

## 1.1 DESCRIPTION

## 1.2 RELATED WORK

- ### 1.3 APPLICABLE PUBLICATIONS

- 460-12-204  
07 51 00.13 - 1

C1371-04.....	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
C1549-04.....	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
D146-04.....	Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
D1644-01 (R2006) .....	Standard Test Methods for Nonvolatile Content of Varnishes
D1863-05.....	Mineral Aggregate Used on Built-Up Roofs
D2178-04.....	Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
D2523-00 (R2006) .....	Standard Practice for Testing Load-Strain Properties of Roofing Membranes
D2823-05.....	Standard Specification for Asphalt Roof Coatings, Asbestos Containing
D3909-97 (2004) .....	Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
D3960-05.....	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D4073-06.....	Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes
D4263-83 (R2005) .....	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
D4586-07.....	Asphalt Roof Cement, Asbestos Free
D4601-04.....	Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
D4897-01.....	Asphalt Coated Glass Fiber Venting Base Sheet Used in Roofing
D5147-07.....	Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
D5201-05 (R2010) .....	Standard Practice for Calculating Formulation Physical Constants of Paints and Coatings
D6162-00 (R2008) .....	Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a

- Combination of Polyester and Glass Fiber Reinforcements
- D6163-00 (R2008) ..... Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
- D6164-05 ..... Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
- D6511-06 ..... Standard Test Methods for Solvent Bearing Bituminous Compounds
- E108--10 ..... Standard Test Methods for Fire Tests of Roof Coverings
- E408-71 (R2008) ..... Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
- E1918-06 ..... Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E1980-01 ..... Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- WK29032-10 ..... Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
- F. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- ASHRAE 90.1-2007 ..... Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix f.
- G. Cool Roof Rating Council:
- CRRC-1 ..... Product Rating Program, [www.coolroofs.org](http://www.coolroofs.org)
- H. FM Approvals: RoofNav Approved Roofing Assemblies and Products.
- 4450-89 ..... Approved Standard for Class 1 Insulated Steel Deck Roofs
- 4470-10 ..... Approved Standard for Class 1 Roof Coverings
- 1-28-09 ..... Loss Prevention Data Sheet: Design Wind Loads.
- 1-49-09 ..... Loss Prevention Data Sheet: Perimeter Flashing

- I. National Roofing Contractors Association: Roofing and Waterproofing Manual
- J. U.S. Environmental Protection Agency (EPA):  
EPA 600/R13/116-02.....Method for the Determination of Asbestos  
in Bulk Building Materials
- K. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog,  
[www.biopreferred.gov](http://www.biopreferred.gov)
- L. U.S. Department of Energy (DoE): Roof Products Qualified Product  
List, [www.energystar.gov](http://www.energystar.gov)

#### **1.4 PERFORMANCE REQUIREMENTS**

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

#### **1.5 QUALITY CONTROL**

- A. Installer Qualifications:
  - 1. Licensed or approved in writing by manufacturer to perform work under warranty requirements of this Section.
  - 2. Employ full-time supervisors knowledgeable and experienced in roofing of similar types and scopes, and able to communicate with owner and workers.
- B. Inspector Qualifications: Inspection of work by third-party technical inspector or technical representative of manufacturer experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty

certification. The Roofing Inspector shall be one of the following:

1. An authorized full-time technical employee of the manufacturer, not engaged in the sale of products.
2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute (RCI), retained by the Contractor or the Manufacturer and approved by the Manufacturer.

C. Product/Material Requirements:

1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.
2. Provide manufacturer's certification that field applied bituminous coatings and mastics, and field applied roof coatings comply with limits for Volatile Organic Compounds (VOC) per the National Volatile Organic Compound Emission Standards for Architectural Coatings pursuant to Section 183(e) of the Clean Air Act with limits as follows:
  - a. Bituminous Coatings and Mastics: 500 g/l (4.2 lb/gal.).
  - b. Roof Coatings: 250 g/l (2.1 lb/gal.).
3. 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](http://www.biopreferred.gov).

D. Roofing system design standard requirements:

1. Recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to modified bituminous sheet roofing for storage, handling and application.
2. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
3. Recommendations of ANSI/SPRI ES-1 for roof edge design.

SPEC WRITER NOTE: Retain paragraph below and enter required uplift pressures if roofing system is required to be designed per ASCE.SEI 7 by local building code.

