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USACE / NAVFAC / AFCEC / NASA | UFGS-07 52 00 (May 2012)
Change 5 - 11/19

Preparing Activity: NAVFAC | Superseding
UFGS-07 52 00 (November 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

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SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING
05/12, CHG 5: 11/19

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NOTE: This guide specification covers the requirements for modified bitumen sheet roofing. Hot mopped asphalt, torch applied, hot air, and cold-applied adhesive applications are included on both existing and new roof systems with slopes from 6 mm to 76 mm 1/4 inch to 3 inches per foot. Both SBS and APP modified bitumen membranes are included.

Due to the potential for fires during roofing installations, torch application of the roofing system is prohibited when the roof deck and/or the materials used in the installation of the roofing system (wood blocking, cant strips, curbs, etc.) are "combustible" as defined by NFPA 101.

When combustible materials are used in the installation of roofing systems or are present on existing roofing conditions, delete all requirements related to torch applications, and select one of the alternate methods for installing Modified Bituminous Membrane Roofing systems.

Existing facilities may likely contain combustible materials underneath existing roofing systems. If the presence of combustible materials cannot be verified, delete all reference to torch applications and select one of the alternate methods of attachment.

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).

****

****

Acids, hydrocarbons, oil, and cooking greases attack modified sheet roofing. When these contaminants may be a problem on a roof, contact modified bitumen sheet manufacturers for specific recommendations.

Coordinate this section with other roof system components specifications such as rough carpentry, electrical, mechanical, insulation and sheet metal flashing, and structure. 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.

Requirements for special conditions, including Hurricane force wind (uplift) and seismic design considerations are included in brackets. References and paragraphs which do not apply to specific projects should be deleted.

****

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.

****

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 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.24	(2022) Roofing - Safety Requirements for Low-Sloped Roofs

ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)

ARMA 410BUR88	(2001) Manual of Roof Maintenance and Repair
ARMA PMBRG98	(1998) Quality Control Guideline for the Application of Polymer Modified Bitumen Roofing

ASTM INTERNATIONAL (ASTM)

ASTM C208	(2022) Standard Specification for Cellulosic Fiber Insulating Board
ASTM C552	(2022) Standard Specification for Cellular Glass Thermal Insulation
ASTM C578	(2022) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C726	(2017) Standard Specification for Mineral Wool Roof Insulation Board
ASTM C728	(2017a; R 2022) Standard Specification for Perlite Thermal Insulation Board
ASTM C1153	(2010; R 2015) Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C1289	(2023) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D312/D312M	(2016a) Standard Specification for Asphalt Used in Roofing
ASTM D1668/D1668M	(1997a; R 2014; E 2014) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D1863/D1863M	(2005; R 2011; E 2012) Mineral Aggregate Used on Built-Up Roofs

ASTM D1970/D1970M	(2019) 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 D2824/D2824M	(2018) Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, and Fibered without Asbestos
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) 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 D4897/D4897M	(2016) Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D5147/D5147M	(2014) Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
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 D6222/D6222M	(2016) Standard Specification for Atactic

	Polypropylene (ARP) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D6223/D6223M	(2016) Standard Specification for Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D6298	(2016) Standard Specification for Fiberglass Reinforced Styrene-Butadiene-Styrene (SBS) Modified Bituminous Sheet with a Factory Applied Metal Surface
ASTM E108	(2020a) Standard Test Methods for Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	(2022) Single-Ply, Polymer-Modified 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 http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2020) Occupational and Educational Personal Eye and Face Protection Devices

MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)

CERTA	(2007) NRCA/MRCA Certified Roofing Torch Applicator Program

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 58	(2020; TIA 20-1; TIA 20-2; TIA 20-3) Liquefied Petroleum Gas Code
NFPA 241	(2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA C3701	(1997) Repair Manual for Low Slope Membrane Roof Systems
NRCA CONDET	(2014) Construction Details Manual

NRCA RoofMan	(2020) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI/FM 4435/ES-1	(2017) Test Standard for Edge Systems Used with Low Slope Roofing Systems

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.12	Construction Work
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.16	Rules of Construction

UNDERWRITERS LABORATORIES (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 DESCRIPTION OF ROOF MEMBRANE SYSTEM[S]

****

NOTE: Coordinate with Part 2 materials specification.

Where one membrane system is required for all roof areas, use the first paragraph. Where different systems are required, use the second paragraph successively and replace the open brackets with a description of the substrate(s) and area of the building or project where each system is to be applied.

Specify the three-ply option including base sheet, interply sheet and cap sheet when mechanical fastening of bottom ply is required either directly to nailable deck or over insulation substrate and into nailable deck, and when perforated base sheet is used. Otherwise, specify two-ply option including modified bitumen base sheet and cap sheet.

Two-ply option may also be considered when the mechanical fastening of the modified bitumen base ply is concealed in the finished base ply installation (i.e., no exposed fasteners in the base ply prior to application of cap sheet such as occurs in base sheets fastened only in the side lap area and where the overlapping adjacent base sheet is torch sealed over the fasteners in the lap area).

Do not specify one ply modified bitumen roof membrane without prior Government approval and only consider for application on open air sheds or light storage structures and ancillary buildings of little importance. One ply membrane includes application of a single ply directly to deck or insulation substrate or over mechanically fastened or perforated base sheets.

Specify SBS for all hot asphalt membrane applications. Torch applied and cold adhesive applications may include either or both SBS and APP, selected based on the specific application and service conditions intended. Torch applications are prohibited on combustible roof decks or when combustible materials are used in the installation of the roofing system.

