SECTION 07 53 23
ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING

SPEC WRITER NOTES:
1. Delete text between // // not applicable to project. Edit remaining text to suit project.
2. Slopes: Do not use on slopes over 1/10 (1 inch per 12 inches). Provide 1/50 (1/4 inch per 12 inches) minimum to drains without any "Gutters" (no slopes between drains). Slope crickets 1/50 (1/4 inch per 12 inches). NO EXCEPTION TO MINIMUM SLOPE.
3. Coordinate with plumbing requirements for roof drains and drain locations at low points and mid span where maximum deflection occurs. Do not put drains at columns or on slopes. Coordinate with insulation to provide sumps at drains.
4. Coordinate details and systems used to provide code required fire rated roofing system.
5. Adhered system is preferred over mechanically fastened or ballasted system.
6. When a ballasted system is used:
   a. Coordinate to ensure structural design provides for ballast dead load. Do not use on an existing structure where the structural system is not designed to support ballast dead load.
   b. Design for wind uplift at project site.
   c. Select rate of ballast according to ANSI/SPRI RP-4.
   d. Use pavers or loose aggregate or both over membrane.
   e. Coordinate details to provide raised roof edge 200 mm (8 inches) minimum above surface of aggregate ballast or clamping device for pavers at edge and strapping where necessary when parapet walls over 600 mm (24 inches) high do not occur.
   f. Do not use over loosely laid insulation.
7. Coordinate with Section 07 22 00, ROOF AND DECK INSULATION for roof insulation under the membrane. Decrease R-value 5 percent when mechanical fasteners are used through insulation to compensate for parallel heat flow.

8. Do not use polystyrene, urethane, or wood fiberboard insulation under membrane.
9. Do not use over bituminous materials where direct contact occurs, including grease, oil, or other substances not compatible with EPDM. Use a thin layer of insulation, slip sheet or separator sheet depending upon method of attachment. Where there is a potential for grease laden vapors, such as kitchen exhaust, provide epichlorohydrin or other manufacturer recommended overlay material in area of exposure.
10. Terminate base flashings minimum 200 mm (8 inches) above roof surface including curb for building expansion joints.
11. Do not put expansion joints at roof surface level.
12. Do not use "pitch pockets" or "sealant pockets" in lieu of base flashings and cap flashings.
13. This specification is for use over cellular insulating concrete decks, concrete decks or insulation. Insert additional text when installed directly to other decks or insulation systems not specified in Section 07 22 00, ROOF AND DECK INSULATION.
14. Do not use pipe boots that provide less than 200 mm (8 inch) height above roof.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ethylene Propylene Diene Monomer (EPDM) sheet roofing // adhered // mechanically fastened // ballasted // to insulated // concrete // metal // roof deck.
2. Fire rated roof system.

1.2 RELATED WORK

SPEC WRITER NOTE: Update and retain references only when specified elsewhere in this section.

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Non-Flooring Adhesives and Sealants VOC Limits.

B. Section 07 01 50.19, PREPARATION FOR REROOFING: Preparation of Existing Membrane Roofs and Repair Areas.

C. Section 07 22 00, ROOF AND DECK INSULATION: Substrate Board, Vapor Retarder, Roof Insulation, and Cover Board.

D. Section 09 06 00, SCHEDULE FOR FINISHES: Roof Membrane Color.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):

FX-1-16.....Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

RP-4 2019.....Wind Design Standard for Ballasted Single-ply Roofing Systems.

C. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):

7-16.....Minimum Design Loads For Buildings and Other Structures.

D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

90.1-13.....Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ASTM International (ASTM):

A276/A276M-17.....Stainless Steel Bars and Shapes.

B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate.

B209M-14.....Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

C67-20.....Sampling and Testing Brick and Structural Clay Tile.

C140/C140M-20a.....Sampling and Testing Concrete Masonry Units and Related Units.

C936/C936M-20.....Solid Concrete Interlocking Paving Units.

C1371-15.....Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

C1549-16.....Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.

D751-19.....Standard Test Methods for Coated Fabrics.

D1248-16.....Polyethylene Plastics Extrusion Materials for Wire and Cable.
D1876-08(2015)e1.....Peel Resistance of Adhesives (T-Peel Test).
D2103-15.....Polyethylene Film and Sheeting.
D2240-15e1.....Rubber Property-Durometer Hardness.
D3884-09(2017).....Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method).
D4263-83(2018).....Indicating Moisture in Concrete by the Plastic Sheet Method.
D4586/D4586M-07(2018)...Asphalt Roof Cement, Asbestos-Free.
D4637/D4637M-15.....EPDM Sheet Used In Single-Ply Roof Membrane.
E96/E96M-16.....Water Vapor Transmission of Materials.
E408-13(2019).....Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
E1918-16.....Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
E1980-11(2019).....Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
G21-15.....Resistance of Synthetic Polymeric Materials to Fungi.

F. Cool Roof Rating Council (CRRC):
1-20.....Product Rating Program.

G. Federal Specifications (Fed. Spec.):
UU-B-790A.....Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant).

H. Florida Department of Business and Professional Regulation (FL):
Approved Product Approval.

I. National Roofing Contractors Association (NRCA):
Manual-19.....The NRCA Roofing Manual: Membrane Roof Systems.

J. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog.

