
USACE / NAVFAC / AFCEC UFGS-07 51 13 (August 2025)

Preparing Activity: NAVFAC

Superseding
UFGS-07 51 13 (May 2012)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 51 13

BUILT-UP ASPHALT ROOFING

08/25

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SECTION 07 51 13

BUILT-UP ASPHALT ROOFING 08/25

NOTE: This guide specification covers the requirements for aggregate surfaced bituminous built-up roofing, and built-up roofing with granule-surfaced modified bitumen cap sheet for existing and new roof systems on slopes from 6 mm to 76 mm 1/4 inch to 3 inches per foot.

Adhere to [UFC 1-300-02](#) Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a [Criteria Change Request \(CCR\)](#).

NOTE: The requirements for hot-mopped, four-ply, aggregate surfaced, built-up bituminous roofing systems and built-up bituminous roof systems consisting of three-ply felts and granule-surfaced modified bitumen cap sheet are included in this guide specification. This guide specification does not include the structural roof deck, insulation, or sheet metal fascias, gravel stops, and flashings.

Coordinate this section with other roof system components specifications such as rough carpentry, insulation and sheet metal flashing. Also coordinate this section with the criteria contained

in UFC 3-110-03 "Roofing", as it relates to the specific project and Service Exceptions indicated therein.

NOTE: In most cases, use aggregate surfacing or granule surfaced modified bitumen cap sheet surfacing in lieu of smooth surfaced built-up roofs. Generally, when properly applied and maintained, aggregate surfaced roofing will have greater life expectancy. Consider granulated cap sheet surfacing where:

1. There is danger of aggregate being drawn into air intakes of jet aircraft.

2. There is danger of wind blown aggregate jeopardizing property and life safety.

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

NOTE: Select one of the following references subject to design criteria and the particular materials selected for the application and remove the other two references sited below within the body of the text citing the applicable reference:

[ASTM D4869] [ASTM D6757/D6757M] [ASTM D1970/D1970M]

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22 (2022; Supp 1 2023; Supp 2 2023; Supp 3 2025) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C208 (2022) Standard Specification for Cellulosic Fiber Insulating Board

ASTM C728 (2017a; R 2022) Standard Specification for Perlite Thermal Insulation Board

ASTM C1153 (2023) Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging

ASTM D41/D41M (2011; R 2023) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

ASTM D312/D312M (2016a) Standard Specification for Asphalt Used in Roofing

ASTM D448 (2012; R 2017) Standard Classification for Sizes of Aggregate for Road and Bridge Construction

ASTM D517 (2023) Asphalt Plank

ASTM D1863/D1863M (2005; R 2011; E 2012) Mineral Aggregate Used on Built-Up Roofs

ASTM D1864/D1864M (1989; E 2009; R 2009) Moisture in Mineral Aggregate Used on Built-Up Roofs

ASTM D1970/D1970M (2021) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

ASTM D2170/D2170M (2018) Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens)

ASTM D2178/D2178M (2015a; R 2021) Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing

ASTM D3617 (2007; R 2015; E 2015) Sampling and Analysis of New Built-Up Roof Membranes

ASTM D4073/D4073M (2006; E 2019; R 2019) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes

ASTM D4263 (1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D4402/D4402M	(2015) Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D4586/D4586M	(2007; R 2018) Standard Specification for Asphalt Roof Cement, Asbestos-Free
ASTM D4601/D4601M	(2004; R 2020) Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D4637/D4637M	(2015) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D4869/D4869M	(2016a) Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing
ASTM D4897/D4897M	(2016) Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D6162/D6162M	(2016) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D6163/D6163M	(2016) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
ASTM D6164/D6164M	(2016) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D6757/D6757M	(2018) Standard Specification for Underlayment Felt Containing Inorganic Fibers Used in Steep-Slope Roofing
ASTM E108	(2025) Standard Test Methods for Fire Tests of Roof Coverings
ASTM E1980	(2024) Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

COOL ROOF RATING COUNCIL (CRRC)

ANSI/CRRC S100	(2021) Standard Test Methods for Determining Radiative Properties of Materials
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FM GLOBAL (FM)

FM 4470	(2022) Single-Ply, Polymer-Modified
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Bitumen Sheet, Built-up Roof (BUR), and
Liquid Applied Roof Assemblies for Use in
Class 1 and Noncombustible Roof Deck
Construction

FM APP GUIDE

(updated on-line) Approval Guide
<https://www.approvalguide.com/>

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1

(2020) Occupational and Educational
Personal Eye and Face Protection Devices

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan

(2025) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1

(2019) Performance Standard for Retrofit
Drains

ANSI/SPRI/FM 4435/ES-1

(2017) Test Standard for Edge Systems Used
with Low Slope Roofing Systems

UL SOLUTIONS (UL)

UL 790

(2022) UL Standard for Safety Test Methods
for Fire Tests of Roof Coverings

UL RMSD

(2012) Roofing Materials and Systems
Directory

1.2 SEQUENCING

Coordinate the work with other trades to ensure that components secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials.[Install roof membrane immediately following application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered roof membrane installation the same day.]

1.3 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wind Uplift Calculations; G, [____]

[Aggregate; G, [____]

] Felt Materials; G, [____]

[Granule Surface Modified Bitumen Cap Sheet; G, [____]

][Heat Island Reduction; S

] Flashing Membrane; G, [____]

Fasteners

Asphalt

Primer

Asphalt Roof Cement

[Walkpad Materials

] Cant Strips

[Pre-Manufactured Curbs and Accessories; G, [____]

][Roof Walkways

][Paver Blocks

[Photovoltaic (PV) Systems; G, [_____]]
Sample Warranties Certificates; G, [_____]]
Fastening Plates
Unsaturated Felt or Rosin-Sized Building Paper

SD-05 Design Data

Wind Uplift Calculations; G, [_____]]

SD-06 Test Reports

Built-Up Roofing

SD-07 Certificates

Bill of Lading

Qualification of Manufacturer

Qualifications of Applicator

SD-08 Manufacturer's Instructions

NOTE: Edit the manufacturers instructions
submission requirements as necessary for the system
specified. Include bracketed requirements only as
applicable to the system being specified.

Felts; G, [_____]]

Flashings; G, [_____]]

[Modified Bitumen Cap Sheet; G, [_____]]

] Asphalt

Primer

Roof Cement

Fasteners

[Cold Weather Conditions installation; G, [_____]]

] SD-09 Manufacturer's Field Reports

[Manufacturer's Field Inspection Report; G, [_____]]

] SD-11 Closeout Submittals

Warranty

Information Card

1.4 QUALITY CONTROL

NOTE: All projects with more than 1400 square meters
15,000 square feet of roof area or that is defined
as critical use or mission critical in the project
DD Form 1391 must have a Registered Roof Consultant
(RRC), a registered professional engineer (PE), or
registered architect (RA) on the design team
experienced in roof system design and quality
assurance services.

1.4.1 Qualification of Manufacturer

NOTE: Specify 20 years manufacturer experience
unless directed otherwise by the Government.

Submit documentation verifying manufacturer has been in the business of
manufacturing the system being installed for a period of not less than
[20][_____] years.

1.4.2 Qualifications of Applicator

Ensure roofing system applicators are approved, authorized, or licensed in
writing by the roofing system manufacturer and have a minimum of
[5][_____] years experience as an approved, authorized, or licensed
applicator with the manufacturer and be approved at a level capable of
providing the specified warranty.

1.4.3 Fire Resistance

NOTE: Specify Class B option only when Class A may
not be attainable such as membrane system
application directly to wood deck. Provide
justification/rationale for Class B option with
design submission

Complete roof covering assembly is required to:

- a. Be Class A rated in accordance with ASTM E108 , FM 4470 , or UL 790; and
- b. Be listed as part of Fire-Classified roof deck construction in UL RMSD ,
or Class I roof deck construction in FM APP GUIDE.

