	<p><i>Application of Air Pressure and Water Flow —</i></p> <ul style="list-style-type: none"> <li>Adjust the water flow rate to 3.4 gal/ft<sup>2</sup>/h (138 L/m<sup>2</sup>/h) times the area of the chamber opening.</li> <li>Simultaneously, increase the air pressure within the chamber to 10 lb/ft<sup>2</sup> (500 Pa).</li> <li>Check for leakage from the perimeter of the chamber. If leakage occurs, stop the test, reseal, and re-start the procedure.</li> </ul> <p><i>Preconditioning —</i> Maintain the water flow rate and pressure for 30 min prior to starting the test.</p>	1.
		<b>Field Notes:</b>	

NOTE: Check for leakage from the perimeter of the chamber . If leakage occurs, stop the test, reseal, and re-start the procedure.

**Record of Observations:**

Testing company should make observations and measurements during the duration of the test, from pre-conditioning at each pre-determined test period as noted below;

- Record the initial water flow rate, air pressure within the chamber, and water level within the reservoir at the beginning of the test after the specified preconditioning period.
- Report the water flow pattern.
  - If a complete sheet of water is observed, report it as “sheet flow”.
  - If the water runs down the surface in patterned or random rivuleted streams or in any other manner that leaves portions of the wall surface un-wetted, report it as “incomplete sheet flow” and document the pattern of flow with sketches drawn to scale.
  - Monitor the water flow pattern during the testing and report any changes.
- Record the water level in the reservoir, air pressure, and water flow rate at the beginning of, at the end of, and at 5-minute (maximum) intervals throughout each test period.
- Record the amount and time at which water is added to replenish the reservoir. Simultaneously, record the new water level with each addition of water to the reservoir.
- Note and photograph visible lateral and vertical migration of dampness outside the chamber. Note leakage from adjacent areas. Note signs of interior moisture or leakage where accessible. Note any interruptions in testing including length of time and reason.

**Calculations:**

- Calculate water loss, to the nearest 0.025 gal (0.1 L), from the reservoir at each recorded time interval.
- Plot the loss of water versus time.
- Calculate surface penetration in gal/ft<sup>2</sup>/hr (L/m<sup>2</sup>/hr) for each period of testing by performing a linear regression fit using all data for that period versus time and dividing the rate of water loss by the area of the chamber opening.

**Report:**

Testing company report should be as following:

- The project name and address of the building;
- Date, time, and temperature during the test;
- Dates and results of previous tests of same area, if applicable;
- Name(s) and address(es) of individual(s) performing the test;
- Description of the construction of the area tested including surface coatings, masonry type, wall assembly structural system, condition of the masonry surface, chamber location including elevation, floor level and position relative to wall ends or openings in

## Commissioning Functional Performance Test

the structure, and repairs performed prior to each test; (NOTE — Examples of masonry surface conditions include presence of cracks, deteriorated units, and so forth.)

- Description of chamber construction and attachment to wall;
- Statement of test conditions as applicable;
- Record of observations
- Document manufacture surface penetration recommendations for the system
- Results of calculations and graphs

**Date:**

**Summary of Results:**

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**Lessons Learned:**

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**Corrective Issues:**

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**Acceptance of Test:**

- This test cannot be accepted at this time due to the Corrective Issues noted above.
- This test was witnessed by the Commissioning Authority identified below. Any Corrective Issues noted above do not adversely impact the overall performance of the system.

Witnessed \_\_\_\_\_

Commissioning Authority

Date \_\_\_\_\_

- This test is accepted by the VA Representative identified below

Accepted \_\_\_\_\_

VA Representative

Date \_\_\_\_\_

## Determining Air Leakage Rate by Fan Pressurization

PROJECT: SLVHCS REPLACEMENT MEDICAL CENTER PROJECT

PROJECT NUMBER: VA 629HS2401

REPORT ID:

DESCRIPTION: ASTM E779, C1060, and E1186

Date of Test:

### DESIGN CRITERIA

#### *Related Documents:*

##### Specification Sections

070800

##### Drawings

##### Submittal Data

#### *Test Equipment Required:*

*See below:*

#### *Test Equipment Required:*

#### *Major Components:*

1. *Air Moving Equipment* — consisting of a fan, blower, or blower door assembly that is capable of moving air into and out of the conditioned space at required flow rates under a range of test pressure differences. The system shall provide constant airflow at each incremental pressure difference at fixed pressure for the period required to obtain readings of airflow rate. Where applicable, the HVAC system of the building may be used in place of the fan or blower.
2. *Pressure-Measuring Device* — A manometer or pressure indicator to measure pressure difference with an accuracy of 65 % of measured pressure.
3. *Airflow Measuring System* — A device to measure airflow with an accuracy of 65 % of the measured flow. The airflow measuring system shall be calibrated in accordance with Test Method E 1258