K. UL LLC (UL):
580-06..... Tests for Uplift Resistance of Roof Assemblies.
1897-20.....Uplift Tests for Roof Covering Systems.

L. U.S. Department of Commerce National Institute of Standards and Technology (NIST):
DOC PS 1-19.....Structural Plywood.

DOC PS 2-18.....Performance Standard for Wood-Based Structural-Use Panels.

M. U.S. Environmental Protection Agency (EPA):

Energy Star.....ENERGY STAR Program Requirements for Roof Products Version 3.0.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at the Project site minimum 30 days before beginning Work of this section.

SPEC WRITER NOTE: Edit participant list to ensure entities influencing outcome attend.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. // Architect/Engineer. //
   c. // Inspection and Testing Agency. //
   d. Contractor.
   e. Installer.
   f. // Manufacturer's field representative. //
   g. Other installers responsible for adjacent and intersecting work, including roof deck, flashings, roof specialties, roof accessories, utility penetrations, rooftop curbs and equipment, lightning protection, and // _____ //.

SPEC WRITER NOTE: Edit meeting agenda to incorporate project specific topics.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Installation schedule.
   b. Installation sequence.
   c. Preparatory work.
   d. Protection before, during, and after installation.
   e. Installation.
   f. Terminations.
   g. Transitions and connections to other work.
   h. Inspecting and testing.
   i. Other items affecting successful completion.
   j. Pull out test of fasteners.
   k. Material storage, including roof deck load limitations.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Roofing membrane layout.

SPEC WRITER NOTE: Retain paragraph below for mechanically fastened membrane.

2. //Roofing membrane fastener pattern and spacing.//
3. Roofing membrane seaming and joint details.
4. Roof membrane penetration details.
5. Base flashing and termination details.
6. // Ballast // and paver // layout.
7. Paver anchoring locations and details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Minimum fastener pull out resistance.
3. Installation instructions.
4. Warranty.

SPEC WRITER NOTE: Retain paragraph below when retaining requirement for use of Federally-mandated products under Quality Control Article above.

5. Product Data for Federally-Mandated Bio-Based Materials: For roof materials, indicating USDA designation and compliance with definitions for bio-based products, Rapidly Renewable Materials, and certified sustainable wood content.

D. Sustainable Construction Submittals:

SPEC WRITER NOTE: Retain sustainable construction submittals appropriate to product.

1. Solar Reflectance Index (SRI) for roofing membrane.
2. Low Pollutant-Emitting Materials:

a. Show volatile organic compound types and quantities.

3. Energy Star label for roofing membrane.

E. Samples:

1. Roofing Membrane: 150 mm (6 inch) square.

2. Base Flashing: 150 mm (6 inch) square.
3. Fasteners: Each type.
4. Roofing Membrane Seam: 300 mm (12 inches) square.

F. Certificates: Certify products comply with specifications.
1. Fire and windstorm classification.

SPEC WRITER NOTE: Retain paragraph below for Florida and Gulf coast projects.

2. High wind zone design requirements.
3. Energy performance requirements.

G. Qualifications: Substantiate qualifications comply with specifications.
1. Installer, including supervisors // with project experience list //.
2. Manufacturer's field representative // with project experience list //.

H. Field quality control reports.

SPEC WRITER NOTE: Retain paragraph below for reroofing projects.

I. Temporary protection plan. Include list of proposed temporary materials.

J. Operation and Maintenance Data:
1. Maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Approved by roofing system manufacturer as installer for roofing system with specified warranty.
2. Regularly installs specified products.
3. Installed specified products with satisfactory service on five similar installations for minimum five years.
a. // Project Experience List: Provide contact names and addresses for completed projects. //
4. Employs full-time supervisors experienced installing specified system and able to communicate with Contracting Officer's Representative and installer's personnel.

B. Manufacturer's Field Representative:
1. Manufacturer's full-time technical employee or independent roofing inspector.
2. Individual certified by Roof Consultants Institute as Registered Roof Observer.

1.7 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.8 STORAGE AND HANDLING

A. Comply with NRCA Manual storage and handling requirements.

B. Store products indoors in dry, weathertight facility.

C. Store adhesives according to manufacturer's instructions.

D. Protect products from damage during handling and construction operations.

E. Products stored on the roof deck must not cause permanent deck deflection.

1.9 FIELD CONDITIONS

A. Environment:

SPEC WRITER NOTE: Coordinate installation temperature with available adhesives. Solvent based adhesives can be used at lower temperatures.

1. Product Temperature: Minimum 4 degrees C (40 degrees F) and rising before installation.
2. Weather Limitations: Install roofing only during dry current and forecasted weather conditions.

1.10 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

SPEC WRITER NOTE:
1. Specify extended manufacturer's warranties for materials only.
2. Contracting Officer's Representative must approve specification of a manufacturer's warranty.

B. Manufacturer's Warranty: Warrant roofing system against material and manufacturing defects and agree to repair any leak caused by a defect in the roofing system materials or workmanship of the installer.

SPEC WRITER NOTE: Specify customarily available warranty period for specified products.

1. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Roofing System: // Adhered // Mechanically fastened // Ballasted // roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards // vapor retarders // ballast // pavers // copings // edge metal // and // walkway pads //.