1.4.4 Wind Uplift Resistance

NOTE: Determine the required wind uplift resistance
based on ASCE 7-22 wind loading calculations or
applicable building code requirements. The
specified FM rating incorporates a safety factor of
2 over the maximum calculated uplift pressure.
Therefore, a FM rating of 1-90 correlates to a

maximum uplift calculation of 2.2kPa 45 psf. When a rated system is specified, ensure the specified roof system is capable of meeting the wind uplift resistance specified. Utilize commercially available sources such as Factory Mutual Roofnav <https://www.roofnav.com> to validate wind uplift rated systems. Use ASCE 7-22 for determining uplift requirements. Where non-rated systems may be permissible, or rated systems cannot be obtained such as a reroof, ensure that validated wind uplift calculations and substantiating data are provided by a licensed engineer.

Delineate calculated values in the roof specification and drawings. Utilize independently tested and rated roof systems, such as Factory Mutual (FM), Underwriters Laboratories (UL), and Single Ply Roofing Industry (SPRI).

Provide a complete roof system assembly that is rated and installed to resist wind loads[indicated][calculated in accordance with ASCE 7-22] and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems except as approved by the Contracting Officer. Submit licensed engineer's wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed of[] km/h [] mph in accordance with ASCE 7-22 and other applicable building code requirements.

[Provide Engineering calculations, signed, sealed, and dated by a qualified Engineer validating the wind resistance per ASCE 7-22, ASTM D4073/D4073M, and ANSI/SPRI/FM 4435/ES-1 of non-rated roof system.

1.4.5 Solar Reflectance Index (SRI)

NOTE: Compliance with ASHRAE 90.1 is required on all projects. For ASHRAE 90.1 compliance, include the first bracketed sentences for projects in ASHRAE climate zones 0 thru 3. See ASHRAE 90.1 Chapter 5, section titled "Roof Solar Reflectance and Thermal Emittance", for exceptions when roof design conditions eliminate these requirements and this section can be deleted. When a designer desires IgCC compliance with cool roof requirements, include the second set of bracketed sentences for projects in ASHRAE climate zones 0 thru 3. See IgCC Chapter 5 for exceptions when design conditions eliminate these requirements.

SRI measures the roof's ability to reject solar heat, defined such that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100.[Provide roof finishes for more than 75 percent of the roof surface having a minimum 3-year aged solar reflectance of 0.55, and a minimum 3-year aged thermal emittance of 0.75 when tested in accordance with ANSI/CRRC S100, or, a minimum 3-year aged Solar Reflectance Index of 64 when determined in accordance with the

Solar Reflectance Index method in [ASTM E1980](#) using a convection coefficient of [6.62 W per m2](#) [2.1 BTU per h ft2.](#)][Use roofing materials having minimum 3-year aged SRI for more than 75 percent of roof surface (less than or equal to 2:12 slope, SRI greater than 64; greater than 2:12 slope, SRI greater than 25).] SRI values are based on a minimum 3-year aged solar reflectance and thermal emittance, as measured in accordance with [ANSI/CRRC S100](#).

1.4.6 Pre-roofing Conference

After approval of submittals and before performing roofing[and insulation] system installation work, hold a pre-roofing conference to review the following:

- a. Drawings and specifications and submittals related to the roof work;
- b. Roof system components installation;
- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer;
- d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and
- e. Quality control plan for the roof system installation;
- f. Safety requirements.

Coordinate pre-roofing conference scheduling with the Contracting Officer. Required conference attendees include the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing[and insulation], flashing and sheet metal work,[[mechanical][and] [electrical] work,] other trades interfacing with the roof work,[Fire Marshall,] and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container is required to bear specification number, type, and class, as applicable. Indicate on labels or [bill of lading](#) for roofing asphalt the asphalt type, finished blowing temperature (FBT), flash point (FP), and equiviscous temperature (EVT), that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with [ASTM D2170/D2170M](#) or 75 centipoise when tested in accordance with [ASTM D4402/D4402M](#). Deliver materials in sufficient quantity to allow work to proceed without interruption.

Submit bills of lading when labels of asphalt containers do not indicate the finished blowing temperature, flash point and equiviscous temperature.

1.5.2 Storage

Protect materials against moisture absorption, contamination, or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work are finished and dry. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Tie covering securely to pallets to make completely weatherproof and yet provide sufficient ventilation to prevent condensation. Maintain roll materials at temperature above 10 degrees C 50 degrees F for a 24-hour period immediately prior to application. Keep aggregate dry as defined by ASTM D1863/D1863M. Immediately remove wet, contaminated, or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 4 degrees C 40 degrees F, or when there is ice, frost, moisture or visible dampness on roof deck.[Restriction on application of roofing materials below 4 degrees C 40 degrees F may be waived if Contractor devises a means, satisfactory to Contracting Officer, of: (1) maintaining surrounding temperature above 4 degrees C 40 degrees F; (2) maintaining application temperature of heated materials without exceeding maximum specified heating temperature; and follows other recommendations of the membrane manufacturer for application in cold weather conditions.]

Submit detailed application instructions and standard manufacturer drawings altered by these specifications.[Include membrane manufacturer requirements for nailers and backnailing of roof membrane on steep slopes.] Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

1.7 WARRANTY

Provide roof system material and workmanship warranties meeting the specified requirements below. Provide revision or amendment to standard membrane manufacturer warranty to comply with the specified requirements. Submit all data required with requirements of this section. Include in Data written acceptance by the roof membrane manufacturer of the products and accessories provided. List products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer. Submit sample warranties certificates during the pre-construction phase to prove all warranty requirements will be achieved.

1.7.1 Roof Membrane Manufacturer Warranty

**NOTE: Buildings with roof area of 700 sq. meters
7535 sq. feet 75 squares or greater, administrative,
classroom and other high use facilities, and
facilities with sensitive use, contents, equipment,
or functions require minimum 20 year warranty. All
environmentally controlled interiors require a
minimum 10 year roof warranty. Designer may specify
5 or 10 year manufacturer warranty on facilities of
small roof area and of minor importance where
interiors and contents are not severely impacted by
water.**

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Write the warranty directly to the Government, commencing at the time of Government's acceptance of the roof work. Provide the following statements for such warranty:

- a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.
- b. The warranty remains in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or the manufacturer's approved applicator fail to perform the repairs within 72 hours of notification.

1.7.2 Contractor's Warranty

**NOTE: Select 5 years for Army and Air Force
projects and 2 years for all other projects.**

The Contractor is required to warrant for a minimum period of [2][5] years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The Contractor is responsible for correction of defective workmanship and replacement of damaged or affected materials. The Contractor is responsible for all costs associated with the repair or replacement work.

1.7.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 PRODUCTS

NOTE: Edit the materials specification requirements as necessary for the system(s) specified in paragraph DESCRIPTION OF ROOF MEMBRANE SYSTEM(S).

See the Note in paragraph DESCRIPTION OF ROOF MEMBRANE SYSTEM(S) for useful information in editing the membrane materials requirements.

Include bracketed requirements only as applicable to the system being specified (e.g., torch applied systems may not require asphalt in the installation; granule surfaced cap sheets do not require gravel or coating surfacing).

2.1 SYSTEM DESCRIPTION

2.1.1 Description of Roof Membrane System(s)

NOTE: Coordinate requirements with paragraph MATERIALS. Delete the bracketed option not applicable to the project.

Asphalt applied,[four-ply felt, aggregate surfaced][three-ply felt with granule-surfaced modified bitumen cap sheet] built-up roof membrane system.