4. Roofing System Design: Provide roofing system that is identical to systems that have been successfully tested by a

qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

- a. Corner Uplift Pressure: //00 kPa/sq. m (00 lbf/sq. ft.)//.
- b. Perimeter Uplift Pressure: //00 kPa/sq. m (00 lbf/sq. ft.)//.
- c. Field-of-Roof Uplift Pressure: //00 kPa/sq. m (00 lbf/sq. ft.)//.

SPEC WRITER NOTE: Retain and edit FM Approvals Listing requirement for VA facilities.

- 5. FM Approvals Listing: Provide roofing membrane, 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.

SPEC WRITER NOTES:

- 1. Select one option in first subparagraph below based on windstorm classification of Project. Utilize calculation based upon FM Approvals Loss Prevention Data Sheet 1-28 to determine the number that establishes the minimum FM Approvals approval rating.
- 2. Verify availability of roofing systems that meet these classifications. Other options for classifications increase in increments of 15, e.g., Class 1A-135, 1A-150, 1A-165, and higher.
- 3. "Class 1A" signifies meeting ASTM E108, Class A fire performance for FMG-approved Class 1 roof coverings.
- 4. For areas having three or more hailstorms annually, FMG recommends roofing systems rated SH (severe hail) instead of MH (moderate hail).
- a. Fire/Windstorm Classification: Class 1A-//60// //75// //90// //105// //120//.
- b. Hail Resistance: //MH// //SH//.

SPEC WRITER NOTE: Consider retaining requirement below in addition to FM Approval Listing requirement above for high windstorm classification areas (1A-105 or greater) to allow

for broader participation in bidding.

6. High Wind Zone Design Requirement: Contractor Option: In lieu of FM Approval Listing windstorm classification, provide roofing membrane, base flashing, and component materials that comply with Miami-Dade County requirements.

E. 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, and Resident Engineer.
2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
3. 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.
  - c. Examine samples and installation instructions of manufacturer.

## 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, SAMPLES.
- B. Product Data:
  1. Asphalt and adhesive materials.
  2. Base and ply sheet roofing and flashing membrane.
  3. Roofing cement.
  4. Fastening requirements.
  5. Roof walkway.
  6. Aggregate surfacing and surfacing adhesive.
  7. Coating.
  8. Application instructions.
- C. Samples:
  1. Nails and fasteners, each type.

- D. Shop Drawings: Include plans, sections, details, and attachments.
  - 1. Base flashings and terminations.
  - 4. Nailers and cants.
- E. Certificates:
  - 1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.
  - 2. Indicating compliance with Miami-Dade County requirements.
  - 3. Indicating compliance with load/strain properties requirement.
  - 4. Indicating compliance with energy performance requirement.
- F. Warranty: As specified. At all work areas of roof removal and patch and repair in-kind, Contractor shall coordinate any and all work with the company who currently/presently holds the warranty of each and every specific system associated with the project.
- G. Documentation of supervisors' and inspectors' qualifications.
- H. Field reports of roofing inspector.
- I. Temporary protection plan. Include list of proposed temporary materials.
- J. Contract Close-out Submittals:
  - 1. Maintenance Manuals.
  - 2. Warranty signed by installer and manufacturer.

#### **1.7 DELIVERY, STORAGE AND MARKING**

- A. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to built-up roofing for storage, handling and installation.

#### **1.8 ENVIRONMENTAL REQUIREMENTS**

- A. Weather Limitations: 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.
- B. Environmental Controls: Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. Protection of interior spaces: Refer to Section 01 00 00, GENERAL REQUIREMENTS.



## 1.9 WARRANTY

- A. Roofing system is subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period is extended to [10] years.
- B. At all work areas of roof removal and patch and repair in-kind, Contractor shall coordinate any and all work with the company who currently/presently holds the warranty of each and every specific system associated with the project.

## PART 2 - PRODUCTS

### 2.1 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.
  - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
  - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Multipurpose Construction Adhesives: 70 g/L.
    - b. Contact Adhesives: 80 g/L.
    - c. Other Adhesives: 250 g/L.
    - d. Nonmembrane Roof Sealants: 300 g/L.
    - e. Sealant Primers for Nonporous Substrates: 250 g/L.
    - f. Sealant Primers for Porous Substrates: 775 g/L.
- B. Water-Based Asphalt Primer: Water-based, polymer modified, asphalt primer with the following physical properties:
  - 1. Asbestos Content, EPA 600/R13/116: None.
  - 2. Non-Volatile Content, minimum, ASTM D2823: 30 percent.
  - 3. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 65 g/L.
- C. Cold-Applied Adhesive for sheet membrane: One-part, asbestos-free, low-volatile, cold-applied adhesive specially formulated for compatibility and use with specified roofing membranes and flashings, with the following physical properties:
  - 1. Asbestos Content, EPA 600/R13/116: None.
  - 2. Volatile Organic Compounds (VOC), maximum, ASTM D6511: <250 g/L.