2.2 SYSTEM PERFORMANCE

A. Design roofing system meeting specified performance:

1. Load Resistance: ASCE/SEI 7; Design criteria //:as indicated on Drawings.//

SPEC WRITER NOTE: Specify actual loads for project if not indicated on the Drawings.

a. //Uplift Pressures:

1) Corner Uplift Pressure: // _____ // kPa/square meter (// _____ // pound square foot).

2) Perimeter Uplift Pressure: // _____ // kPa/square meter (// _____ // pound square foot).

3) Field-of-Roof Uplift Pressure: // _____ // kPa/square meter (// _____ // pound square foot).//

SPEC WRITER NOTE:
1. Energy performance requirements apply only when white roofing membrane is specified.
2. Retain one or more paragraphs below for compliance with:
   a. Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings incorporated in Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management, dated January 24, 2007.
   b. Energy Policy Act of 2005 (EPA 2005).
   c. Energy Independence and Security Act of 2007 (EISA 2007).
   d. LEED mandate.
   e. Conformance with locally-applicable requirements.

2. Energy Performance:

SPEC WRITER NOTE: Retain paragraph below for Energy Star compliance.

a. EPA Energy Star Listed for low-slope roof products.

SPEC WRITER NOTE: Retain paragraph below for LEED heat island effect (roof) credit compliance.

b. ASTM E1980; Minimum 78 Solar Reflectance Index (SRI).

SPEC WRITER NOTE: Retain paragraph below for California Energy Commission (CEC) Title 24 compliance.

c. CRRC-1; Minimum 0.70 initial solar reflectance and minimum 0.75 emissivity.

SPEC WRITER NOTE: Typically retain below for VA new construction and reroofing projects in ASHRAE Climate Zones 1 through 3 and elsewhere where cool roof technology is cost-effective.

d. Three-Year Aged Performance: Minimum 0.55 solar reflectance tested in according to ASTM C1549 or ASTM E1918, and minimum 0.75 thermal emittance tested in according to ASTM C1371 or ASTM E408.

1) Where tested aged values are not available:

a) Calculate compliance adjusting initial solar reflectance according to ASHRAE 90.1.

b) Provide roofing system with minimum 64 three-year aged Solar Reflectance Index calculated according to ASTM E1980 with 12 watts/square meter/degree K (2.1 BTU/hour/square foot) convection coefficient.

2.3 PRODUCTS - GENERAL

A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Provide roof system components from one manufacturer.

C. Sustainable Construction Requirements:

SPEC WRITER NOTE:
1. Retain paragraph below when complying with Federal Guiding Principles IV from Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings incorporated in Executive Order 13423 "Strengthening Federal Environmental, Energy, and

Transportation Management, dated January 24, 2007, Enhance Indoor Environmental Quality - Biobased Content Requirement. Requirement differs from related requirements in LEED definitions.
2. Indicate project goals for percentages of bio-based, rapidly-renewable, and certified sustainable wood products in Section 01 00 00, GENERAL REQUIREMENTS.

1. Bio-Based Materials: Where applicable, provide products designated by USDA and meeting or exceeding USDA recommendations for bio-based content, and products meeting Rapidly Renewable Materials and certified sustainable wood content definitions; refer to www.biopreferred.gov.

SPEC WRITER NOTE:
1. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS includes comprehensive product list setting VOC limits for low-emitting materials.
2. Retain subparagraphs applicable to products specified in this section.

2. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
   a. Non-flooring adhesives and sealants.

2.4 EPDM ROOFING MEMBRANE

SPEC WRITER NOTE:
1. Use fabric-backed sheet for adhered systems to cellular insulating concrete, structural concrete, or when re-roofing over other incompatible substrates where manufacturer recommends fabric backing for separation.
2. Use sheets without fabric backing when adhering to rigid insulation boards and cover boards.
3. Use reinforced membrane for ballasted and mechanically fastened systems.
4. Use non-reinforced adhered systems over cover boards on new VA construction unless other application is specifically approved by VA.

A. EPDM Sheet: ASTM D4637/D4637M, // Type I - non-reinforced // Type II - internally reinforced // Type III - fabric backed //.

1. Thickness: // 1.5 mm (60 mils) // 2.54 mm (100 mils) //.

SPEC WRITER NOTE: EPDM is available in black and white-on-black colors. Only white-on-black color will meet energy performance requirements.

2. Color: See Section 09 06 00, SCHEDULE OF FINISHES.

B. Additional Properties:

PROPERTY	TEST METHOD	REQUIREMENT
Shore A Hardness	ASTM D2240	55 to 75 Durometer
Water Vapor Permeance	ASTM E96/E96M	Minimum 8 ng/Pa/s/sq. m (0.14 perms) Water Method
Fungi Resistance	ASTM G21	After 21 days, no sustained growth or discoloration.

1. Use fire retardant membrane when not protected by ballast or pavers. Verify for UL or approval.

2.5 MEMBRANE ACCESSORY MATERIALS

A. Sheet roofing manufacturer's specified products.

B. Flashing Sheet: Manufacturer's standard; same material, and color as roofing membrane.

1. Self-curing EPDM flashing adaptable to irregular shapes and surfaces.

2. Minimum Thickness: 1.5 mm (0.060 inch).

C. Factory Formed Flashings: Inside and outside corners, pipe boots, and other special flashing shapes to minimize field fabrication.