2.1.2 Conformance and Compatibility

Provide the entire roofing and flashing system in accordance with specified and indicated requirements, including fire and wind resistance requirements. Perform all work not specifically addressed and any deviation from specified requirements in general accordance with recommendations of the **NRCA RoofMan**, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

2.1.3 Elimination, Prevention, or Control of Fall Hazards

NOTE: Incorporate in the design fall prevention methods or techniques to eliminate fall hazards from any part or component of the building, facility, structure, or equipment requiring future maintenance work, in accordance with ANSI/ASSE A1264.1. Fall prevention methods may include identifying,

designing, and installing anchorages (hard points) for safe use of fall arrest equipment and systems. Select materials for metal compatibility in order to minimize corrosion, type 316 stainless steel is recommended. Based on the design, include specifics of the system(s) and material(s) in the following subsection.

2.1.3.1 Fall Protection Systems

[_____]

2.1.4 Energy[and Cool Roof] Performance

NOTE: Facilities with dominant cooling loads, or in mild or warm climate zones, are required to meet "cool roofing" requirements of FEMP. Design cool roofs in accordance with the requirements in UFC 3-110-03 "Roofing", and ASHRAE 90.1 Chapter 5, for the design of insulation and energy performance of the building. If a cool roof is not selected in climate zones 1-3, meet one of the exception requirements listed in ASHRAE 90.1 Chapter 5 or provide thermal insulation above the deck with an R value of 33 or greater. Consider that when cool roofing is used with insulation R values greater than 24, the 'cool roof' surface has little, if no, influence on the energy performance of the building. Additionally, designers should be aware of the possible negative impacts of using cool roofing that may result in unintended consequences. Condensation on the underside of mechanically-fastened systems can result in ice build-up in winter, mold growth on the facers, moisture dripping into the interior, and replacement of the roofs with less than 4 years of service. See UFC 3-110-03 for more information. Poor design of cool roofs in ASHRAE climate zones 4 and higher have resulted in the unintended consequence of condensation below the membrane-a result of the material's inability to warm and drive moisture downward. Roofs that experience this condensation have had to be replaced. Other unintended consequences include the overheating of masonry walls, interior spaces, roof top piping, and mechanical equipment because of the reflected UV rays.

NOTE: Designer to specify the roof performance by R-Value on the drawings or stated in other specification sections.

NOTE: Retain the next to last bracketed note for projects with cool roof requirement. Retain the last bracketed sentence for project with sustainable

third party certification credit requirement for
reduced heat island effect.

Install a roof system that meets an overall performance as specified on the drawings or by insulation specified in other sections.[Provide a top surface finish that meets the criteria for Cool Roof Products.[Provide emittance and reflectance percentages, solar reflectance index values,[and] slopes [____], to meet sustainable third party certification requirements for [Heat Island Reduction](#).]]

2.2 MATERIALS

2.2.1 [Felt Materials](#)

NOTE: Select the base sheet option required and delete other base sheet options. Base sheets under insulation should be specified in the insulation specification section.

Perforated venting base sheet option should only be specified for application directly on concrete deck. Base sheets with perforations are rolled into place and then top mopped with hot asphalt. Base sheets without perforations are mechanically attached to nailable substrates.

Submit information demonstrating number of ply, base sheet, and ventilating felt as applicable.

- [a. Venting Base Sheet: [ASTM D4897/D4897M](#), Type II,[without][with] perforations and as approved by the roof membrane manufacturer.
-] [b. Fiberglass Felt Base Sheet: [ASTM D4601/D4601M](#), Type II,[without][with] perforations and as approved by the roof membrane manufacturer.
-] c. Ply Felt: [ASTM D2178/D2178M](#), Type[IV][or][VI].

2.2.2 [Base Flashing Membrane](#)

[ASTM D6163/D6163M](#). Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the built-up roof membrane and as recommended in membrane manufacturer's published literature. Provide a minimum base ply of flashing membrane of [1.8 mm 70 mils](#) thick. Provide a minimum granule surface modified bitumen flashing cap sheet of [3 mm 120 mils](#) thick on the selvage edge.

2.2.3 [Asphalt](#)

NOTE: Specify asphalt type based on roof slope.
Adhere to the following general requirements:

Roof Slope, mm/m in./ft Type Asphalt	
Less than 25 Less than 1/2	Type II, Type III in hot climate
25 to 50 1/2 to 1	Type III
50 to 75 1 to 1-1/2	Type III, Type IV in hot climate

In locations where ambient temperature frequently exceeds 38 degrees C 100 degrees F and roof slope is 15 mm 1/2 inch per foot or greater, specify Type IV asphalt.

Roof Slope, mm/m in./ft Type Asphalt	
Less than 25 Less than 1/2	Type II, Type III in hot climate
25 to 50 1/2 to 1	Type III
50 to 75 1 to 1-1/2	Type III, Type IV in hot climate

ASTM D312/D312M, Type[II][or][III][or][IV], in accordance with membrane manufacturer requirements and compatible with the slope conditions of the installation.

2.2.4 Surfacing Material

NOTE: Do not use coral as a gravel surface in humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5. Coral usually blackens with algae and deteriorates, becoming a growth medium for sprouting seeds. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations. Aggregate is not permitted when the basic wind speed is 160 km/hr 100 MPH or greater or at airfields.

[2.2.4.1 Aggregate for Surfacing Built-up Roofing

Water-worn gravel, crushed stone, or crushed slag, conforming to ASTM D1863/D1863M, or marble, expanded slag, or expanded shale, conforming to ASTM D1863/D1863M except density not less than 880 kg per cubic meter 55 pcf. Aggregate conforming to gradation sizes No. 6, No. 7, and No. 67 in conformance with ASTM D448 is acceptable provided other requirements of ASTM D1863/D1863M are met. Provide 2 percent maximum moisture content as determined by ASTM D1864/D1864M. Provide light colored and opaque aggregate. Limestone, volcanic rock, crushed shells, and cinders are prohibited. Submit information on material origination, gradation, and

cleaning process.

]2.2.4.2 Granule Surface Modified Bitumen Cap Sheet

NOTE: Do not use gravel surface cap sheet in humid locations or project locations with Environmental Severity Classifications (ESC) of C4 and C5. See UFC 1-200-01 for determination of ESC for project locations. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). Use a reflective mineral surfaced cap sheet system or a reflective coated smooth surface system.

NOTE: Specify ASTM D6163/D6163M, fiberglass reinforced cap sheet, as a standard cap sheet. Also may include the alternate for ASTM D6162/D6162M cap sheet, combination fiberglass and polyester. For high puncture resistance and for high traffic roofs, specify ASTM D6164/D6164M only (polyester reinforced cap sheet).

[ASTM D6163/D6163M][ASTM D6162/D6162M][ASTM D6164/D6164M]; Type II, Grade G, minimum 3 mm 120 mils thick at selvage edge, and meeting specified fire safety rating.

Submit Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

]2.2.5 Primer

ASTM D41/D41M for asphalt roofing systems and as approved by the membrane manufacturer.

2.2.6 Asphalt Roof Cement

ASTM D4586/D4586M for use with asphalt roofing systems, Type II for vertical surfaces and built-up bituminous flashings; Type I for horizontal surfaces and as recommended by the membrane manufacturer.

2.2.7 Cant Strips

NOTE: Use wood cant in non-supported flashing and wood blocking details (i.e., expansion joints, area dividers, and wall/roof intersections where roof deck is not supported by a wall).

Provide standard perlite cant strips conforming to ASTM C728[or wood fiber conforming to ASTM C208] treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Provide minimum 38 mm 1-1/2 inch thick cant strips and provide for minimum 125 mm 5 inch face and 89 mm 3-1/2 inch vertical

height when installed at 45 degree face angle, except where clearance restricts height to lesser dimension.

Certificate attesting that the fiberboard furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

2.2.8 Unsaturated Felt or Rosin-Sized Building Paper

NOTE: Include requirement for unsaturated felt or
rosin-sized building paper under base sheet on wood
decks substrates to prevent bitumen drippage through
deck joints.