3. Nonvolatile Content, minimum, ASTM D6511: 75 percent.
  4. Uniformity and Consistency, ASTM D6511: Pass.
- D. Cold-Applied Adhesive for membrane flashing: One-part, cold-applied adhesive specially formulated for compatibility and use with specified roofing membranes and flashings, with the following physical properties:
1. Asbestos Content, EPA 600 R13/116: None.
  2. Volatile Organic Compounds (VOC), maximum, ASTM D6511: <250 g/L.
  3. Nonvolatile Content, minimum, ASTM D6511: 75 percent.
  4. Uniformity and Consistency, ASTM D6511: Pass.
- E. Roof Cement: ASTM D4586, Type II.

## 2.2 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 load/strain properties performance requirement in Part 1 of this Section.

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, Type II, venting, nonperforated, heavyweight, asphalt-impregnated and coated, glass-fiber base sheet with coarse granular surfacing or embossed venting channels on bottom surface.

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

- C. Base Sheet: ASTM D4601, Type II, nonperforated, asphalt-impregnated and coated glass-fiber sheet dusted with fine mineral surfacing on both sides, with the following properties:
1. Breaking Strength, minimum, ASTM D146: cross machine direction, 12.2 kN/m (70 lbf/in).
  2. Pliability, 12.7 mm (1/2 inch) radius bend, ASTM D146: 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, Type II or III, nonperforated, asphalt-coated, composite polyester/fiberglass/polyester reinforced sheet dusted with fine mineral surfacing on both sides, with the following properties:

1. Breaking Strength, minimum, ASTM D146: 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: No failures.

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

E. Ply Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and coated glass-fiber sheet dusted with fine mineral surfacing on both sides, with the following properties:

1. Breaking Strength, minimum, ASTM D 146: machine direction, 90 lbf/in; cross machine direction, 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, asphalt-impregnated and -coated, glass-fiber cap sheet, with white coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface.

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, Grade G, Type II, glass-fiber-reinforced, SBS/SEBS/SIS modified asphalt sheet; granular surfaced; and as follows:

1. Exterior Fire-Test Exposure, ASTM E108: Class A.
2. Tensile Strength at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 24 kN/m (140 lbf/in).

3. Tear Strength at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 880 N (200 lbf).
4. Elongation at 23 deg. C (73 deg. F), minimum, cross machine direction, at 5 percent maximum load ASTM D5147: 40 percent.
5. Low Temperature Flex, maximum, ASTM D5147: -31 deg. C (-25 deg. 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, 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 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 12.2 kN/m (70 lbf/in).
  3. Tear Strength at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 440 N (100 lbf).
  4. Elongation at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 7.5 percent.
  5. Low Temperature Flex, maximum, ASTM D5147, -26 deg. C (-15 deg. F).
  7. Reflectance, ASTM C1549: 71 percent.
  8. Thermal Emittance, ASTM C1371: 0.87.
  9. 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, 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 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 84 kN/m (480 lbf/in).

3. Tear Strength at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 330 N (750 lbf).
4. Elongation at 23 deg. C (73 deg. F), minimum, cross machine direction, ASTM D5147: 6 percent.
5. Low Temperature Flex, maximum, ASTM D5147, -26 deg. C (-15 deg. 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, Type II, asphalt-impregnated and coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- L. Base Flashing Backer Sheet: Same as ply sheet.
- M. Base Flashing Sheet: ASTM D6164, Grade G, Type II, polyester-reinforced, SBS-modified asphalt sheet; granular surfaced; Granule Color: White.

### **2.3 FASTENERS:**

- A. Roofing Fasteners: Factory-coated steel fasteners and metal or plastic plates, where applicable, meeting requirements of FM Approvals 4470, tested by fastener manufacturer for required pullout strength, 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.