D. Splice Adhesive or Tape: Manufacturer's standard for roofing membrane and flashing sheet.

E. Splice Lap Sealant: Liquid EPDM rubber for exposed lap edge.

SPEC WRITER NOTE: Solvent based adhesives may be required for roofing installation in cold climates.

F. Bonding Adhesive: Manufacturer's standard, // water // solvent // based, to suit substrates.

G. Termination Bars: Manufacturer's standard, stainless steel or aluminum, 25 mm wide by 3 mm thick (1 inch wide by 1/8 inch thick) factory drilled for fasteners.

H. Battens: Manufacturer's standard, galvannealed or galvanized steel, 25 mm wide by 1.3 mm thick (1 inch wide by 0.05 inch thick), factory punched for fasteners.

I. Pipe Compression Clamp:

1. Stainless steel drawband.
2. Worm drive clamp device.

J. Fasteners: Manufacturer's standard coated steel with metal or plastic plates, to suit application.

K. Fastener Sealer: One part elastomeric adhesive sealant.

L. Temporary Closure Sealers (Night Sealant): Polyurethane two part sealer.

M. Primers, Splice Tapes, Cleaners, and Butyl Rubber Seals: As specified by roof membrane manufacturer.

N. Asphalt Roof Cement: ASTM D4586/D4586M.

2.6 FASTENERS

A. Fasteners and washers required for securing pavers together with straps and to walls or other anchorage:

1. Straps for Securing Pavers Together:
   a. Stainless Steel: ASTM A276/A276M, Type 302 or 304, minimum 0.46 mm (0.018 inch) thick.
   b. Aluminum Strap: ASTM B209/B209M, minimum 2.39 mm (0.094 inch) thick.
   c. Round corners on straps.
   d. Form straps 38 mm (1-1/2 inches) wide, 3 m (10 feet) maximum length with 6 by 10 mm (1/4 by 3/8 inch) punched slotted holes at 100 mm (4 inch) centers centered on width of strap. Punch hole size 2 mm (1/16 inch) larger than fastener shank when shank is thicker than 5 mm (3/16 inch).

B. Fasteners or Connectors for Pavers:

1. For Concrete Pavers: Extruded interlocking hollow shape polyethylene connector:
   a. ASTM D1248, Type 1, low density, Class C, black weather resistant, Grade E6, tensile strength 15 MPa (2200 psi), Shore D hardness of 4, brittleness low temperature - 82 degrees C (180 degrees F), softening temperature above 80 degrees C (176 degrees F).
   b. Length: 50 mm (2 inches), with center stop and insert leg with ribs to resist withdrawal; minimum 1.3 mm (0.05 inch) thick.

2. Fasteners for Pavers Straps:
   a. Stainless steel as recommended by manufacturer of paver in which fastener is anchored.
   b. Fasteners that are not acceptable include:
      1) Impact or power actuated fasteners.
      2) Fasteners that do not require a predrilled pilot hole.
      3) Fasteners with lead or white metal anchors.
      4) Plastic anchors not stabilized against ultraviolet light.

2.7 SEPARATION SHEET

A. Polyethylene Film: ASTM D2103, 0.2 mm (6 mils) thick.

B. Building Paper: Fed. Spec. UU-B-790.
   1. Water Vapor Resistance: Type I, Grade A, Style 4, reinforced.
   2. Water Vapor Permeable: Type I, Grade D, Style 4, reinforced.

2.8 FLEXIBLE TUBING

A. Closed cell neoprene, butyl polyethylene, vinyl, or polyethylene tube or rod.

B. Diameter approximately 1-1/2 times joint width.

2.9 WALKWAY PADS

A. Manufacturer's standard, slip resistant, approximately 450 mm by 450 mm (30 by 30 inches) square and 5 mm (3/16 inch) thick with rounded corners.

SPEC WRITER NOTE: Use of a protection mat or separator sheet is required under ballast.

2.10 PROTECTION MAT OR SEPARATOR SHEET

A. Protection Mat:
   1. Water pervious; either woven or non-woven sheet of long chain polymeric filaments or yarns such as polypropylene, black polyethylene, polyester, or polyamide; or, polyvinylidene-chloride formed into a pattern with distinct and measurable openings.
   2. Filter fabric equivalent opening size (EOS): Not finer than the U.S.A. Standard Sieve Number 120 and not coarser than the U.S.A. Standard Sieve Number 100. EOS is defined as the number of the U.S.A. Standard Sieve having openings closest in size to the filter cloth openings.
   3. Edges of fabric selvaged or otherwise finished to prevent raveling.
   4. Abrasion Resistance:

a. After being abraded in conformance with ASTM D3884 using rubber-hose abrasive wheels with one kg load per wheel and 1000 revolutions, perform tensile strength test as specified in ASTM D1682, paragraph.

b. Result: 25 kg (55 pounds) minimum in any principle direction.