Provide rosin-sized sheathing paper weighing minimum 3 kilogram per 10 square meter 5 pounds per 100 square feet or unsaturated felt weighing approximately 3.7 kilogram per 10 square meter 7-1/2 pounds per 100 square feet.

2.2.9 Fasteners

Coated, corrosion resistant fasteners compatible with components being attached and contact surfaces. Conform to FM 4470 for fasteners for attachment to deck substrate of Class I roof deck construction and FM APP GUIDE for the wind resistance specified. Use hard copper fasteners in contact with copper; aluminum or stainless steel fasteners in contact with aluminum; and stainless steel fasteners in contact with steel. For fastening only roofing felts, use fasteners driven through metal discs, or one-piece composite fasteners with heads not less than 25 mm 1 inch in diameter or 25 mm 1 inch square with rounded or 45-degree tapered corners.

[2.2.9.1 Wood Substrates and Nailers

Provide 11 gauge annular threaded shank nails with 7/16 to 5/8 inch diameter heads; or one-piece composite nails with annular threaded shanks not less than 11 gauge for securing felts and metal items. Provide fasteners long enough to penetrate minimum 25 mm 1 inch into or minimum 6 mm 1/4 inch through wood substrate materials. Do not penetrate wood decking exposed to view on the underside.

]2.2.9.2 Masonry or Concrete Walls and Vertical Surfaces

Provide hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 25 mm 1 inch long for securing felts, metal items, and accessories. Use power-driven fasteners only when approved in writing by Contracting Officer.

]2.2.9.3 Metal Fastening Plates

Flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; minimum 50 mm 2 inch in diameter. Form discs to prevent dishing or cupping.

[2.2.10 Pre-manufactured Curbs and Accessories

NOTE: Edit, delete, and insert accessory materials requirements as required for the specific project and installed components.

Provide manufacturer's standard pre-manufactured accessories for intended purpose, [comply with applicable specification section,] compatible with the membrane roof system and approved for use by the roof membrane manufacturer. Submit product data for government review.

[2.2.10.1 Pre-fabricated Curbs

Provide [_____] gauge [G90 galvanized][AZ55 galvalume] [_____] curbs with minimum 100 mm 4 inch flange for attachment to roof nailers. Provide minimum height of 250 mm 10 inch above the finished roof membrane surface.

] [2.2.10.2 Photovoltaic (PV) Systems - Rack Mounted Systems

NOTE: Refer to UFC 3-110-03 for considerations when including PV systems on roofs. Delete this section when no PV systems are included in the project.

Adhere to the Guidelines for Roof-Mounted PV Systems, published by NRCA.

] [2.2.11 Walkpads

NOTE: Use walkpads or walkways at roof access points and where the roof or areas of the roof are intended to bear foot traffic for maintenance or other purposes once a month or more frequently.

Provide polyester reinforced roof walkpads, granule-surfaced modified bitumen membrane material, ASTM D6162/D6162M or ASTM D6164/D6164M, minimum [_____] 5 mm [_____] [200] mils thick, compatible with the roof membrane and as recommended by the roof membrane manufacturer. Do not exceed 1.2 meters 4 feet in length for each panel. Other walkpad materials require approval of the Contracting Officer prior to installation.

2.2.11.1 Roof Walkways

Provide 950 by 1830 millimeter by 15 millimeter 36 by 72 inch by 1/2 inch thick asphalt planks, consisting of a homogeneous core of asphalt, plasticizers, and fillers bonded between two saturated and coated facing sheets. Surface top side is with ceramic granules. Conform to ASTM D517, mineral-surfaced asphalt.

] [2.2.12 Paver Blocks

NOTE: Use concrete pavers as walkways on aggregate surface roofs where the roof or areas of the roof are intended to bear foot traffic for maintenance or other purposes once a month or more frequently. Use paver blocks under heavy bearing components, irregular base bearings and for support and

**attachment of lightweight pipe, conduit, and
drainage lines routed along roof surface.**

Precast concrete, minimum 38 mm 1-1/2 inch thick, minimum 450 mm 18 inch square for walkways and minimum 150 mm by 300 mm 6-inch by 12-inch for use in supporting surface bearing components but extending not less than 50 mm 2 inch beyond all sides of surface bearing bases. Install walkpad material under all paver blocks.

]2.2.13 Roof Insulation Below Membrane System

**NOTE: If the roofing system contains insulation,
coordinate with the appropriate insulation
specification section. The insulation specification
should include materials and installation up to the
substrate on which the roof membrane base sheet and
or membrane layers are installed. Coordinate base
sheet attachment (mechanically fastened or mopped)
with FM or UL fire and wind uplift requirements.**

Provide insulation compatible with the roof membrane, approved by the membrane manufacturer.

]2.2.14 Membrane Liner

Self-adhering modified bitumen underlayment conforming to ASTM D1970/D1970M, EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material conforming to ASTM D4869/D4869M, or ASTM D6757/D6757M, and as approved by the Contracting Officer.

2.3 VERIFICATION OF CONDITIONS

Before applying roofing materials, ensure that the following exist:

- a. Do not install items that show visual evidence of biological growth.
- b. [Drains,] [curbs,] [cants,] [control joints,] [expansion joints,] [perimeter walls,] [roof penetrating components,] [and] [equipment supports] are in place.
- c. Surfaces are rigid, clean, dry, smooth, and free of cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls. Inspect surfaces and approve immediately before application of roofing and flashings. Apply the roofing and flashings to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials.
- d. The plane of the substrate does not vary more than 6 mm 1/4 inch within an area 3 by 3 meters 10 by 10 feet when checked with a 3 meter 10 foot straight edge placed anywhere on the substrate.
- e. Substrate is sloped as indicated to provide drainage.
- f. Walls and vertical surfaces are constructed to receive counterflashing and permits mechanical fastening of the base flashing materials.

- g. Wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.

NOTE: Coordinate with Section 06 10 00 ROUGH
CARPENTRY to ensure that waterborne preservative
treatment is specified for wood which will be in
contact with roofing components.

- h. Wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of felts, edging strips, attachment flanges of sheet metal, and roof fixtures.[Embedded nailers are flush with deck surfaces.][Surface-applied nailers are same thickness as roof insulation.]

NOTE: Wood cants should also be used where there
are non-wall supported flashings at wood blocking
forming area dividers and expansion joints, and at
wall and roof intersections where roof deck is not
supported on wall.

- i. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is approximately 45 degrees and the height of the vertical leg is not less than nominal 89 mm 3-1/2 inch. Lay cants in a solid asphalt mopping or coat of asphalt cement just prior to laying the roofing plies.

NOTE: Include venting provision for wet fill
substrate materials like lightweight cellular
concrete.

[j. Venting is provided in accordance with the following:

[(1) Edge Venting: Perimeter nailers are kerfed across width of the nailers to permit escape of gaseous pressure at roof edges.

][(2) Underside Venting: Vent openings are provided in steel form decking for cast-in-place concrete substrate.

]*****
NOTE: Coordinate with Section 06 10 00 ROUGH
CARPENTRY, to ensure that waterborne preservative
treatment is specified for wood which will be in
contact with roofing components.

- [k. Exposed nail heads in wood substrates are properly set. Warped and split[boards][sheets] have been replaced. There are no cracks or end joints 6 mm 1/4 inch in width or greater. Knot holes are covered with sheet metal and nailed in place. [Wood][Plywood]decks are covered with rosin paper or unsaturated felt prior to base sheet or roof membrane application.[Joints in plywood substrates are taped

with 50 mm 2 inch wide masking tape to prevent air leakage from the underside.]

-]l. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6 mm 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.
-] m. [Cast-in-place concrete substrates have been allowed to cure and the surface dryness requirements specified under paragraph FIELD QUALITY CONTROL have been met.]No viable moisture present when conducting ASTM D4263.
- n. [Joints between precast concrete deck units, including weld plates, are grouted, leveled, and covered with 4 inch wide ply felt or other bituminous stripping membrane set in bituminous cement prior to applying other roofing materials over the area.]Prior to application of primer on precast concrete decks, cover joints with a minimum 100 mm 4 inch strip of felt or bituminous stripping membrane set in bituminous cement.

