SECTION 07 51 13.13
COLD-APPLIED BUILT-UP ASPHALT 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. 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.
6. Terminate base flashings minimum 200 mm (8 inches) above roof surface including curb for building expansion joints.
7. Do not put expansion joints at roof surface level.
8. Do not use "pitch pockets" or "sealant pockets" in lieu of base flashings and cap flashings.
9. 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.
10. 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. Cold-applied bituminous [hybrid] built-up roofing with // solar reflective granular coating // solar reflective aggregate surfacing // smooth surface with applied solar reflective coating //.

1.2 RELATED REQUIREMENTS

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

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

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

C. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.

D. Sheet Metal Components and Wind Uplift Requirements for Roof-Edge Design: Section 07 60 00, FLASHING AND SHEET METAL.

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

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):

1. FX-1-01(R2006) - Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

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

1. 7-10 - Minimum Design Loads for Buildings and Other Structures.

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

1. 90.1-13 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ASTM International (ASTM):

1. C1370-00(R2012) - Determining Chemical Resistance of Aggregates for Use in Chemical-Resistant Sulfur Polymer Cement Concrete and Other Chemical-Resistant Polymer Concretes.
2. C1371-15 - Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
3. C1549-09(2014) - Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.

4. D146/D146M-04(2012)e1 - Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing.
5. D1644-01(2012) - Nonvolatile Content of Varnishes.
6. D1863/D1863M-05(2011)e1 - Mineral Aggregate Used on Built-Up Roofs.
7. D2178/D2178M-15a - Asphalt Glass Felt Used in Roofing and Waterproofing.
8. D2523-13 - Testing Load-Strain Properties of Roofing Membranes.
9. D3909/D3909M-14 - Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules.
10. D4073-06(2013) - Tensile-Tear Strength of Bituminuous Roofing Membranes.
11. D4263-83(2012) - Indicating Moisture in Concrete by the Plastic Sheet Method.
12. D4586/D4586M-07(2012)e1 - Asphalt Roof Cement, Asbestos Free.
13. D4601/D4601M-04(2012)e1 - Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
14. D4897/D4897M-01(2009) - Asphalt Coated Glass Fiber Venting Base Sheet Used in Roofing.
15. D5147/D5147M-14 - Sampling and Testing Modified Bituminous Sheet Material.
16. D5201-05a(2014) - Calculating Formulation Physical Constants of Paints and Coatings.
17. D6162/D6162M-00A(2015)e1 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
18. D6163/D6163M-00(2015)e1 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
19. D6164/D6164M-11 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
20. D6511/D6511M-06(2011)e1 - Solvent Bearing Bituminous Compounds.
21. E108-11 - Fire Tests of Roof Coverings.
22. E408-13 - Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
23. E1918-06(2015) - Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
24. E1980-11 - Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

F. Cool Roof Rating Council (CRRC):

1. 1-15 - Product Rating Program.

G. National Roofing Contractors Association (NRCA):

1. Manual -15 - The NRCA Roofing Manual: Membrane Roof Systems.

H. U.S. Department of Agriculture (USDA):

1. BioPreferred® Program Catalog.

I. UL LLC (UL):

1. 580-06 - Tests for Uplift Resistance of Roof Assemblies.
2. 1897-15 - Uplift Tests for Roof Covering Systems.

J. U.S. Department of Commerce National Institute of Standards and Technology (NIST):

1. DOC PS 1-09 - Structural Plywood.
2. DOC PS 2-04 - Performance Standard for Wood-Based Structural-Use Panels.

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

1. EPA 600/R-93/116-93 - Method for the Determination of Asbestos in Bulk Building Materials.

SPEC WRITER NOTE: Energy Star Version 2.3 is in effect until June 30, 2017. Version 3.0 becomes effective July 1, 2017.

2. Energy Star - ENERGY STAR Program Requirements for Roof Products // Version 2.3. // Version 3.0. //

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at 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.

C. Manufacturer's Literature and Data:
   1. Description of each product.
   2. Minimum fastener pullout resistance.
   3. Installation instructions.
   4. Warranty.

D. 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.

E. Sustainable Construction Submittals:

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

1. Solar Reflectance Index (SRI) for roofing membrane.
2. Biobased Content:
   a. Show type and quantity for each product.
3. Low Pollutant-Emitting Materials:
   a. Show volatile organic compound types and quantities.
4. Energy Star label for roofing membrane.

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 instructions.