5. Puncture Strength:

a. ASTM D751 tension testing machine with ring clamp; steel ball replaced with an 8 mm (5/16 inch) diameter solid steel cylinder with a hemispherical tip centered within the ring clamp.

b. Result: 57 kg (125 pounds) minimum.

6. Non-degrading under a wet or humid condition within minimum 4 degrees C (40 degrees F) to maximum 66 degrees C (150 degrees F) when exposed to ultraviolet light.

7. Minimum Sheet Width: 2400 mm (8 feet).

SPEC WRITER NOTES:
1. When roof membrane is anchored to substrate and left exposed, specify and show pavers on the Drawings around equipment requiring servicing for protection of membrane.
2. Use pavers or walkway pads for walkways and around equipment requiring servicing when aggregate ballast is used.
3. Pavers are preferred over aggregate ballast, or a combination of pavers and aggregate, over aggregate only.
4. Check ballast and paver weights required for Fire Rated system.
5. Use only pavers when required for wind loads.

2.11 BALLAST

A. Ballast: ASTM D1863; with sized according to ASTM D448.

SPEC WRITER NOTE: Size 2 is largest and Size 6 is smallest aggregate.

1. Size 2 for 146 kg/square meter (30 pounds/square foot) or more.
2. Size 3 for 122 kg/square meter (25 pounds/square foot) or more.
3. Size 5 for 73 kg/square meter (15 pounds/square foot) or more.

Size 6 for 49 kg/square meter (10 pounds/square foot) or more.

2.12 ROOF PAVERS

SPEC WRITER NOTE:
1. Ensure pavers are detailed showing size and shape.

2. Do not exceed 600 mm square (24 inches square) for non-interlocking units with approximate weight of 23 kg (50 pounds) each.
3. Pavers require 73 kg/square meter (15 pounds/square foot) minimum for fire rating.
4. Interlocking pavers are preferred over non interlocking pavers.
5. Use interlocking type that have been tested in a wind tunnel for wind uplift.
6. Do not use light weight aggregate pavers.
7. Retain ribbed bottom surface when pavers are installed directly on roof membrane.

A. Roof Pavers: Precast, normal weight, // interlocking // non-interlocking // concrete units // with ribbed bottom surface for drainage //.
   1. Weight: Minimum 73 kg/square meter (15 pounds/square foot).
   2. Size: As indicated on drawings.
   3. Compressive Strength: ASTM C140; Minimum (8,000 psi).
   4. Water Absorption: ASTM C936; Maximum 5 percent.
   5. Freeze Thaw: ASTM C67; Maximum 1 percent mass loss.

2.13 ACCESSORIES

A. Temporary Protection Materials:
   1. Expanded Polystyrene (EPS) Insulation: ASTM C578.
   2. Plywood: NIST DOC PS 1, Grade CD Exposure 1.
   3. Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine and verify substrate suitability for product installation with roofing installer and roofing inspector present.

SPEC WRITER NOTE: Require firestopping verification for fire rated roof assemblies.

   1. Verify roof penetrations are complete, secured against movement, // and firestopped //.
   2. Verify roof deck is adequately secured to resist wind uplift.
   3. Verify roof deck is clean, dry, and in-plane ready to receive roofing system.

B. Correct unsatisfactory conditions before beginning roofing work.

3.2 PREPARATION

A. Complete roof deck construction before beginning roofing work:
   1. Curbs, blocking, edge strips, and other components to which roofing and base flashing is attached in place ready to receive insulation and roofing.
   2. Coordinate roofing membrane installation with flashing work and roof insulation work so insulation and flashing are installed concurrently to permit continuous roofing operations.
   3. Complete installation of flashing, insulation, and roofing in same day except for the area where temporary protection is required when work is stopped for inclement weather or end of work day.

B. Dry out surfaces // including roof deck flutes, // that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates, only.

C. Broom clean roof decks. Remove dust, dirt and debris.

D. Remove projections capable of damaging roofing materials.

E. Concrete Decks, except Insulating Concrete:
   1. Test concrete decks for moisture according to ASTM D4263 before installing roofing materials.
   2. Prime concrete decks. Keep primer back 100 mm (f4our inches) from precast concrete deck joints.
   3. Allow primer to dry before application of bitumen.

F. Insulating Concrete Decks:
   1. Allow deck to dry out minimum five days after installation before installing roofing materials.
   2. Allow additional drying time when precipitation occurs before installing roofing materials.

G. Existing Membrane Roofs and Repair Areas:
   1. Comply with Section 07 01 50.19 PREPARATION FOR REROOFING.

3.3 TEMPORARY PROTECTION

A. Install temporary protection consisting of a temporary seal and water cut-offs at the end of each day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent.

B. Install temporary cap flashing over top of base flashings where permanent flashings are not in place to protect against water intrusion into roofing system. Securely anchor in place to prevent blow off and damage by construction activities.

C. Temporarily seal exposed insulation surfaces within roofing membrane.

1. Apply temporary seal and water cut off by extending roofing membrane beyond insulation and securely embedding edge of the roofing membrane in 6 mm (1/4 inch) thick by 50 mm (2 inches) wide strip of temporary closure sealant. Weight roofing membrane edge with sandbags, to prevent displacement; space sandbags maximum 2400 mm (8 feet) on center.
2. Direct water away from work. Provide drainage, preventing water accumulation.
3. Check daily to ensure temporary seal remains watertight. Reseal open areas and weight down.