2.3.1 Summary Of Minimum Material Weights (Per 10 sq meter 100 sq ft)

Asphalt assembly:

[Sheathing paper] [Base sheet]	[____kg] [____pounds]
[Asphalt mopping] [Adhesive] to receive insulation	[____kg] [____pounds]
Vapor retarder	[____kg] [____pounds]
Roof insulation	[____kg] [____pounds]
Asphalt mopping to receive base sheet	[____kg] [____pounds]
Asphalt-saturated roofing felts ed roofing felts	[____kg] [____pounds]
Asphalt moppings between felts ([____] at [____] kg) pounds)	[____kg] [____pounds]
Cap sheet	[____kg] [____pounds]
Flood coat	[____kg] [____pounds]
[Gravel] [Slag] [Aggregate] surfacing	[____kg] [____pounds]
Approximate total weight	[____kg] [____pounds]

PART 3 EXECUTION

3.1 PREPARATION

Verify that work of other trades that penetrates the roof deck or requires men and equipment to traverse the roof deck is complete. Examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness which would prevent the execution and quality of application.

Proceed with the roofing application only after defects have been corrected. Starting work designates acceptance of the surfaces by the Contractor.

3.1.1 Protection of Property

3.1.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists and kettles prior to starting the work. Lap protective coverings not less than 6 inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.1.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane. Form felt bitumen stops with two 300 mm 12 inch wide strips of organic ply felt. Laminate with and set strips into a coating of asphalt roof cement with one-half of the width overhanging the edge of the roof or opening. Where nailers are provided, nail the strips with roofing nails spaced 300 mm 12 inch on center in addition to embedding in asphalt roof cement. Protect the free portion of each strip from damage throughout the roofing period. After the plies of felt are in place, fold free portion of the strips back over the roofing membrane and embed in a continuous coating of asphalt roof cement. Secure with roofing nails spaced 75 mm 3 inch on center.

3.1.2 Equipment

3.1.2.1 Mechanical Application Devices

Provide and maintain mechanical application devices with pneumatic tires that operate without damaging the insulation, roofing membrane, or structural components.

3.1.2.2 Flame-Heated Equipment / Kettles

Do not place flame-heated equipment (such as kettles) on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

[3.1.2.3 Open-Flame Application Equipment

Use only open-flame equipment recommended by the roofing materials manufacturer. Do not ignite open-flame equipment and then leave it unattended. Provide and maintain a fire extinguisher adjacent to open-flame equipment on the roof. Do not use open-flame equipment for application of any roof materials where combustible material is present on the roof or within the roof assembly.

]3.1.3 Priming of Surfaces

Prime all surfaces in contact with adhered membrane materials. Apply primer at the rate of 3 liters per 10 sq. meters 0.75 gallon per 100 sq. ft. or as recommended by roof membrane manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable

primer material conditions in torch applied membrane base flashing applications.

[3.1.3.1 Priming of Concrete and Masonry Surfaces

NOTE: Include this paragraph when roofing and base flashing are applied directly to concrete or masonry surfaces.

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive roofing and base flashing uniformly with primer. Allow primer to dry before application of roofing and flashing materials.

]3.1.3.2 Priming of Metal Surfaces

Prime flanges of metal components embedded into the roofing system prior to setting in bituminous materials or stripping into roofing system.

3.1.3.3 Fire Watch

NOTE: Include and edit the following paragraph for Torch Applied and Hot-Mopped systems.

Ensure all personnel on the roof during[torch application][hot-mopped application] are properly trained to use a fire extinguisher. Provide a fire watch for a minimum of[2 hours after completion of all torch work][30 minutes after completion of hot-mopped kettle operations] at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist.[Utilize heat sensing meters to scan for hot spots in the work.][For torch applications, provide and utilize a minimum of one calibrated thermal imaging camera, minimum 160 by 120 thermal IR resolution per torch capable of detecting infrared (IR) spectrum heat emission that could indicate a potential fire during the fire watch to verify cool, safe, and non-combustible conditions exist. Provide a minimum duration fire watch of 2 hours conducted by personnel properly trained in the use of the camera to survey the underside of the roof deck, attic, and plenum spaces (where possible) and the topside of possible smoldering elements. Ensure camera has a manufacturer's certificate of calibration, and the use of the camera is in compliance with Installation security policies.]

NOTE: Include and edit the following paragraph for Torch Applied systems.

Do not torch in areas of poor or no visibility (curbs, corners, eaves, expansions joints, flashing, other voids and small penetrations) which could allow a torch flame to ignite combustible material(s) hidden from view or within the underside of the roof deck or building interior. Use cold finish applications in these areas whenever possible and per manufacturer's printed instructions, NRCA 4002, MRCA R&NW manual for "cold adhered" materials.

**NOTE: Include the following paragraph for Torch
Applied and Hot-Mopped systems.**

Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

[3.1.3.4 Open-Flame Application (Torch) Equipment and Personnel Safety

**NOTE: Include and edit the following paragraph for
Torch Applied systems.**

Only NRCA/MRCA CERTA certified roofing applicators are allowed to operate any torching equipment. Verify that all such applicators maintain and are currently carrying a valid Certified Roofing Torch Applicator (CERTA) card.

]3.1.3.5 Additional Personnel Safety Measures

**NOTE: Include the following paragraph for Torch
Applied and Hot-Mopped systems.**

Train all crew members in preventive measures for indirect and direct dangers and hazards associated with roofing work, which include, but are not limited to the following:

- a. Heat Stress: Wear light colored clothing, a hat for ultra-violet protection, and other eye protective devices. Drink sufficient quantities of non-alcoholic, non-caffeine liquids. Stage shifts for crew members to allow for breaks from heat and sun exposure without interfering with work progress.
- b. First Aid for Burns: Immediately call for an ambulance. Contact local Occupational Health Services (OHS).

All crew members are required to wear correct personal protective equipment (PPE), including, but not limited to the following items:

- a. Long-sleeved shirts buttoned at the collar and cuffs, made of non-flammable materials. Polyester materials are not allowed.
- b. Work boots covering ankles with rubber or composite soles.
- c. Long pants without cuffs to extend over the top of the work boots, made of non-flammable materials. No polyester allowed.
- d. Heavy leather gloves and flame retardant gauntlets must be worn during all handling of a torch, whether operating or not.
- e. Wear OSHA and ANSI/ISEA Z87.1 approved face shields, goggles, or safety glasses during torching and any other applicable roofing

functions.

f. OSHA and ANSI approved hard hats.

3.1.4 Covering of Wood Substrate

Cover wood substrate with a layer of unsaturated felt or rosin-sized building paper lapped 50 mm 2 inch at sides and 100 mm 4 inch at ends. Nail to hold in place prior to application of roofing system.

3.1.5 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Provide visible working thermometer and thermostatic controls set to the temperature limits. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus one degree C 2 degrees F, to check temperatures of the asphalt frequently. When temperatures exceed maximum specified, remove asphalt from the site. Do not permit cutting back, adulterating, or fluxing of asphalt.

3.1.5.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt above 274 degrees C 525 degrees F for longer than four consecutive hours. Do not heat asphalt within 4 degrees C 25 degrees F of the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 14 degrees C 25 degrees F of the equiviscous temperature (EVT). Before heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt used.

3.2 APPLICATION

NOTE: Include requirements for temporary roofing
and flashing when construction will require
considerable work on roof (that is, installing
cooling towers, antennas, pipes, ducts, solar
collectors) and temporary roofing is considered
necessary to ensure that permanent roofing is not
damaged during construction.