4. *Temperature-Measuring Device* — An instrument to measure temperature with an accuracy of 61°C (2°F).
5. *Wind Speed-Measuring Device (Optional)* — A device to give an accuracy within 60.25 m/s (0.56 mph) at 2.5 m/s (5.6 mph). Perform wind speed measurements at a distance three to five building heights away from the buildings, where practical. List the height above ground at which wind speed is measured.

**Safety:**

Due to the nature of the test and equipment used safety of operators and observers will be important. All applicable OSHA safety requirements as well as the fan equipment manufacturer's safety guidelines and specific requirements shall be enforced for all testers and observers. Safety equipment will be required and will, at a minimum, consist of;

5. *Eye Protection* — Glass should not break at the building pressure differences normally applied to the test structure; however, for added safety, adequate precautions, such as the use of eye protection should be taken to protect the personnel.
6. *Safety Clothing* — Use safety equipment required for general field work, including safety shoes, and hard hats.
7. *Equipment Guards* — The air-moving equipment shall have a proper guard or cage to house the fan or blower and to prevent accidental access to any moving parts of the equipment.
8. *Noise Protection* — Make hearing protection available for personnel who must be close to the noise that may be generated by the fan.

**NOTE: - Debris and Fumes** — The blower or fan forces a large volume of air into or out of a building while in operation. Exercise care not to damage plants, pets, occupants, or internal furnishings due to influx of cold or warm air. Exercise similar cautions against sucking debris or exhaust gases from vehicles, fireplaces, and flues, etc. into the interior of the building. Active combustion devices require a properly trained technician to shut them off or to determine the safety of conducting the test.

**Summary of the ASTM test.**

This test method consists of mechanical pressurization or de-pressurization of a building and measurements of the resulting airflow rates at given indoor-outdoor static pressure differences. From the relationship between the airflow rates and pressure differences, the air leakage characteristics of a building envelope can be evaluated. This test should be combined with ASTM E1060 and ASTM E 1168.

*Functional Performance Test Prerequisites*

Prerequisite	Yes	No	Comments
1. Contractor QA/QC Testing Reports completed & submitted to CxA and <u>VA Resident Engineer</u> .			
2. Construction Checklist completed & submitted to CxA and <u>VA Resident Engineer</u> .			
3. O&M Manuals submitted to CxA and <u>VA Resident Engineer</u> for review.			
4. Weather Forecast for a two day period with low speed winds and small temperature differentials			
5.			

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**Functional Test Procedures:**