D. Before the work resumes, cut off and discard portions of roof membrane in contact with temporary seal.
   1. Cut minimum 150 mm (6 inches) back from sealed edges and surfaces.

E. Remove sandbags and store for reuse.

SPEC WRITER NOTE: Use pull out tests for decks other than wood and wood blocking.

3.4 INSTALLATION, GENERAL

A. Install products according to manufacturer's instructions // and approved submittal drawings //.
   1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

B. Comply with NRCA Manual installation requirements.

SPEC WRITER NOTE: The code requires roof coverings on fully adhered or mechanically fastened non-ballasted roofs to be tested according to UL 580 or UL 1897.

C. Comply with // UL 580 // UL 1897 // for uplift resistance.

D. Do not allow membrane and flashing to contact surfaces contaminated with asphalt, coal tar, oil, grease, or other substances incompatible with EPDM.

3.5 ROOFING INSTALLATION

A. Install membrane perpendicular to long dimension of insulation boards.

B. Begin membrane installation at roof low point and work towards high point. Lap membrane shingled in water flow direction.

C. Position membrane free of buckles and wrinkles.

D. Roll membrane out; inspect for defects as membrane is unrolled. Remove defective areas:
   1. Allow 30 minutes for membrane to relax before proceeding.
   2. Lap edges and ends minimum 75 mm (3 inches). Clean lap surfaces.
   3. Install seam adhesive or tape, unless furnished with factory applied adhesive strips. Apply pressure to develop full adhesion.
   4. Check seams to ensure continuous adhesion and correct defects.
   5. Finish seam edges with beveled bead of lap sealant.
   6. Finish seams same day as membrane is installed.
   7. Anchor membrane perimeter to roof deck and parapet wall as indicated on drawings.

E. Membrane Perimeter Anchorage:
   1. Install batten with fasteners at perimeter of each roof area, curb flashing, expansion joints and similar penetrations on top of roof membrane as indicated on drawings.
   2. Mechanical Fastening:
      a. Space fasteners maximum 300 mm (12 inches) on center, starting 25 mm (1 inch) from ends.
      b. When battens are cut, round edge and corners before installing.
      c. Set fasteners in lap sealant and cover fastener head with fastener sealer, including batten.
      d. Stop batten where batten interferes with drainage. Space ends of batten 150 mm (6 inch) apart.
      e. Cover batten with 225 mm (9 inch) wide strip of flashing sheet. Seal laps with lap seam adhesive and finish edges with lap sealant.
      f. At // gravel stops // fascia-cants // turn roofing membrane down over front edge of blocking, cant, or nailer. Secure roofing membrane to vertical portion of nailer; with fasteners spaced maximum 150 mm (6 inches) on centers.
      g. At parapet walls intersecting building walls and curbs, secure roofing membrane to structural deck with fasteners 150 mm (6 inches) on center or as shown in NRCA Manual.

SPEC WRITERS NOTE:
1. Delete Paragraphs F and G if a ballasted system is used.
2. Delete Paragraph G if an adhered system is used.
3. Delete Paragraph F if a mechanically anchored system is used.

F. //Adhered System Installation:

1. Apply bonding adhesive in quantities required by roofing membrane manufacturer.
2. Fold sheet back on itself, clean and coat the bottom side of the membrane and the top of substrate with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturer's instructions, roll roofing membrane into adhesive minimizing voids and wrinkles.
4. Repeat for other half of sheet.
5. Cut voids and wrinkles to lay flat. Clean and patch cut area.//

G. //Mechanical Fastened System Installation:

1. Secure roofing membrane to structural deck with fasteners through battens to achieve specified wind uplift performance.
   a. Drill pilot holes for fasteners installed into cast-in-place concrete. Drill hole minimum 10 mm (3/8 inch) deeper than fastener penetration.
2. When fasteners are installed within membrane laps, locate battens minimum 13 mm (1/2 inch) from edge of sheets.
3. Apply lap sealant under battens and anchor to deck while lap sealant is still fluid. Cover fastener head with fastener sealer.
4. Where fasteners are installed over roofing membrane after seams are welded, cover fasteners with minimum 200 mm (8 inch) diameter EPDM membrane cap centered over fasteners. Where battens are used cover battens with minimum 200 mm (8 inch) wide EPDM strip cap centered over batten. Splice caps to roofing membrane and finish edges with lap sealant.//

H. //Loosely Laid and Ballasted System Installation:

1. Loosely lay roofing membrane.
2. Adhere membrane to comply with ANSI/SPRI RP-4 requirements.//

3.6 FLASHING INSTALLATION

A. Install flashings on same day as roofing membrane is installed. When flashing cannot be completely installed in one day, complete installation until flashing is watertight and provide temporary covers or seals.

SPEC WRITER NOTE:
1. Ensure roof drain flashing details are shown on drawings with sump to depress

notched clamping ring below roof surface.
2. Offset drains in sump to side of steel beams so drain is not above low point when roof slope terminates on top of beam.