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) for minimum 48 hours 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: Cold-applied bituminous [hybrid] built-up roofing with // solar reflective granular coating // solar reflective aggregate surfacing // smooth surface with applied solar reflective coating //.

2.2 SYSTEM PERFORMANCE

A. Design roofing system complying with specified performance:

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

SPEC WRITER NOTE: Specify actual loads when known for project.

a. Uplift Pressures:

1) Corner Uplift Pressure: // _____ // kPa/sq. m (// _____ // psf).

2) Perimeter Uplift Pressure: // _____ // kPa/sq. m (// _____ // psf).

3) Field-of-Roof Uplift Pressure: // _____ // kPa/sq. m (// _____ // psf).

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 (EPAct).
c. Energy Independence and Security Act of 2007 (EISA).
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 W/sq. m/degree K (2.1 BTU/h/sq. ft.) convection coefficient.

SPEC WRITER NOTE: Edit load strain properties below to represent tensile strength of specified roof system; this allows for comparison of differing but comparably-performing systems. Default tensile strain value of 2.67 kN (600 lbf.) is recommended for roof membranes isolated from roof deck by insulation values in excess of R30, which corresponds to ASHRAE 90.1 minimum requirements. High insulation values result in high daily thermally-induced tensile strain values on conventionally-located roof membranes.

B. 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:

C. Tensile strain at failure, at -18 degrees C (0 degrees F): // 2.67 kgf (600 lbf.) // cross machine direction, minimum; // 4.0 to 5.5 // percent elongation at break.

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:

1. Solar Reflectance Index: 78 minimum.

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.

2. Biobased Content: 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.

3. 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 MEMBRANE AND SHEET MATERIALS

A. Membrane Materials, General: Provide combination of base, ply, and cap sheet materials that have been tested in combination and comply with specified load/strain performance.

SPEC WRITER NOTE: Retain venting base sheet below when required as part of 2- or 3- ply system over a lightweight insulating concrete substrate.

B. Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated and as approved by modified bitumen roof membrane manufacturer.

SPEC WRITER NOTE: Retain base sheet below when required as part of 2- or 3- ply system.

C. Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, with the following properties:
   1. Breaking Strength, minimum, ASTM D146/D146M: cross machine direction, 12.2 kN/m (70 lbf/in).
   2. Pliability, 12.7 mm (1/2 inch) radius bend, ASTM D146/D146M: No failures.

SPEC WRITER NOTE: Retain base sheet below when required as part of 2- or 3- ply high tensile strength system.

D. Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, with the following properties:
   1. Breaking Strength, minimum, ASTM D146/D146M: cross machine direction, 21.0 kN/m (120 lbf/in).
   2. Tear Strength, minimum, ASTM D4073: cross machine direction, 880 N (200 lbf.).
   3. Pliability, 12.7 mm (1/2 inch) radius bend, ASTM D146/D146M: No failures.

SPEC WRITER NOTE: Retain paragraph below for ply sheets set in cold-applied adhesive. Do not use ASTM D2178/D2178M sheets with cold adhesive.

E. Ply Sheet: ASTM D4601/D4601M, Type II, nonperforated, with the following properties:
   1. Breaking Strength, minimum, ASTM D146/D146M: machine direction, 16.0 kN/m (90 lbf/in); cross machine direction, 12.0 kN/m (70 lbf/in).

SPEC WRITER NOTE: Retain smooth-surfaced sheet below as the cap sheet for a multi-ply system to receive a field-applied coating or aggregate surfacing. Certain aggregate surfacing systems meet Class A fire-test requirements.

F. Cap Sheet: Same as ply sheet.

G. Cap Sheet: ASTM D3909/D3909M.

SPEC WRITER NOTE: Following are three SBS cap sheet options for use in hybrid roofing installation. All optional cap sheets below meet surface burning characteristic requirements for Class A.

H. Cap Sheet: ASTM D6163/D6163M, Grade G, Type II, and as follows:
   1. Exterior Fire-Test Exposure, ASTM E108: Class A.
   2. Tensile Strength at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 24 kN/m (140 lbf/in).
   3. Tear Strength at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 880 N (200 lbf.).
   4. Elongation at 23 degrees C (73 degrees F), minimum, cross machine direction, at 5 percent maximum load ASTM D5147/D5147M: 40 percent.
   5. Low Temperature Flex, maximum, ASTM D5147/D5147M: -31 degrees C (-25 degrees F).