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>GENERAL SYSTEM READINESS</b>			
	1	Verify test location has been set up per specification 08 08 00	
		<b>Field Notes:</b>	
	2	Verify 2 day weather outlook is conducive to the test parameters.	1. .
		<b>Field Notes:</b>	
	3	Verify single zone established, and all interconnecting doors etc are closed.	1. .
		<b>Field Notes:</b>	
	4	Verify space conditioned to be within 10%+/- of measured inside/outside pressure differential.	1. .
		<b>Field Notes:</b>	
	5	Make general observations of the condition of the building. Take notes on the windows, doors, opaque walls, roof, and floor.	1. .
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	6	<p>Measure and record the <b>indoor and outdoor temperatures</b> at the beginning and the end of the test so that their average values can be estimated. If the product of the absolute value of the indoor/outdoor air temperature difference multiplied by the building height, gives a result greater than 200 m°C (1180 ft°F), do not perform the test, because the pressure difference induced by the stack effect is too large to allow accurate interpretation of the results.</p> <p><b>Field Notes:</b></p>	<p>Indoor T=</p> <p>Outdoor T=</p> <p>Difference =</p> <p>Building Height =</p>
	7	<p>If the wind speed is to be part of the measurement record, use a wind-measuring device or obtain readings from a nearby weather bureau. Preferred test conditions are wind speed of 0 to 2 m/s (0 to 4 mph) and an outside temperature from 5 to 35°C (41 to 95°F).</p> <p><b>Field Notes:</b></p>	<p>Wind speed =</p>
	8	<p>Verify that the blower door assembly to the building envelope, using a window, door, or vent opening. Seal or tape openings to avoid leakage at these points.</p> <p><b>Field Notes:</b></p>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	9	<p>Verify that the Envelope Pressure Sensor(s) are installed —</p> <ul style="list-style-type: none"> <li>• Install the pressure measuring device across the building envelope.</li> <li>• Document the location of the sensor. (It is good practice to use more than one location across the building envelope for pressure measurement, for example, one across each facade. Diagram (from the ASTM test) below illustrates preferred locations for exterior pressure measurement locations that avoid extremes of exterior pressures (at exterior corners).)</li> <li>• Verify that the location avoids exterior corners and complex architectural features and should be close to the middle of the exterior wall.</li> <li>• Verify that is the, buildings more than three stories, or 7.5 m (25.5 ft), high, that the exterior pressures measured at more than one height on the exterior walls.</li> <li>• The pressures from each location should be averaged, typically using a manifold.</li> <li>• Verify the measurements are taken average the pressures over at least a 10-s time period.</li> </ul> <p><b>Field Notes:</b></p>	1.
	10	<p>Document zero flow pressures with the fan opening blocked. These zero flow envelope pressures are measured before and after the flow measurements. These zero flow pressures are to be subtracted from the envelope pressures measured during pressurization and depressurization.</p> <p><b>Field Notes:</b></p>	1.
	11	<p>The range of the induced pressure difference shall be from 10 to 60 Pa (0.04 to 0.24 in. H<sub>2</sub>O)</p>	1.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		<b>Field Notes:</b>	
	12	Verify the testing company will use increments of 5 to 10 Pa (0.02 to 0.04 in. H <sub>2</sub> O) for the full range of induced pressure differences.	1.
		<b>Field Notes:</b>	
	13	At each pressure difference, measure the airflow rate and the pressure differences across the envelope. After the fan and instrumentation have stabilized, the average over at least a 10-s interval should be used.	1.
		<b>Field Notes:</b>	
	14	For each test, collect data for both pressurization and de-pressurization	1.
		<b>Field Notes:</b>	
	15	Determine the elevation of the measurement site, <i>E</i> (m or ft), above mean sea level within 100 m (330 ft).	1.
		<b>Field Notes:</b>	
	16	When the building is at max pressurization, photo graph the building inside and out using an inferred camera, per ASTM C1060.	<ol style="list-style-type: none"> <li>1. Document the building before the blower door test. Using the inferred camera.</li> <li>2. Take both a color and IR photo of the Location.</li> <li>3. Indicate the location of the camera and direction of the camera on the floor Plan.</li> </ol>
		<b>Field Notes:</b>	

	17	The testing company should Use tracer gas/smoke test to determine area and the causes of excess leakage locations, per ASTM E1186.	

### Data Analysis and Calculations:

- Verify the testing company performs the necessary calculations as outlined in ASTM 779.

### Report:

Testing company report should be as following:

Report the following information:

- Building description, including location, address (street, city, state or province, zip or postal code, country, and elevation [above mean sea level in m (ft)]).
- Construction, including date built (estimate if unknown), floor areas for conditioned space, attic, basement, and crawl space, and volumes (optional) for conditioned spaces, attic, basement, and crawl space.
- Condition of openings in building envelope including:
  - Doors, closed, locked or unlocked;
  - Windows, closed, latched or unlatched;
  - Ventilation openings, dampers closed or open;
  - Chimneys, dampers closed or open; and a
  - Statement whether the test zone is interconnected with at least door-sized openings. If not, the results of pressure measurements between portions of the zone.
- HVAC system, including the location and sizes of ducts that penetrate the test zone envelope.
- Procedure, including the test equipment used (manufacturer, model, serial number), and calibration records of all measuring equipment.
- Measurement data, including:
  - Fan pressurization measurements (inside-outside zero flow building pressure differences);
    - inside and outside temperature (at start and end of test) and the product of the absolute value of the indoor/outdoor air temperature difference multiplied by the building height;
    - tabular list of all air leakage measurements and calculations:
    - time, building pressure difference, air density, nominal airflow rate, fan airflow rate, and air leakage rate;
    - and deviations from standard procedure.
  - Optional data, including wind speed/direction and whether wind speed is estimated to exceed 0 to 2 m/s (0 to 4 mph).