B. Flashing Roof Drains:
1. Install roof drain flashing according to roofing membrane manufacturer's instructions.
a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
b. Do not allow roof cement to contact EPDM roofing membrane.
c. Adhere roofing membrane to metal flashing with bonding adhesive.
2. Turn metal drain flashing and roofing membrane down into drain body. Install clamping ring and strainer.

SPEC WRITER NOTE:
1. See NRCA Manual for base flashing details.
2. Use with metal cap flashing.
3. Do not use "pitch pocket" or "sealant pocket" construction detail.
4. Coordinate with sheet metal work to provide metal cap flashing for base flashing on curbs and walls and penetrations.
5. Do not terminate base flashing or membrane edge exposed on top of parapet walls or in reglets on horizontal or sloped wash surface.
6. Terminate only under cap flashings or coping covers except for draw bands on pipe boots and gravel stops.
7. Use 200 mm (8 inch) minimum height for base flashing.

C. Installing Base Flashing and Pipe Flashing:
1. Install flashing sheet to pipes, walls and curbs to minimum 200 mm (8 inches) height above roof surfaces and extend roofing manufacturer's standard lap dimension onto roofing membranes.
a. Adhere flashing with bonding adhesive.
b. Form inside and outside corners of flashing sheet according to NRCA Manual. Form pipe flashing according to NRCA Manual.
c. Lap ends roofing manufacturer's standard dimension.

d. Adhesively splice flashing sheets together, and adhesively splice flashing sheets to roofing membranes. Finish exposed edges with lap sealant.

2. Anchor top of flashing to walls and curbs with fasteners spaced maximum 150 mm (6 inches) on center. Use surface mounted fastening strip with sealant on ducts. Use pipe clamps on pipes or other round penetrations.
3. Apply sealant to top edge of flashing.

D. Installing Building Expansion Joints:

SPEC WRITER NOTE:
1. Do not put expansion joints at roof membrane level.
2. Design joints to be installed on curbs minimum 200 mm (8 inches) high.
3. Detail expansion joint.

1. Install base flashing on curbs as specified.
2. Coordinate installation with // metal expansion joint cover // roof expansion joint system //.
3. Install flexible tubing 1-1/2 times width of joint centered over joint. Cover tubing with flashing sheet adhered to base flashing and lapping base flashing roofing manufacturer's standard dimension. Finish edges of laps with lap sealant.

E. Repairs to Membrane and Flashings:

1. Remove sections of roofing membrane or flashing sheet that are creased, wrinkled, or fishmouthed.
2. Cover removed areas, cuts and damaged areas with patch extending 100 mm (4 inches) beyond damaged, cut, or removed area. Adhesively splice patch to roofing membrane or flashing sheet. Finish edge of lap with lap sealant.

3.7 WALKWAY PAD INSTALLATION

A. Clean membrane where pads are applied.

B. Adhere pads to membrane with splicing cement.

C. Layout with minimum 25 mm (1 inch) and maximum 50 mm (2 inch) space between pads.

3.8 //BALLAST AND// PAVER INSTALLATION

SPEC WRITER NOTES:
1. Use pavers in the following locations as a minimum:
   a. At working and access areas of equipment requiring servicing.

b. At equipment having discharges detrimental to roof membrane, under gooseneck discharges from kitchens and chemical exhausts.
c. At landing points for hatches, ladders, and doors entering roof level.

2. Confirm that walkways and pavers are shown on drawings.
3. Confirm location of aggregate ballast and weight for each location are shown on drawings if not specified.
4. Design the rate of aggregate ballast applied and paver system according to ANSI/SPRI RP-4 for applicable site wind uplift.
5. Aggregate ballast:
   a. Increase weights and size of aggregate for wind design criteria according to ANSI/SPRI RP-4.
   b. When aggregate is used for a fire rated roof system, larger aggregates require greater weights for fire rating.
   c. Specify weights for size aggregate. See Paragraph 3.2.C. Modify aggregate size and weights for fire and wind loads.
   d. Specify weights for roof perimeter, corners and field, for drain areas, and for large penetrations over 0.19 square meter (2 square feet).
   e. Do not use less than 49 kg/square. m (10 pounds/square foot) of aggregate for ballasted membranes requiring fire rating.
   f. Do not use aggregate in hurricane areas.
6. Pavers:
   a. Specify pavers and anchorage for pavers when weight of pavers does not meet the requirements for wind velocities according to ANSI/SPRI RP-4.
   b. Pavers without interlocking connectors require strapping together and edge clamps when pavers do not provide minimum weight for wind uplift resistance.
   c. Use mechanical strapping to create perimeter anchor, at penetrations, cuts at valleys, over drains, and where partial or cut units occur.
   d. Detail strapping, perimeter restraints, edge clamps and location of strapping. Do not

anchor through base flashing or into cants.

e. Interlocking connectors:
   1) Use 400 mm (16 inches) on center minimum spacing of connectors.
   2) Decrease spacing to 300, 200, or 100 mm (12, 8, or 4 inches) on center for greater wind velocities.

A. Install ballast and pavers as soon as roof membrane is installed.

B. Protective underlayment installation under ballast:
   1. Loose lay protection mat or separator sheet over roofing membrane smooth and free of tension and stress without wrinkles. Do not stretch sheet.
   2. Use full sheet width at perimeters with end laps held back minimum 3 m (10 feet) from roof edge at corners.
   3. Lap ends minimum 300 mm (one foot).
   4. Extend 50 to 75 mm (2 to 3 inches) above ballast at perimeter and penetrations.