SPEC WRITER NOTE: Retain cap sheet below as part of system where Class A fire-test roof surface is required and surface must meet solar reflectance and emittance requirements.

I. Cap Sheet: ASTM D6163/D61636M, Grade G, Type II, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced with a factory applied, white, reflective, acrylic coating; CRRC listed and California Title 24 Energy Code compliant; and as follows:
   1. Exterior Fire-Test Exposure, ASTM E108: Class A.
   2. Tensile Strength at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 12.2 kN/m (70 lbf/in).
   3. Tear Strength at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 440 N (100 lbf.).
   4. Elongation at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 7.5 percent.
   5. Low Temperature Flex, maximum, ASTM D5147/D5147M, -26 degrees C (-15 degrees F).
   6. Reflectance, ASTM C1549: 71 percent.
   7. Thermal Emittance, ASTM C1371: 0.87.
   8. Solar Reflectance Index (SRI), ASTM E1980: 87.

SPEC WRITER NOTE: Retain cap sheet below as part of high tensile strength system where Class A fire-test roof surface is

required and surface must meet solar reflectance and emittance requirements.

J. Cap Sheet: ASTM D6162/D6162M, Grade G, Type III, composite polyester and glass-fiber-reinforced, SBS/SEBS-modified asphalt sheet; granular surfaced with a factory applied, white, reflective, acrylic coating; CRRC listed and California Title 24 Energy Code compliant; and as follows:
   1. Exterior Fire-Test Exposure, ASTM E108: Class A.
   2. Tensile Strength at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 84 kN/m (480 lbf/in).
   3. Tear Strength at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 330 N (750 lbf.).
   4. Elongation at 23 degrees C (73 degrees F), minimum, cross machine direction, ASTM D5147/D5147M: 6 percent.
   5. Low Temperature Flex, maximum, ASTM D5147/D5147M, -26 degrees C (-15 degrees F).
   6. Reflectance, ASTM C1549: 75 percent.
   7. Thermal Emittance, ASTM C1371: 0.86.
   8. Solar Reflectance Index (SRI), ASTM E1980: 92.

K. Base Flashing Backer Sheet: ASTM D4601/D4601M, Type II.

L. Base Flashing Sheet: ASTM D6164/D6164M, Grade G, Type II, polyester-reinforced, SBS-modified asphalt sheet; with granular surface; Granule Color: White.

2.5 ADHESIVE AND ASPHALT MATERIALS

A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.

B. Water-Based Asphalt Primer: Water-based, polymer modified, asphalt primer with the following physical properties:
   1. Asbestos Content, EPA 600/R-93/116: None.

C. Cold-Applied Adhesive for Sheet Membrane: One-part, asbestos-free, low-volatile organic compound, cold-applied adhesive compatible with specified roofing membranes and flashings, with the following physical properties:
   1. Asbestos Content, EPA 600/R-93/116: None.
   2. Nonvolatile Content, minimum, ASTM D6511/D6511M: 75 percent.
   3. Uniformity and Consistency, ASTM D6511/D6511M: Pass.

D. Cold-Applied Adhesive for Membrane Flashing: One-part, cold-applied adhesive compatible with specified roofing membranes and flashings, with the following physical properties:
   1. Asbestos Content, EPA 600 R-93/116: None.
   2. Nonvolatile Content, minimum, ASTM D6511/D6511M: 75 percent.
   3. Uniformity and Consistency, ASTM D6511/D6511M: Pass.
E. Roof Cement: ASTM D4586/D4586M, Type II.

2.6 FASTENERS

A. Roofing Fasteners: Coated, corrosion-resistant steel fasteners and metal or plastic plates, where applicable, tested by fastener manufacturer for required uplift resistance, and recommended by roofing manufacturer for application.
B. Accessory Fasteners: Corrosion-resistant fasteners compatible with adjacent materials and recommended for application by manufacturer of component to be fastened.

2.7 SURFACING AND COATINGS

SPEC WRITER NOTE: Select aggregate type from three listed below. Third aggregate meets solar reflective requirements in combination with white cold applied surfacing adhesive listed below.