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- Calculations, including:
  - The leakage coefficient and pressure exponent for both pressurization and de-pressurization;
  - The effective leakage area. Also, report if a reference pressure other than 4 Pa is used; and,
  - An estimate of the confidence limits.

**Date:**

**Summary of Results:**

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**Lessons Learned:**

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**Corrective Issues:**

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***Acceptance of Test:***

- This test cannot be accepted at this time due to the Corrective Issues noted above.
- This test was witnessed by the Commissioning Authority identified below. Any Corrective Issues noted above do not adversely impact the overall performance of the system.

Witnessed \_\_\_\_\_

Date \_\_\_\_\_

Commissioning Authority

- This test is accepted by the VA Representative identified below

Accepted \_\_\_\_\_

Date \_\_\_\_\_

VA Representative

## Determining Water Penetration

**PROJECT:** SLVHCS REPLACEMENT MEDICAL CENTER PROJECT

**PROJECT NUMBER:** VA 629HS2401

**REPORT ID:**

**DESCRIPTION:** ASTM E1105, E1186 & E783

**Date of Test:**

### DESIGN CRITERIA

#### *Related Documents:*

#### Specification Sections

#### Drawings

#### Submittal Data

#### *Test Equipment Required:*

Test chamber: to be constructed on the interior or exterior of the building.

Blower fan: to obtain specified static pressures

Pressure differential magnehelic manometer

Spray rack with nozzles spaced on a uniform grid located at 15" from the test specimen creating five to eight per hour per square foot.

Due to the nature of the test and equipment used safety of operators and observes will be important. All applicable OSHA safety requirements as well as the fan equipment manufacturer's safety guidelines and specific requirements shall be enforced for all testers and observers. Safety equipment will be required and will, at a minimum, consist of;

1. *Eye Protection* — Glass should not break at the building pressure differences normally applied to the test structure: however, for added safety, adequate precautions, such as the use of eye protection should be taken to protect the personnel.
2. *Safety Clothing* — Use safety equipment required for general field work, including safety shoes, and hard hats.
3. *Equipment Guards* — The air-moving equipment shall have a proper guard or cage to house the fan or blower and to prevent accidental access to any moving parts of the equipment.
4. *Noise Protection* — Make hearing protection available for personnel who must be close to the noise that may be generated by the fan.

**Summary of the ASTM test:**

ASTM E1105, E1186 and E783 will be run at the same time using the same testing equipment. The test chamber needs to be sized to handle all the requirements of the tests.

- *Test Chamber*— The test chamber consists of a well sealed chamber which is designed to resist the pressure differentials used in the test. The test chamber is sealed to the air barrier system component and contains a connection point for attaching the fan inlet or outlet. The test chamber may also contain an adjustable bleed valve for controlling the pressure inside the chamber and a pressure tap to facilitate determining the pressure differential across the specimen with a manometer.
- *Air Exhaust (or Supply) System*—A fan or blower that is capable of providing sufficient airflow to achieve the desired pressure differential across the test area is used. A speed control on the fan or an adjustable bleed valve in the test chamber can be used to control the pressure in the chamber.

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**Functional Performance Test Prerequisites**

Prerequisite	Yes	No	Comments
1. Contractor QA/QC Testing Reports completed & submitted to CxA and <u>VA Resident Engineer</u> .			
2. Construction Checklist completed & submitted to CxA and <u>VA Resident Engineer</u> .			
3. Locations of tests have been verified by the CxA, <u>VA Resident Engineer</u> and Architect			
4.			
5.			

System Identification	
System Identification	Location

Functional Test Procedures:

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>GENERAL SYSTEM READINESS</b>			
	1	Fit the test chamber to the perimeter of the test specimen and seal all joints between the test specimen perimeter and test chamber.	
		<b>Field Notes:</b>	
	2	Verify the means for measuring the air pressure difference across the test specimen.	
		<b>Field Notes:</b>	
<b>ASTM E783</b>			
	3	Verify that the air flow, through the test chamber, provides the specified test pressure difference across the test specimen. When the test conditions are stabilized, record the air flow through the flow meter and the test pressure difference.	
		<b>Field Notes:</b>	
	4	Measure and record the following: <ul style="list-style-type: none"> <li>○ barometric pressure</li> <li>○ temperature</li> <li>○ relative humidity of the air near the exposed area of the test specimen, and of the air near the air intake/exhaust of the air system</li> <li>○ speed and direction of the air movement (wind) at or near the exposed surface of the test specimen. Such measurements shall be taken immediately prior to or during the test.</li> </ul>	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>ASTM E 1186</b>			
	<b>5</b>	Verify the blower fan is used to pressurize (or depressurize) the test chamber the smoke tracer source is moved over the surface of the test specimen. The direction of movement of the smoke trace is carefully noted. When the tracer source is used on the high pressure side of the test specimen, smoke will be drawn into air leakage sites. Conversely, if the tracer source is used on the low pressure side of the test area, smoke will be forced away from air leakage sites.	
		<b>Field Notes:</b>	
<b>ASTM E1105</b>			
<b><i>Procedure A: Uniform static air pressure difference</i></b>			
	<b>6</b>	Verify that the valve on the water-spray system so that the intake water is being delivered at the calibrated pressure. Record the pressure.	
		<b>Field Notes:</b>	
	<b>7</b>	Verify the testing company is applying the specified static air pressure difference within 15 seconds and maintain this pressure, along with the specified rate of water spray for 15 minutes.	
		<b>Field Notes:</b>	
	<b>8</b>	Observe and note points of water penetration that occur during the test.	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	9	Verify the testing company has removed the air pressure difference and stop the water spray. Inspect the test specimen for any additional evidence of water penetration and note any such evidence for the report.	
		<b>Field Notes:</b>	
	10	Measure and record the barometric pressure and temperature of the air near the exposed surface of the test specimen and of the air near the air intake or exhaust of the air system.	
		<b>Field Notes:</b>	
	11	Measure and record the barometric pressure and temperature of the air near the exposed surface of the test specimen and of the air near the air intake or exhaust of the air system.	
		<b>Field Notes:</b>	
	12	Measure and record the speed and direction of the air movement (wind) at/or near the exposed surface of the test specimen. Take such measurements immediately prior to/ during the test.	
		<b>Field Notes:</b>	
<b>Procedure B: Cyclic static air pressure difference</b>			
	13	Verify the valve on the water-spray system so that the intake water is being delivered at the calibrated pressure.	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	14	Verify the testing company is applying the specified static air pressure difference across the test specimen promptly and maintain this pressure, along with the specified rate of water spray, for the period of time stipulated by the specification or the specified. Unless otherwise specified, the duration of the pressure cycle shall be five minutes.	
		<b>Field Notes:</b>	
	15	Verify the testing company is reducing the air pressure difference to zero for a period of not less than one minute while maintaining the water spray.	
		<b>Field Notes:</b>	
	16	Verify the testing company is repeating the preceding two steps for the specified number of cycles. In no case, however, shall the total time of pressure application be less than 15 minutes.	
		<b>Field Notes:</b>	
	17	Observe and note points of water penetration that occur during the test.	
		<b>Field Notes:</b>	
	18	At the conclusion of the required number of cycles, remove the air pressure difference and stop the water spray. Inspect the test specimen for any additional evidence of water penetration and note any such evidence for the report.	
		<b>Field Notes:</b>	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	19	Measure and record the barometric pressure and temperature of the air near the exposed surface of the test specimen, and the air near the air intake or exhaust of the air system. Measure and record the speed and direction of the air movement (wind) at/near the exposed surface of the test specimen. Take such measurements immediately prior to/during the test.	
		<b>Field Notes:</b>	

**Testing company report should be as following:**

**Report the following information for ASTM E 783:**

- Testing agency, requester of test, date and time of test, date of report, identification, and location of building.
- Test specimen description.
- Detailed drawings of the specimen (if available).
- Sampling procedures.
- Test parameters.
- Ambient test conditions.
- Pressure differences and Leakage.

**Report the following information for ASTM E 1186:**

- Testing agency, requester of test, date and time of test, date of report, identification, and location of building.
- Test specimen description.
- Detailed drawings of the specimen (if available).
- Sampling procedures.
- Test parameters.
- Ambient test conditions.
- The direction of movement of the smoke trace.

## Commissioning Functional Performance Test

**Report the following information for ASTM E1105**

- Testing agency, requester of test, date and time of test, date of report, identification, and location of building.
- Test specimen description.
- Detailed drawings of the specimen (if available).
- Sampling procedures.
- Test parameters.
- Test conditions.
- Test results.
- Compliance statement.