### **2.4 SURFACING AND COATINGS**

- A. Aggregate Surfacing, Stone: ASTM D1863, except the use of crushed stone is prohibited.
- B. Aggregate Surfacing, Slag or Gravel: Use slag on slopes over 1:10 (one inch per foot).
- 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, with VOC content less than 250 g/L, 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. Volatile Organic Compounds (VOC), maximum, ASTM D 6511: 250 g/L.
3. Nonvolatile Matter, minimum ASTM D 6511: 50 percent.
4. Reflectance (adhesive plus aggregate), ASTM C 1549: 71 percent.
5. Thermal emittance (adhesive plus aggregate), ASTM C 1371: 0.85.
6. Solar Reflectance Index (SRI), adhesive plus gravel, ASTM E 1980: 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 owner 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 D 1644: 60 percent.
3. Volatile Organic Compounds (VOC), ASTM D 3960: 35g/L.
4. Percent Solids (by volume), minimum, ASTM D 5201: 60 percent.
5. Reflectance, minimum, ASTM C 1549: 86 percent.
6. Emissivity, minimum, ASTM C 1370: 0.93.
7. Solar Reflectance Index (SRI), ASTM E 1980: 103.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION:**

- A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.

- B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

### 3.2 PREPARATION

- A. Complete roof deck construction prior to commencing roofing work:
  - 1. Install curbs, blocking, edge strips, nailers, cants, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.
  - 2. Complete deck and insulation to provide designed drainage to working **roof drains**.
  - 3. Document installation of related materials to be concealed prior to installing roofing work.
- B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates.
- C. Sweep decks to broom clean condition. Remove all dust, dirt or debris.
- D. Remove projections that might damage materials.
- E. Concrete Decks, except Insulating Concrete:
  - 1. Test concrete decks for moisture prior to application of roofing materials. Test for capillary moisture by plastic sheet method according to ASTM D4263.
  - 2. Prime concrete decks, including precast units, with primer as specified. Keep primer back four inches from joints in precast units.
  - 3. Allow primer to dry before application of bitumen.
- F. Insulating Concrete Decks:
  - 1. Allow to dry out for at least five days after installation before the placement of 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 in accordance with manufacturer's printed instructions prior to application of roofing materials.
- H. Existing Membrane Roofs and Repair Areas:
  - 1. Comply with requirements in Section 07 01 50.19 PREPARATION FOR REROOFING.

2. At areas to be altered or repaired, remove loose, damaged, or cut sheet that is not firmly adhered only where new penetrations occur or repairs are required.
3. Cut and remove existing roof membrane for new work to be installed. Clean cut edges and install a temporary seal to cut surfaces. Use roof cement and one layer of 7 Kg (15 pound) felt strip cut to extend 150 mm (6 inches) on each side of cut surface. Bed strip in roof cement and cover strip with roof cement to completely embed the felt.
4. At base flashing to be repaired, either bend up cap flashing or temporarily remove cap flashing. Brush and scrape away all deteriorated sheets or surface material of base flashing.

### **3.3 TEMPORARY PROTECTION**

- A. Install temporary protection at the end of day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent. Comply with approved temporary protection plan.
- B. Install temporary cap flashing over the top of base flashings where permanent flashings are not in place to provide protection against moisture entering the roof system through or behind the base flashing. Securely anchor in place to prevent blow off and damage by construction activities.
  1. Glaze coat exposed surfaces of felts to seal within the bitumen coating. Do not leave felt surfaces or edges exposed.
- C. Provide for removal of water or drainage of water away from the work.
- D. 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.

### **3.4 INSTALLATION, GENERAL**

- A. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FM 4450 and FMG 4470 as part of a membrane roofing system as listed in FM Approval's "RoofNav" for fire/windstorm classification indicated.



- Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.
- B. NRCA Installation Standard: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations, including ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing"
  - C. Manufacturer Recommendations: Comply with roofing system manufacturer's written installation recommendations.
  - D. Coordination with related work: Coordinate roof operations with roof insulation and sheet metal work so that insulation and flashings are installed concurrently to permit continuous roofing operations.
  - E. Installation Conditions:
    - 1. Apply dry roofing materials. Apply roofing work over dry substrates and materials.
    - 2. Apply materials within temperature range and surface and ambient conditions recommended by manufacturer.
    - 3. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:
      - a. Do not apply materials when the temperature is below 4 deg. C (40 deg. F).
      - b. Do not apply materials to substrate having temperature of 4 deg. C (40 deg. F) or less.

### 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 07220 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:
    - A. Apply cold-applied adhesive in a uniform application at rate recommended by manufacturer.