A. Aggregate Surfacing, Stone: ASTM D1863/D1863M, except the use of crushed stone is prohibited.
B. Aggregate Surfacing, Slag or Gravel: Use slag on slopes over 1: 10 (1 inch per 12 inches).
C. Aggregate Surfacing, Solar Reflective: White marble aggregate, Solar Reflectance Index (SRI) when applied with specially formulated white adhesive, Hardness 3.5 Mohs.
D. Aggregate Surfacing Adhesive: Cold-applied surfacing adhesive, formulated for fire-resistant properties.
E. Aggregate Surfacing Adhesive, Solar Reflective: One-part, white, highly reflective polymeric surfacing adhesive, CRRC listed and California Title 24 Energy Code compliant when combined with approved white gravel, with following physical properties:
   1. Asbestos Content, EPA 600 R-93/116: None.
   2. Nonvolatile Matter, minimum ASTM D6511/D6511M: 50 percent.
   3. Reflectance (adhesive plus aggregate), ASTM C1549: 71 percent.
      a. Thermal emittance (adhesive plus aggregate), ASTM C1371: 0.85.

b. Solar Reflectance Index (SRI), adhesive plus gravel, ASTM E1980: 86.

SPEC WRITER NOTE: When cap sheet does not meet solar reflectance requirements, select one of two coatings below. Select second coating when required to meet combustibility requirements of authorities having jurisdiction. Note that use of applied coating may introduce maintenance requirement on 5 to 7 year basis.

F. White Roof Coating: Water-based, Energy Star Certified, CRRC listed and California Title 24 Energy Code compliant elastomeric roof coating formulated for use on bituminous roof surfaces, with the following physical properties:
   1. Asbestos Content, EPA/600/R13/116: None.
   2. Non-Volatile Content (by weight), minimum, ASTM D1644: 60 percent.
   3. Percent Solids (by volume), minimum, ASTM D5201: 60 percent.
   4. Reflectance, minimum, ASTM C1549: 86 percent.
   5. Emissivity, minimum, ASTM C1370: 0.93.
   6. Solar Reflectance Index (SRI), ASTM E1980: 103.

G. White Roof Coating: Intumescent, fire-retardant, Energy Star Certified, CRRC listed and California Title 24 Energy Code compliant, elastomeric, acrylic latex roof coating formulated for use on bituminous roof surfaces, with the following physical properties:
   1. Asbestos Content, EPA/600/R13/116: None.
   2. Non-Volatile Content (by weight), minimum, ASTM D1644: 67 percent.
   3. Reflectance, minimum, ASTM C1549: 82 percent.
   4. Solar Reflectance Index (SRI), ASTM E1980: 103.

2.8 ROOF WALKWAY

A. Prefabricated asphalt plank consisting of a homogeneous core of asphalt, plasticizers and inert fillers, bonded by heat and pressure between two saturated and coated sheets of felt:
   1. Top side of plank surfaced with ceramic granules. Granule Color: White.
   2. Size: Minimum 13 mm (1/2 inch) thick, manufacturer’s standard size, but minimum 300 mm (12 inches) in least dimension and 600 mm (24 inches) in length.

2.9 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 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 commencing roofing work:

1. Curbs, blocking, edge strips, nailers, cants, 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, including precast units, with primer as specified. Keep primer back 100 mm (4 inches) from precast concrete deck joints.
3. Allow primer to dry before application of bitumen.

F. Insulating Concrete Decks:
1. Allow to dry out minimum five days after installation before installing roofing materials.
2. If rain occurs during or at end of drying period or during installation of roofing, allow additional drying time before the placement of the roofing materials.

G. Poured Gypsum Decks: Dry out poured gypsum according to manufacturer's instructions before application of roofing materials.

H. Existing Membrane Roofs and Repair Areas:
1. Comply with requirements in 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.

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 instructions.

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.

3.5 INSTALLATION OF BUILT-UP BITUMINOUS ROOFING

SPEC WRITER NOTE:
1. Delete substrates and listings of components and quantities which do not apply.
2. Include the requirement for base sheet or venting base sheet when roofing is uninsulated. Do not include this requirement when the roof is insulated per Section 07 22 00 or the substrate is plywood.

A. Primer: Apply primer to substrates where recommended by roofing manufacturer, in application quantities recommended by roofing manufacturer.

B. Cold-Applied Adhesive:

1. Apply cold-applied adhesive in a uniform application at rate recommended by manufacturer.

C. Built-Up Membrane Sheets:

1. Number of Plies: Four, minimum, including cap sheet, and not including base sheet if any. Provide additional plies as required to meet load/strain properties specified in Part 2 of this Section.
2. Begin laying sheets at low points.