**Date:**

**Summary of Results:**

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**Lessons Learned:**

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**Corrective Issues:**

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***Acceptance of Test:***

- This test cannot be accepted at this time due to the Corrective Issues noted above.
- This test was witnessed by the Commissioning Authority identified below. Any Corrective Issues noted above do not adversely impact the overall performance of the system.

Witnessed \_\_\_\_\_

Commissioning Authority

Date \_\_\_\_\_

This test is accepted by the VA Representative identified below

Accepted \_\_\_\_\_

Date \_\_\_\_\_

VA Representative

DRAFT

## Field Testing Uplift Resistance of Adhered Membrane Roofing Systems

**PROJECT:** SLVHCS REPLACEMENT MEDICAL CENTER PROJECT

**PROJECT NUMBER:** VA 629HS2401

**REPORT ID:**

**DESCRIPTION:** ASTM E907-96

**Date of Test:**

### DESIGN CRITERIA

#### *Related Documents:*

Specification Sections

Drawings

Submittal Data

#### *Test Equipment Required:*

Test chamber: square chamber – dome shaped designed to withstand pressure w/o collapsing.

Vacuum Equipment – to obtain specified pressures

Pressure sensing device – manometer

Dial Indicator – to measure deflection in roof surface in test area.

**Summary of the ASTM test:**

This test method is intended to be used as a measure of the uplift resistance of the roofing system. Systems containing cold adhesive shall be in place for the cure time specified by the adhesive manufacturer to obtain optimum adhesion before conducting the test. Hot-applied systems shall be permitted to cool to normal prevailing surface temperatures before conducting the test.

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**Functional Performance Test Prerequisites**

Prerequisite	Yes	No	Comments
1. Contractor QA/QC Testing Reports completed & submitted to CxA and <u>VA Resident Engineer</u> .			
2. Construction Checklist completed & submitted to CxA and <u>VA Resident Engineer</u> .			
3. Locations of tests have been verified by the CxA, <u>VA Resident Engineer</u> and Architect			
4.			
5.			

System Identification	
System Identification	Location

Functional Test Procedures:

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
<b>GENERAL SYSTEM READINESS</b>			
	1	Measure and record air temperature with a thermometer, and roof surface temperature with a surface thermometer.	
		<b>Field Notes:</b>	
	2	Conduct tests when the temperature of the roof surface is in the range from 4 to 38°C (40 to 100°F). Temperatures outside this range will produce questionable results. For safety considerations, tests shall not be conducted when the wind speed at the roof level is over 6.5 m/s (15 mph). When necessary to measure and record wind speed, a portable anemometer shall be used.	
		<b>Field Notes:</b>	
<b>ASTM E907-96</b>			
	3	Place the bar with attached dial indicator so that the tip of the dial indicator is in contact with the roof membrane near the center of the test area (See Fig.3 below)	
		<b>Field Notes:</b>	
	4	Place the assembled chamber over the roof test area so that the deflection bar with attached dial indicator is centered within the chamber and is perpendicular to two sides of the chamber. The edges of the chamber shall be sealed to the roof surface. Orient the chamber on the roof so that the edges are parallel with the direction of the structural framing of the building. (See example of chamber below)	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		<b>Field Notes:</b>	
	5	Install the pressure measuring device. If a manometer is used, fill it with water to zero calibration level.	
		<b>Field Notes:</b>	
	6	Connect the vacuum equipment to the hole provided for it in the chamber. Make sure that the bypass valve on the vacuum equipment is open before starting the equipment, or if a rheostat is used, that it is in the OFF position.	
		<b>Field Notes:</b>	
	7	Continuously observe the deflection and pressure measuring device throughout the period that vacuum is created for sudden or variable rates of movement.	
		<b>Field Notes:</b>	
	8	Regulate the negative pressure in the chamber to the specified level. Unless otherwise specified, conduct the test by raising the negative pressure in the chamber to 720 6 20 Pa (15 lbf/ft <sup>2</sup> ) and holding this pressure for 1 min. Thereafter, raise the pressure in increments not greater than 360 6 20 Pa (7.5 lbf/ft <sup>2</sup> ) until the agreed upon pressure is reached. Hold the pressure at each increment for 1 min. Terminate the test when failure occurs or at the completion of 1 min at the agreed upon specified negative pressure.	
		<b>Field Notes:</b>	

**Interpretation of Results:**

Most roof systems subjected to a negative pressure will exhibit an upward deflection that will increase as the negative pressure increases. Poorly adhered systems will exhibit relatively large increases in upward deflections with relatively small increases in applied pressure. For roof systems that are well adhered, the increase in deflection will be gradual and at a relatively constant rate up to a point at or near failure. When failure occurs due to lack of adhesive or cohesive resistance of the roof system, there will be a sudden increase in the upward deflection.