C. //Aggregate Installation:
   1. Except where pavers are used, uniformly distribute aggregate over protective underlayment.
   2. Place // _____ // kg/square meter (// _____ // pounds/square foot) over a 1800 mm (6 foot) wide area around perimeter, for 3300 mm (11 foot) square corner area, for 1200 mm (4 foot) square area around drains, and 1200 mm (4 foot) wide area around penetrations over 600 mm (2 feet) square more than 1800 mm (6 feet) from the roof edge.
   3. Place // _____ // kg/ square meter (// _____ // pounds/square foot) over remaining roof areas.
   4. Pavers may be substituted for aggregate over entire roof area.
      a. Paver Weight: As specified for aggregate, unless interlocking type or strapped together and clamped down at roof edge.
      b. Interlocking pavers as required for wind exposure conditions and fire protection.//

D. Paver Installation:
   1. Saw cut or core drill pavers for cut units.
   2. Install pavers with butt joints in running bond with minimum one half-length units at ends.

a. Stagger end joints; generally locate joints near midpoint of adjacent rows, except where end joints occur in valleys. Miter end joints to fit in valleys.

b. Cut to fit within 13 mm (1/2 inch) of penetrations.

3. Install interlocking connectors in channel units for complete tie in of units, including cut units. Use corner spacings for distance of 1200 mm (4 feet) or more around roof drains, penetrations, and other vertical surfaces in field of roof area. Comply with roof load and uplift resistance requirements.

a. Space connectors at // _____ // mm (// _____ // inches) on center at corners for 3 meter (10 foot) square area.

b. Space connectors at // _____ // mm (// _____ // inches) on center at perimeter for 1800 mm (6 foot) wide strip.

c. Space connectors at // _____ // mm (// _____ // inches) on center in field.

d. Install pavers under perimeter retainer as shown on drawings.

4. Install strapping where shown.

a. Limit strap lengths to maximum of 9 meters (30 feet).

b. Install straps at corner connection to perimeter retainer at approximately 45 degree angle at approximately 3 to 3.6 meters (10 to 12 feet) from corner.

c. Install straps on both sides of valleys, hips, and ridges, with cross straps spaced maximum 1200 mm (4 feet) on center between end straps.

d. Install straps at perimeter of penetrations more than two pavers in width or length.

e. Anchor straps to each paver with two fasteners per unit.

f. Pre-drill holes for fasteners in pavers.

3.9 FIELD QUALITY CONTROL

SPEC WRITER NOTES:
Section 01 45 29, TESTING LABORATORY SERVICES includes VA provided testing for large projects and contractor provided testing for small projects. Coordinate testing responsibility.

A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

SPEC WRITER NOTE: ANSI/SPRI FX-1 sets testing frequency as 10 tests for first

4,650 square meter (50,000 square foott.) and five tests for each additional 4,650 square meter (50,000 square foot). Specify frequency to suit project conditions.

1. Fastener Pull Out Tests: ANSI/SPRI FX-1; one test for every 230 square meter (2,500 square foot) of deck. Perform tests for each combination of fastener type and roof deck type before installing roof insulation.
   a. Test at locations selected by Contracting Officer's Representative.
   b. Do not proceed with roofing work when pull out resistance is less than manufacturer's required resistance.
   c. Test Results:
      1) Repeat tests using different fastener type or use additional fasteners achieve pull out resistance required to meet specified wind uplift performance.
      2) Patch cementitious deck to repair areas of fastener tests holes.
2. Examine and probe roofing membrane and flashing seams in presence of Contracting Officer's Representative and Manufacturer's field representative.
3. Probe seams to detect marginal bonds, voids, skips, and fishmouths.
4. Cut 100 mm (4 inch) wide by 300 mm (12 inch) long samples through seams where directed by Contracting Officer's Representative.
5. Cut one sample for every 450 meter (1500 feet) of seams.
6. Cut samples perpendicular to seams.
7. Failure of samples to pass ASTM D1876 test will be cause for rejection of work.
8. Repair areas where samples are taken and where marginal bond, voids, and skips occur.
9. Repair fishmouths and wrinkles by cutting to lay flat. Install patch over cut area extending 100 mm (4 inches) beyond cut.

B. //Manufacturer Services:
   1. Inspect initial installation, installation in progress, and completed work.
   2. Issue supplemental installation instructions necessitated by field conditions.
   3. Prepare and submit inspection reports.

4. Certify completed installation complies with manufacturer's instructions and warranty requirements.//

3.10 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed roofing surfaces. Remove contaminants and stains // to comply with specified solar reflectance performance //.

3.11 PROTECTION

A. Protect roofing system from // traffic and // construction operations.
   1. Protect roofing system when used for subsequent work platform, materials storage, or staging.
   2. Distribute scaffolding loads to exert maximum 50 percent roofing system materials compressive strength.

B. Loose lay temporary insulation board overlaid with plywood or OSB.
   1. Weight boards to secure against wind uplift.

C. Remove protection when // no longer required // when directed by Contacting Officer's Representative //.

D. Repair damage.

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