3. Roll sheets into cold-applied adhesive brushing down to firmly embed, free of wrinkles, fish mouths, blisters, bubbles, voids, air pockets or other defects that prevent complete adhesion:
4. Cut to fit closely around pipes, roof drains, bitumen stops, and similar roof projections.
5. Lap sheets shingle fashion starting with starter strips at right angles to slope of roof.
6. Laps for base sheet and ply sheets:
   a. Base sheet, lapped 50 mm (2 inches).
   b. Two plies with 450 mm (18 inches) and 900 mm (36 inch) starting widths, lapped 480 mm (19 inches).
   c. Three plies with 300 mm (12 inches) 600 mm (24 inches) and 900 mm (36 inch) starting widths, lapped 624 mm (24-1/2 inches).
   d. Four plies with 230, 460, 690 and 900 mm (9, 18, 27 and 36 inch) starting widths, lapped 700 mm (27-1/2 inches).
   e. End joints of ply and base sheet, lapped 50 mm (2 inches). Stagger end joints in relation to joints in adjacent and proceeding plies.

SPEC WRITER NOTE: Use venting base sheet over all insulating concrete and poured gypsum decks to relieve possible vapor pressures that may occur.

D. Roofing on Nailable Decks:
1. On insulating concrete, install one ply of venting base sheet with mineral aggregate surface down, nailed to deck with lap as specified and seal lap edges with roof cement. Terminate venting base sheet as follows:
   a. At vertical surfaces: Extend venting base sheet up vertical surface over cants to top of base flashing or curb.
   b. At roof edge under gravel stops install venting base sheet over blocking: Extend base sheet minimum50 mm (2 inches) beyond outer edge and turn down so that venting can be accomplished.
   c. At roof edge over fascia-cant: Extend base sheet over top of cant and turn down over outer face of cant to permit venting at the edge.
2. On poured gypsum, precast gypsum plank, cement-wood fiber plank, wood plank, or plywood decks install one layer of building paper followed by base sheet.

a. Apply building paper lapping ends and edges 50 mm (two inches) Lay smoothly without buckles or wrinkles. Staple or nail sufficiently to hold in place until roof membrane is installed.

b. One ply of venting base sheet. Lay base sheet down dry on deck, Nail as specified. Lap as specified and seal lap edges with roof cement.

E. Roof Edges and Terminations:

SPEC WRITER NOTES:
1. Ensure details show all wood nailers used in conjunction with roofing and sheet metal components of roofing system.
2. Refer to NRCA details for various conditions.
3. Use cants at vertical surfaces except for pipes.

1. Where nailers occur at roof edges under gravel stops or penetrations to receive metal base flashing, apply a continuous strip of underlayment over the nailers before the first ply sheet is applied. Strip shall be installed on top of venting base sheet if any.
2. After membrane is installed, turn the underlayment back over the roofing, and secure in place with cold-applied adhesive before gravel stops or other metal flanges extending out onto the membrane are installed.
3. Where cants occur at vertical surfaces, cut off roofing sheets 50 mm (2 inches) above top of cant strips, except at prefabricated curbs, scuttles and other roof accessories having integral cants, extend membrane over cant and up vertical surface to top of curb or nailer as shown.
4. Where fascia-cant occurs at roof edges, extend membrane beyond outside cant face and cut off at outside after base flashing is installed.
5. Where reglet occurs at vertical surfaces, extend plies roofing sheets up into reglet the full depth of the reglet.

SPEC WRITER NOTE: Use base sheet over wood and composite wood decks and where recommended by roofing system manufacturer.

F. Base Sheet Installation:

1. One ply of base sheet dry to deck, except mop between laps. Lap and attach as specified to deck.

SPEC WRITER NOTE: Use venting base sheet over insulating concrete and poured gypsum decks to relieve vapor pressures.

G. Venting Base Sheet Installation:
   1. At vertical surfaces: Extend venting base sheet up vertical surface over cants to top of base flashing or curb.
   2. At roof edge under gravel stops install venting base sheet over blocking: Extend base sheet minimum 50 mm (2 inches) beyond outer edge and turn down to allow venting at the edge.
   3. At roof edge over fascia-cant: Extend base sheet over top of cant and turn down over outer face of cant to allow venting at the edge.