Failure is taken as uplifting of the roof covering as indicated by a measured upward deflection of 25 mm (1 in.) or greater at the center unless a particular system exhibits greater limits of deflection without failure as determined by examination or past test experience, or both. A sudden increase in deflection indicates a problem that requires further investigation to determine if adhesion or attachment of roofing system components is adequate.

**Testing company report should be as following:****Report the following information for ASTM E907:**

- Area, height, and plan view of the roof showing the location of the test areas.
- Complete detailed description of the roof assembly construction being tested. Include the type of roof deck and method of attachment, deck support spacing, vapor retarder and adhesive, if any, types and thicknesses of insulation, if any, methods of attachment, and the type of adhered roofing including surfacing.
- Dates of tests, air and roof surface temperatures, and wind speed (if measured). The internal pressure of the building shall be recorded before starting the uplift tests.
- Description of the test procedure giving the negative pressure increments, length of time pressure maintained at each increment, and the maximum applied pressure.
- Tabulation of results observed at each pressure increment including visual observations and deflection. The deflection shall be measured and recorded at the start and end of each pressure increment.
- If failure occurs during the tests, the complete record shall include:
  - (a) the negative pressure at which failure occurred,
  - (b) observations obtained by thorough examination of the failed area including cuts through the membrane if necessary (cuts in built-up membranes shall be made as shown in Fig. 4 (below) to preserve the integrity of the test cut area),
  - (c) description of type of failure and its location within the roof assembly, and
  - (d) other observations of the roof assembly conditions that are attributed to the failure. The cut area of roofing shall be repaired after examination of the failed area.
- Names, signatures, and affiliations of the persons observing the tests.

Date:

**Summary of Results:**

- 

**Lessons Learned:**

- 

**Corrective Issues:**

- 

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**Acceptance of Test:**

- This test cannot be accepted at this time due to the Corrective Issues noted above.
- This test was witnessed by the Commissioning Authority identified below. Any Corrective Issues noted above do not adversely impact the overall performance of the system.

Witnessed \_\_\_\_\_ Date \_\_\_\_\_  
Commissioning Authority

- This test is accepted by the VA Representative identified below

Accepted \_\_\_\_\_ Date \_\_\_\_\_  
VA Representative

**SLVHCS REPLACEMENT MEDICAL CENTER PROJECT**

**APPENDIX C**

**FIELD TEST REPORT DOCUMENTATION**

DRAFT

**Report No.:**

**Party Filling Out This Form:**

**Set-Up Date:**

**Set-Up Completion Data:**

**Test Date:**

**Test Completion Data:**

**Report Date:**

**Verification the system is ready to test:**

The Construction Manager has certified that the system is substantially complete and ready for testing.

Construction Manager Signature: \_\_\_\_\_ Date:  
\_\_\_\_\_

All the system sub-contractors has certified that the construction is substantially complete and ready for testing verification

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Project Identification:**

**Project Summary:**

**Test Methods:**

**Pre-Test Inspection:**

**Test Procedure:**

**Field Modification:**

**Performance Criteria:**

**Document the following:**

1. Attach floor plan and elevations indicating test locations
2. Attach photos of all tests failure locations
3. For infrared photos: Attach non-infrared & infrared photo of the testing area

**Information on Equipment/Performing Test (List All):**

**Make:**

**Model:**

**SLVHCS REPLACEMENT MEDICAL CENTER PROJECT**

**Last Date Certified Inspection of Equipment:**

**Name of Certified Inspector:**

DRAFT

**SLVHCS REPLACEMENT MEDICAL CENTER PROJECT**

**TEST RESULTS**

Date:

Ambient Exterior Air Temperature: °F

General Note:

**Test Specimen #1:**

Description:

Test Area Size:

Location:

Title of Test:

Test Results:

Allowable:

(What is the baseline for the Test Result? Or, what is the min or max value that is considered acceptable for this test?)

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**Test Specimen #2\*:**  
Description:

Test Area Size:

Location:

Title of Test:

Test Results:

Allowable:  
(What is the baseline for the Test Result? Or, what is the min or max value that is considered acceptable for this test?)