Apply roofing materials as specified unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Except for aggregate surfacing, complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperature for asphalt. Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system. Do not apply aggregate surfacing until the other roofing application procedures specified herein are completed.

3.2.1 Phased Membrane Construction

NOTE: Include bracketed option only when
granule-surfaced modified bitumen cap sheet is
specified as the built-up roof surfacing.

Phased application of membrane plies is prohibited.[Follow any delay in modified bitumen cap sheet installation by thoroughly cleaning the applied membrane material surface and drying immediately prior to cap sheet installation. Prime the applied membrane surface per the Manufacturer instructions prior to cap sheet installation.]

[3.2.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing[cooling towers,][antennas,][pipes,][ducts,] [_____,] is performed on the roof or where construction scheduling or weather conditions require protection of building interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

3.2.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of permanent roofing system.

]3.2.3 Base Sheet Application - General

NOTE: Include this paragraph when either base sheet
or ventilating base sheet is specified in paragraph
DESCRIPTION OF ROOF MEMBRANE SYSTEM.

Mechanically fastened base sheets are required when
uninsulated roof membrane system is applied directly
to nailable decks, excluding steel deck.
Ventilating base sheet is required when roof
membrane is applied directly to wet fill deck
materials like lightweight insulating or cellular
concrete and gypsum fill, and when applied over new
poured concrete decks.

NOTE: Select the applicable application method.
Delete other options.

Delete requirements for adhered base sheets where
the sheet is mechanically fastened through to
nailable deck.

Apply base sheets at right angles to roof slope,
except on insulated roofs where nailers (insulation
stops) have been applied at right angles to slope
and on decks sloped 1:12 25 mm per meter 1 inch per

**foot or more, apply felts parallel to roof slope.
Include requirements for applying felts to
barrel-type roofs only when applicable.**

[[Fully adhere][Spot adhere]base sheets in accordance with membrane manufacturer's printed instructions.[Provide spot adhesion with hot asphalt applied in 300 mm 12 inch diameter spots installed in two staggered rows, centered 300 mm 12 inch in from edge of the base sheet.] Roll and broom in the base sheet to ensure full contract with the hot asphalt application.][On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, base sheet may be mechanically fastened in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions.] Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 50 mm 2 inch unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 150 mm 6 inch and staggered a minimum of 1 meter 36 inch. Apply sheets[at right angles to the roof slope so that the direction of water flow is over and not against the laps][parallel to the roof slope][so that plies of sheets extend from eave line on one side of the barrel-type roof and 450 mm 18 inch over the center line of the crown of the roof. Apply sheets on the other side in the same manner, resulting in twice the normal amount of roofing sheets and asphalt at the crown]. Extend base sheets approximately 50 mm 2 inch above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Ensure retrofit roof drains conform with ANSI/SPRI RD-1. Ensure application is free of ridges, wrinkles, and buckles.

[3.2.3.1 Ventilating Base Sheets

**NOTE: Include this paragraph in conjunction with
applicable portions of the above paragraph when
ventilating base sheets are specified in paragraph
DESCRIPTION OF ROOF MEMBRANE SYSTEM.**

**Where rigid roof insulation is a component of the
roof system, specify ventilating base sheet in the
appropriate roof insulation section.**

Apply ventilating base sheet material recommended by the roof membrane manufacturer. Extend sheets over roof cants, up vertical surfaces, and terminate under cap flashing; at roof edges terminate sheets under outside edge of perimeter edge nailers or under gravel stop.[Top mop perforated ventilating base sheet with a full, continuous mopping of hot asphalt.]

]3.2.4 Ply Felts

**NOTE: Apply roofing felts at right angles to the
roof slope, except that on insulated roofs where
surface-applied wood nailers (insulation stops) have**

been applied running at right angles to roof slope and on decks sloped 1:6 50 mm per meter 2 inch per foot or more, apply the roofing felts parallel to roof slope. Delete the add-on requirement for applying felts to barrel-type roofs when not applicable.

Ensure proper alignment of felts prior to installation.[Apply ply felts shingle fashion perpendicular to slope of roof, including application on areas of tapered insulation that change slope direction.][Apply ply felts parallel to slope of roof[so that plies of felt extend from eave line on one side of barrel-type roof and 450 mm 18 inch over center line of the crown of roof. Apply felts on other side in same manner, resulting in twice normal amount of roofing felts and asphalt at crown].] Bucking or backwater laps are prohibited. Apply felts in a continuous operation. Provide starter sheets of felt to maintain the specified number of plies throughout the roofing. Apply felts with side laps in accordance with the material manufacturer's printed instructions for the number of plies installed in uniform alignment. Lap ends not less than 150 mm 6 inch and stagger 1 meter 36 inch minimum. Place the full width of each ply in hot bitumen immediately behind the bitumen applicator. Lay plies free of wrinkles, creases, ridges, or fishmouths. Extend felts approximately 50 mm 2 inch above top of cant strips at vertical surfaces and to top of cant strips elsewhere. Trim felts to a neat fit around vent pipes, roof drains, and other projections. Avoid traffic on mopped surfaces when the bitumen is fluid and for a minimum of one hour after ply application.

3.2.4.1 Hot-Mopping of Ply Felts

Bond plies to each other and to the[base sheets][substrate] with hot asphalt. Apply felts immediately following application of asphalt. Do not work ahead with asphalt. At the instant felts come into contact with asphalt, ensure asphalt is completely fluid, with asphalt temperatures within specified EVT range. Apply asphalt uniformly in a full, continuous mopping and firmly bonding film. Apply asphalt at the rate of approximately 13 kg per 10 sq. meters 25 pounds per 100 sq. feet plus or minus 25 percent. Require application rate on the high end of the application range when mopping directly to absorptive insulation substrates of perlite and woodfiber. As felts are rolled into the hot asphalt, immediately squeegee, roll or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. Ensure bitumen is visible beyond all edges of each ply as it is being installed. Install individual ply and the completed roof membrane system free of air pockets, felt delamination, ridges, creases, fishmouths, dry laps, or blisters. Do not lay felts dry or turn back laps for mopping between plies.

[3.2.4.2 Backnailing of Ply Felts

NOTE: Backnailing is required generally for slopes of 25 mm 1 inch or greater for Type III asphalt, 15 mm 1/2 inch for Type I asphalt at a maximum backnail spacing of 305 mm 12 inches. However, due to technical improvements in today's materials and methodology, backnailing is becoming obsolete.

On low slope roofs 15 mm 1/2 inch to 1 inch per

foot,) depending on the products used, apply felts shingle fashion, perpendicular to slope, starting at the lowest point.

On slopes greater than 25 mm 1 inch, require backnailing and install nailers of the same thickness as the roof insulation. Run felts parallel to slope and nail through the back edge of the felts into the nailers

When roof slope exceeds 1:6 50 mm per meter 2 inch per foot include the applicable paragraphs on backnailing. For insulated roofs, delete the second bracketed option. For uninsulated roofs on nailable decks, delete the first bracketed option and include only the second.

Unless otherwise recommended by the roof membrane manufacturer and approved by the Contracting Officer, provide minimum 90 mm 3-1/2 inch wide nailing strips matching insulation thickness and applied perpendicular to roof slope for backnailing of roof membrane. Space nailing strips as recommended by the membrane manufacturer, but not exceeding 5 meters 16 feet on center unless approved otherwise by the Contracting Officer. Coordinate the nailer installation with insulation requirements. As the felt plies are installed, nail each ply 25 mm 1 inch from the leading edge at each nailer line. fasten each felt ply 25 mm 1 inch from the leading edge and spaced at maximum 5 m 15 feet on center along the leading edge. Provide fasteners with a 25 mm 1 inch diameter metal cap or fasten through 25 mm 1 inch diameter caps. Set fasteners firm and flush without puncturing felt ply. Conceal fasteners with succeeding plies of felt.