H. Roof Ply Installation:
   1. Extend first ply sheet 100 mm (4 inches) beyond the insulation and the second ply sheet 75 mm (3 inches) beyond the first. Lap ends 75 mm (3 inches) with joints broken 450 mm (18 inches) in each ply.

SPEC WRITER NOTE: Retain and edit paragraph and subparagraphs below when SBS modified bitumen sheet is used as cap sheet.

I. Cap Sheet Installation:
   1. Install cap sheet in a solid application of cold-applied adhesive.
   2. Extend cap sheet 100 mm (4 inches) beyond the underlying ply 75 mm (3 inches). Lap ends 75 mm (3 inches) with joints broken 450 mm (18 inches) in each ply.

3.6 BASE FLASHING

A. Prime vertical surfaces of masonry and concrete with asphalt primer except where vented base sheet is required to provide edge venting.

B. Apply flashing on top of built-up roofing, up face of cant and vertical surfaces, at least 200 mm (8 inches) above the roof, full height beneath counter flashing or top of curb flashing:
   1. At fascia-cants, extend to top of cant and cut off.
   2. Extend plies of roofing into reglet the full depth of the reglet.

C. Except at metal fascia cants, secure top edge of base flashing with nails on a line approximately one inch below top edge, spaced maximum 200 mm (8 inches) on center.

1. Cover all nail heads with roof cement.
2. Cover the top of the base flashing with counter flashing as specified in Section 07 60 00, FLASHING AND SHEET METAL. At the cants secure the top edge of the flashing with fascia compression clamp as specified in Section 07 60 00, FLASHING AND SHEET METAL.

D. Install flashing using longest pieces practicable. Complete splices between flashing and main roof sheet before bonding to vertical surface. Seal splice minimum 76 mm (3 inches) beyond fasteners that attach membrane to blocking. Apply bonding adhesive to both flashing and surface to which flashing is being adhered per manufacturer recommendations. Nail top of flashing 300 mm (12 inches) on center under metal counter flashing or cap.

1. Parapet Walls: Extend up parapet and turn over top edge. Apply with 100 percent adhesive.

E. Install flashing over cants to make system watertight.

F. Install flashing before final roofing coat and aggregate are installed.

3.7 APPLICATION OF COATING

A. Apply coating on cap sheet and membrane flashings that do not meet solar reflectance requirements.

B. Apply coating to built-up roofing and base flashings according to manufacturer's instructions by spray or roller.

C. Provide dry film thickness of minimum 0.5 mm (20 mils).

3.8 STRIPPING

A. Set flanges of metal flashing in roof cement before the final bituminous coat and roof aggregate are installed and nail to blocking per Section 07 60 00, FLASHING AND SHEET METAL.

B. Before the final bituminous coat and aggregate are installed, cover that portion of the horizontal flanges of metal base flashing, gravel stops and other flanges, extending onto the roofing with flashing sheet.

3.9 AGGREGATE SURFACING

A. After bituminous base flashing and stripping has been installed, uniformly coat the entire roof surface, except cants, with bitumen pour coat at the rate scheduled.

B. Embed aggregate to cover the roofing sheet completely without bare spots, but minimum 20 kg/sq. m (400 lbs./100 sq. ft.) of dry gravel or

15 kg/sq. m (300 lbs./100 sq. ft.) of dry slag per. Do not leave any exposed bitumen.

C. Do not embed aggregate under roof walkways.

D. In cold weather preheat aggregate before application.

E. Do not place aggregate material in piles or rows on bare or glaze coated felt.

F. If aggregate surfacing is delayed, promptly apply glaze coat of cold-applied adhesive at rate scheduled.

3.10 WALKWAY INSTALLATION

SPEC WRITER NOTES:
1. Use walkways 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. Show extent of walkways on roof plan.

A. Install roof walkways where shown.

B. Set prefabricated planks in solid application of cold-applied adhesive. Maintain 75 mm (3 inch) to 150 mm (6 inch) space between planks.

3.11 FIELD QUALITY CONTROL

A. Field Inspections:

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

B. 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 sq. m (50,000 sq. ft.) and five tests for each additional 4,650 sq. m (50,000 sq. ft.). Specify frequency to suit project conditions.

1. Fastener Pull Out Tests: ANSI/SPRI FX-1; one test for every 230 sq. m (2,500 sq. ft.) 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 m (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.

C. 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.

3.12 CLEANING

A. Remove excess adhesive before adhesive sets.

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

3.13 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 protective materials immediately before acceptance.

D. Repair damage.

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