### C. Built-Up Membrane Sheets:

1. Number of Plies: [4], minimum, including cap sheet, and not including base sheet if any. Provide additional plies as required to meet load/strain properties specified in Part 1 of this Section.
2. Commence the laying of sheets at the 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 not less than two 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. Insure details show all wood nailers used in conjunction with roofing and sheet metal components of roofing system.
  - 2. Refer to NRCA details 200-MB series for various conditions. Supplement NRCA details with requirements of FM Approvals PLPDS 1-49, including use of wood cants.
  - 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 two 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 not less than 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 not more than 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 not less than 76mm (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 300mm (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 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.

**3.8 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.
- C. Embed aggregate to cover the roofing sheet completely without bare spots, but not less than 20 Kg/m<sup>2</sup> (400 pounds/) of dry gravel or 15 Kg/m<sup>2</sup> (300 pounds/100 square feet) of dry slag per. Do not leave any exposed bitumen.
- D. Do not embed aggregate under roof walkways.
- E. In cold weather preheat aggregate prior to application.
- F. Do not place aggregate material in piles or rows on bare or glaze coated felt.
- G. If aggregate surfacing is delayed, promptly apply glaze coat of cold-applied adhesive at rate scheduled.

**3.9 REPAIR AND ALTERATIONS TO EXISTING ROOF**

- A. Areas to be altered or repaired, remove loose aggregate and aggregate not firmly embedded where new penetrations occur or repairs are required:
  - 1. Remove aggregate 900 mm (3 feet) beyond areas to be cut.
    - a. Clean, dry and store aggregate away from roof area until ready to reuse.
    - b. Remove unsuitable and excess aggregate not used from Project.
- B. Cut and remove existing roof membrane for new work to be installed. Clean cut edges and install a temporary seal to cut surfaces. Use roof cement and one layer of 7 Kg (15 pound) felt strip cut to extend 150 mm (6 inches) on each side of cut surface. Bed strip in roof cement and cover with roof cement to completely embed the felt.
- C. Bend up cap flashing or temporarily remove at built-up base flashing to be repaired. Brush and scrape away deteriorated and loose bitumen, felts or surface material of built-up base flashing.
- D. Repairs to existing membrane and base flashing:
  - 1. Remove temporary patches prior to starting new work.
  - 2. Blisters and fish mouths:
    - a. Cut blisters open and turn membrane back to fully adhered portion. Cut fish mouths so membrane can be turned back and subsequently laid flat.

- b. Heat membrane to facilitate bending and to dry surface of exposed blister areas.
  - c. Mop turned back membrane in cold-applied adhesive. Roll to insure full adhesion and embedment in substrate.
  - d. Cover cut areas with two plies of felt. Extend first ply 100 mm (4-inches) beyond cut area edge. Extend second 100 mm (4 inches) beyond first ply. Mop down in cold-applied adhesive as specified for new work. Resurface to match existing.
- 3. Exposed Felts:
  - a. Cut away exposed deteriorated edges of sheets.
  - b. Glaze coat felt edges.
  - c. Resurface to match existing.
- 4. Built-up Base Flashing:
  - a. Restore felts and cap sheet removed, lapping 100 mm (4-inches) over existing.
  - b. Install new felts and cap sheet as specified for new work.
- 5. Horizontal Metal Flanges:
  - a. Remove loose, buckled or torn stripping.
  - b. Remove loose fasteners and install new fasteners.
  - c. Restrip flanges as specified for new work.
- 6. Resurfacing:
  - a. Over repaired membrane, embed aggregate as specified for new work.
  - b. Cover all membrane areas. Do not leave any exposed membrane surface.
- E. Match existing roofing materials and construction. Use bitumen compatible with existing for roof repair and alteration.
- F. Perform alterations, maintenance and repairs to roof membrane immediately after membrane has been cut or damaged, with permanent new work as specified in this specification. Repair items damaged in surface preparation and aggregate removal.

### **3.11 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 written instructions by spray or roller.
- C. Provide dry film thickness of minimum 20 mils (0.5 mm).

**3.12 FIELD QUALITY CONTROL**

- A. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of [5] [7] [10] full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final reports. Roofing Inspector's quality assurance inspections shall comply with criteria established in ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
  - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.
  - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

**3.13 PROTECTING AND CLEANING**

- A. Protect membrane roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of acceptance by Owner.
- C. Clean overspray and spillage from adjacent construction. Clean membrane and restore surface to like-new condition meeting solar reflectance requirements.

- - - E N D - - -