3.2.4.3 Valleys and Ridges

Valleys: Apply roofing at valleys and waterways in the following manner:

- a. Continue base sheets across valleys and terminate 450 millimeter 18 inch from the valley.
- b. Continue felt plies across valleys and terminate 300 millimeter 12 inch from the valley. Terminate exposed laps on a line 300 millimeter 12 inch from, and parallel to, the gutter valley. Provide two plies of felt, 225 and 300 millimeter 9 and 12 inch wide, successively mop in over each felt line of the termination.
- c. If the application can be completed without wrinkles, buckles, or fishmouths and if side laps do not face the direction of drainage, roofing felts and base sheets may be laid continuously across or parallel to shallow valleys such as those formed by reverse-slope roofs. For this application, reinforce valleys with one ply of felt, 900 millimeter 36 inch wide, center on the valley gutter and lay in a solid mopping of asphalt over the top ply of roofing.

3.2.5 Membrane Flashing

Provide two plies of modified bitumen membrane strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to

make the work watertight. Ensure the top ply of flashing is granule-surfaced modified bitumen membrane. Install flashing after plies of roof membrane felt have been applied but before aggregate surfacing is applied. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of base flashing 150 mm 6 inch on center through minimum 25 mm 1 inch diameter tin caps with fasteners of sufficient length to embed minimum 25 mm 1 inch into attachment substrate.[Apply matching granules in any areas of asphalt bleed out while the asphalt is still hot.] Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.2.5.1 Strip Flashing

Set primed flanges of sheet metal flashings into roofing system in a uniform coating of asphalt roof cement not less than 1/16 inch thick applied over the ply felts. Strip-in with one layer of smooth surface modified bitumen membrane and cap with granule-surfaced modified bitumen membrane. Set strip flashing in hot asphalt or cement to the tops of the flanges, roofing membrane, and to each other. Use coatings of asphalt roof cement not less than 1/16 inch thick for ply felt. Use hot asphalt or modified bitumen cement for modified bitumen sheets. Extend first stripping ply not less than 100 mm 4 inch beyond outer edge of flange onto roof membrane. Extend each additional ply 100 mm 4 inch beyond the edge of the previous ply.

[3.2.5.2 Membrane Flashing at Roof Drain

NOTE: Include these requirements where roof drains are provided. Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashings for roof drains are specified in Section 07 60 00 FLASHING AND SHEET METAL.

Extend roofing plies to edge of drain bowl opening at roof drain deck flange. Neatly fit and press primed roof drain flashing into heavy coat of asphalt roof cement applied to top of roofing plies. Strip in and completely cover flashing with two layers of modified bitumen sheet, extending the first sheet 150 mm 6 inch on the roofing beyond the edge of flashing. Extend the cap sheet 150 mm 6 inch beyond the previous flashing ply. Bond the two layers to the metal flashing and to each other with hot asphalt. Securely clamp membrane, metal flashing, and strip flashing in the flashing clamping ring. Secure clamps so that strip flashing and metal flashing are free from wrinkles and folds. Trim membrane, flashing, and stripping flush with inside of clamping ring.

][3.2.5.3 Pre-fabricated Curbs

Anchor prefabricated curbs securely to nailer or other base substrate as indicated and flash with modified bitumen flashing membrane.

]3.2.5.4 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Install set-on accessories to permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.2.5.5 Lightning Protection

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

[3.2.6 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 150 mm 6 inch separation between adjacent walkpads to accommodate drainage. Provide walkpad [or an additional layer of cap sheet] under precast concrete paver blocks to protect the roofing.

] [3.2.7 Elevated Metal[Walkways][and][Platforms]

Provide protection mat of walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

]3.2.8 Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Set paver block on a layer of walkpad [or modified bitumen cap sheet] applying over the completed roof membrane.

[3.2.9 Aggregate Surfacing

NOTE: Include only the applicable surfacing, delete the other option.

After completion of roof membrane ply and flashing installation, and correction of tears, gouges or other deficiencies in the installed work, apply aggregate surfacing. Uniformly flood coat the surface with hot asphalt at a rate of approximate 2.9 kg 60 pounds per square. While asphalt is still hot, apply gravel aggregate surfacing material at a rate of 19.5 kg 400 pounds per square. Provide for full and uniform coverage of the roof surface. Ensure 50 percent of the aggregate is solidly adhered in the asphalt.

] [3.2.10 Granule-Surfaced Modified Bitumen Cap Sheet

NOTE: Include the option of hot asphalt or torch application of cap sheet where permissible. Torch applied cap sheet can be applied over hot mopped membrane plies.

Where finished appearance of the roof is of consequence, include the bracketed requirement for granule application in areas of bitumen bleed out.

Inspect underlying applied membrane and repair free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Provide cleaning and artificial drying with heated blowers or torches to ensure clean, dry surface prior to cap sheet application. When delays in cap sheet installation may have occurred, do not apply cap sheet if underlying materials have been exposed to rain or frozen precipitation within the previous 24 hours. Unroll cap sheet membrane and allow to relax a minimum of 1 hour prior to installation and as otherwise recommended by the membrane manufacturer. Apply cap sheet in same direction as the underlying felt plies. Align cap membrane and apply with minimum 75 mm 3 inch side laps and minimum 150 mm 6 inch end laps and as otherwise required by membrane manufacturer. Set cap sheet in hot asphalt. Cap sheet may be torch applied as recommended by the modified bitumen membrane manufacturer as long as there are no combustible materials present on the roof or within the roof assembly. Cut a 45 degree angle across selvage edge of cap membrane and overlap in end lap areas prior to applying overlapping cap membrane.[Apply matching granules in any areas of bitumen bleed out while the bitumen is still hot.] Minimize traffic on newly installed cap sheet membrane.

[3.2.10.1 Backnailing of Cap Sheet Membrane

NOTE: Include this paragraph for roof slopes greater than or equal to 1:6 50 mm per meter 2 inch per foot. Coordinate with insulation Section 07 22 00 ROOF AND DECK INSULATION and nailer requirements Section 06 10 00 ROUGH CARPENTRY to allow for backnailing of the membrane.

Unless otherwise recommended by the roof membrane manufacturer and approved by the Contracting Officer, install the modified bitumen cap sheet to provide for end laps at nailer locations. Nail the modified bitumen cap sheet at the end lap area across the width of the sheet. Nail within 25 mm 1 inch of each edge of the sheet and at 200 mm to 215 mm 8 to 8-1/2 inch on center across the width of the sheet in a staggered fashion. Provide nails with a 25 mm 1 inch diameter metal cap or nail through 25 mm 1 inch diameter caps. Cover nails by overlapping adjacent upslope sheet at the end lap area.

]3.2.11 Correction of Deficiencies

Where any form of deficiency is found, take additional measures to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.[Where interplay moppings are too light, apply additional two plies of felt in full moppings of asphalt. Apply with 100 mm 4 inch side and end laps. Where free water, skips, excessive voids, dry laps, desponding, or any form of delamination are discovered between the plies, remove, and rebuild affected area. Correct inadequate number of plies, improper lap widths, or non-uniform or

excessive asphalt mopping as directed by the Contracting Officer.] Where insulation is found wet, remove insulation and provide new built-up roofing and insulation.

3.2.12 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.3 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.3.1 Test for Surface Dryness

Before application of insulation or membrane materials and starting work on the roofed area, perform test for surface dryness in accordance with the following:

- a. Foaming: When poured on the surface to which materials are being applied, one pint of asphalt when heated in the range of 176 to 204 degrees C 350 to 400 degrees F, is not to foam upon contact.
- b. Strip-ability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should[a][JB1] portion of the sample be readily stripped clean from the surface, do not consider the surface dry and do not start application. Should rain occur during application, stop work, and do not resume until surface has been tested by the method above and found dry.
- c. Prior to installing any roof system on a concrete deck, conduct a test per ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

3.3.2 Construction Monitoring

During progress of the roof work, perform visual inspections to ensure compliance with specified parameters. Additionally, verify the following:

- a. Equipment is in working order. Metering devices are accurate.
- b. Materials are not installed in adverse weather conditions.
- c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.
 - (1) Nailers and blocking are provided where and as needed.
 - (2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.
 - (3) The proper number, type, and spacing of fasteners are installed.
 - (4) Materials comply with the specified requirements.

- (5) All materials are properly stored, handled and protected from moisture or other damages.
- (6) Asphalt is heated and applied within the specified temperature parameters.
- (7) Hot asphalt application is provided uniformly for voidless coverage and as necessary to ensure full adhesion of materials. Materials are set in place while asphalt is within the specified temperature range.
- (8) The proper number and types of plies are installed, with the specified overlaps.
- (9) Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.
- (10) Membrane is without ridges, wrinkles, kinks, fishmouths, or other voids or delamination.
- (11) Installer adheres to specified and detailed application parameters.
- (12) Associated flashings and sheet metal are installed in a timely manner in accord with the specified requirements.
- (13) Temporary protection measures are in place at the end of each work shift.

[3.3.2.1 Manufacturer's Inspection

NOTE: Include this paragraph when manufacturer's inspection of work is required. Use bracketed option in second paragraph to specify minimum number of required visits. The minimum and default is three visits during installation. To help determine if more than three visits should be specified, divide the total project roof area in squares by 100 and round to the nearest whole number. Coordinate this requirement with Section 01 45 00 QUALITY CONTROL, paragraph QUALITY CONTROL (QC) SPECIALISTS - Experience Matrix.

The roofing material manufacturer's technical representative must visit the work site to inspect ongoing work. Inspections are to include observing installation technique and verifying the quality of work-in-place for compliance with the manufacturer's instructions. Deficiencies identified by the manufacturer's technical representative must be corrected and re-inspected by the manufacturer's technical representative.

3.3.2.1.1 Frequency

The manufacturer's technical representative must visit the work site to inspect and document ongoing work a minimum of [three][_____] separate occasions during the course of the installation. One visit must occur during the first 20 squares of installation, one at substantial completion

of the roof work, and all others during different periods of installation. Notify the Contracting officer a minimum of five working days prior to each visit by the manufacturer's technical representative.

3.3.2.1.2 Field Inspection Report

Document inspection results in a report prepared and signed by the manufacturer's technical representative for each visit. Submit the report to the Contracting Officer with the contractor's daily Quality Control report. The manufacturer's field inspection report must include a description of ongoing work observed and whether the inspected work was satisfactory or unsatisfactory. The final report must include certification by the manufacturer's technical representative that the work was performed in accordance with the manufacturer's instructions and contains no deficiencies. Submit the final [manufacturer's field inspection report](#) to the Contracting Officer within five working days of the final visit.

3.3.3 Samples of [Built-Up Roofing](#)

NOTE: This requirement is included for optional enforcement at the discretion of the Contracting Officer. It is not the intent to require cut samples on all roof projects.

After application of specified roofing felts and prior to applying surfacing, take field samples of built-up roofing as directed by the Contracting Officer. Take and test samples in accordance with [ASTM D3617](#) and at locations selected by the Contracting Officer immediately prior to cutting. Cut [100 mm by 1000 mm 4 inch by 40 inch](#) samples across felt laps in a manner to expose the specified number of plies. The [100 mm 4 inch](#) edge is required to coincide with an edge lap of felt and not be positioned over an end lap. Use [100 mm by 1000 mm 4 inch by 40 inch](#) samples for visual inspection. The Contracting Officer may inspect the samples for the specified number of plies, bond between plies, skips in interply moppings, uniform asphalt mopping, presence of excessive voids or large voids in the ply construction, presence of harmful foreign materials, visible presence of moisture in the sandwich and wet insulation. Use [300 mm by 300 mm 12 inch by 12 inch](#) cut samples to calculate bitumen quantities in accordance with [ASTM D3617](#) and directed by the Contracting Officer. Do not proceed with surfacing until all deficiencies disclosed as a result of cut tests have been corrected and approved by the Contracting Officer. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area and patch as specified.

Submit test reports on roofing field samples if testing is required, verifying the composition of each sample. Submit copies of laboratory analysis within 30 calendar days after samples are taken. Submit reports in accordance with [ASTM D3617](#).

3.3.3.1 Number of Cut Tests

Take cut samples as directed by the Contracting Officer for quality assurance validation or as necessary to determine the extent of deficiencies discovered in the construction. Except where cut samples are taken to investigate deficiencies, provide no more than two cut samples

per 1000 square meters 100 squares or one cut sample from each day's work.

3.3.3.2 Sample Cutting Device

Provide a rectangular, 100 mm by 1000 mm 4 inch by 40 inch template and 300 mm by 300 mm 12 inch by 12 inch template, of a type that results in accurate cutting of samples with standard roofing knives. Keep cutting edge of knife clean by washing in solvent after each cut.

3.3.3.3 Patching Cut-Out Area

Immediately after inspection, replace cut-out sample. When sample is needed for laboratory analysis or other circumstance makes it unavailable, substitute a new section of equivalent size and structure. For non-nailable decks, replace sample in hot asphalt. For nailable decks, insert one ply of ply felt into opening from which sample was taken and sprinkle nail to hold in place; coat felt heavily with asphalt roof cement and press cutout sample firmly into asphalt roof cement. Repair area of cut with new patch of the same number of plies as the primary roof membrane. Extend the first ply minimum 150 mm 6 inch all around the cut area. Extend each additional ply minimum 100 mm 4 inch beyond the previous ply.

[3.3.4 Roof Drain Test

NOTE: Include this paragraph when roof drains are required. Consult with structural engineer to verify loading capability of roof structural system.

After roofing system is complete except for surfacing, perform the following test of roof drains and adjacent roofing for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect the installation. Repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

]3.4 PROTECTION OF APPLIED ROOFING

3.4.1 Protection Against Moisture Absorption

When precipitation is imminent and at the end of each day's work, protect applied roofing as follows:

[3.4.2 Water Cutoffs

NOTE: Include this paragraph when roof insulation is a substrate for the modified bitumen sheet roofing.

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective

manner.[Seal off flutes in metal decking along the cutoff edge.] Remove the water cutoffs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

]3.4.3 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.4.4 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats, or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

[3.4.5 Glaze Coat

Use light glaze coating of bitumen to waterproof roof areas requiring extended time to complete, as directed by the Manufacturer. Apply bitumen glaze coat on exposed felts at a rate of 0.25 kg to 0.50 kg per square meter 5 to 10 pounds per square. Lower application rates, in accordance with membrane manufacturer's recommendations, may be required when modified bitumen cap sheet surfacing is specified. Provide valleys and low areas that may pond water with glaze coating.

]3.5 CLOSEOUT ACTIVITIES

[3.5.1 Infrared Inspection

NOTE: This optional requirement should be included only under special circumstances and on roof systems conducive to effective infrared scanning, or as otherwise instructed. This section may be necessary at project locations where infrared inspections cannot be performed during construction due to climate or other adverse conditions.

Prior to the installation of the gravel surfacing or cap sheet, the Contractor is required to inspect the roof surface using infrared (IR) scanning in the presence of the Contracting Officer in accordance with ASTM C1153. Where the IR inspection indicates moisture intrusion, replace wet insulation and damaged or deficient materials or construction in a manner to provide watertight construction and maintain the specified roof system warranties.[Coordinate infrared inspections with building envelope commissioning activities.]

]3.5.2 Information Card

For each roof, furnish a typewritten information card for facility records and a photoengraved 1 mm 0.032 inch thick aluminum card for exterior display. Provide card measuring 215 mm by 275 mm 8-1/2 by 11 inch minimum, identifying facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck

type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

3.5.3 Instructions to Government Personnel

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

-- End of Section --