Felt base sheet may be specified in a low to moderate service three-ply application. Specify venting base sheet for application directly to new concrete deck and over nailable lightweight fill substrate materials.

****

[[Minimum [two-ply][three-ply] SBS [or] [APP] [modified bitumen roof membrane consisting of [modified bitumen base sheet][fiberglass felt [venting]base sheet] [,interply sheet] and cap sheet. Modified bitumen roof membrane must be [set in hot asphalt][torch applied]][set in cold-applied adhesive].]

][[_____]: Minimum [two-ply][three-ply] SBS [or] [APP] modified bitumen roof membrane consisting of [modified bitumen base sheet][fiberglass felt [venting] base sheet] [,interply sheet] and cap sheet. Modified bitumen roof membrane must be [set in hot asphalt][torch applied][set in cold-applied adhesive].

] All work must follow the NRCA RoofMan guidelines and standards stated within this Section.

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, Air Force, and NASA 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.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

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.][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-02 Shop Drawings

Roof Plan; G[, [_____]] drawing depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, as applicable

Field Inspection and Existing Conditions Report

Identify all fire safety issues including exposed or concealed combustible materials, which may require additional protection during roof installation.

SD-03 Product Data

Modified Bitumen Sheets; G[, [_____]]

[Heat Island Reduction; S

][Energy Star Label for Top Coating; S

][Asphalt

][Cold-Applied Membrane Adhesive; G[, [_____]]

][Fiberglass Felt; G[, [_____]]

] Primer; G[, [_____]]

Modified Bitumen Roof Cement; G[, [_____]]

[Pre-Manufactured Accessories

] Fasteners And Plates; G[, [_____]]

Sample Warranty certificate; G[, [_____]]

Submit all data required by Section 07 22 00 ROOF AND DECK INSULATION, together with requirements of this section. Include in data written acceptance by the roof membrane manufacturer of the products and accessories provided. Provide oroducts as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-05 Design Data

****
NOTE: Coordinate with requirements of WIND UPLIFT paragraph. Include bracketed requirement where non-rated systems may be permissible.
****

Wind Uplift Calculations; G[, [_____]]

[Provide Engineering calculations, signed, sealed, and dated by a qualified Engineer validating the wind resistance per ASCE 7-16, ASTM D4073/D4073M, and ANSI/SPRI/FM 4435/ES-1 of non-rated roof system.

] SD-07 Certificates

Provide evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph QUALIFICATION OF MANUFACTURER.

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph QUALIFICATION OF APPLICATOR.

****
NOTE: Include bracketed requirement when torch applications are permitted as an acceptable method of attachment.
****

[Qualification of Torch Operator; G[, [_____]]

Certify that the torch operator(s) meet requirements specified under paragraph QUALIFICATION OF TORCH OPERATOR. Submit a valid copy of each applicator's Certified Roofing Torch Applicator (CERTA) card.

] Qualification of Engineer of Record

Certify that the Engineer of Record is fully qualified, competent, and currently licensed to practice in the project jurisdiction.

****
NOTE: Include bracketed requirement when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

[Bill of Lading

Submit bill of lading when labels of asphalt containers do not bear the flash point (FP), finished blowing temperature (FBT), and equiviscous temperature (EVT).

] Wind Uplift Resistance; G[, [_____]] classification, as applicable

Fire Resistance classification; G[, [_____]]

Submit the roof system assembly [wind uplift and] fire rating classification listings.

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 (e.g., torch applied systems may not require asphalt in the installation).
****

Modified Bitumen Membrane Application; G[, [_____]]

Flashing; G[, [_____]]

[Temperature Limitations for Asphalt

][Torches

][Cold Adhesive Applied Modified Bitumen Membrane; G[, [_____]]

][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.

] Primer

Fasteners

Ventilating Base Sheets

[Coating Application; G[, [_____]]

] Cold Weather Installation; G[, [_____]]

Include detailed application instructions and standard manufacturer drawings altered as required 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.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To [Government][Contractor] Personnel

Include copies of Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials.

1.4 QUALITY ASSURANCE

****
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) or a registered professional engineer (PE) or registered architect (RA) that derives his or her principal income from roofing design on the quality control staff of the design team.
****

1.4.1 Qualification of Manufacturer

****
NOTE: Specify minimum five years manufacturer experience unless directed otherwise by the Government
****

Modified bitumen sheet roofing system manufacturer must have a minimum of [5][_____] years experience in manufacturing modified bitumen roofing products.

1.4.2 Qualification of Applicator

****
NOTE: Specify minimum three years as an approved contractor unless directed otherwise by the Government
****

Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and have a minimum of [five][_____] years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Qualification of Torch Operator

****
NOTE: Specify a CERTA certified torch applicator when torch applications are permitted.
****

Torch applicators must be CERTA certified to operate torch equipment and must maintain and carry a valid Certified Roofing Torch Applicator (CERTA) card.

1.4.4 Qualifications of Photovoltaics (PV) Rooftop Applicator

The PV rooftop applicator must be approved, authorized, or certified by a Roof Integrated Solar Energy (RISE) Certified Solar Roofing Professional (CSRP), and comply with applicable codes, standards, and regulatory requirements to maintain the weatherproofing abilities of both the integrated roof system and photovoltaic system.

1.4.5 Qualification of Engineer of Record

[Engineer of Record must be currently licensed within the jurisdiction of the project.

][Engineer of Record must be approved, authorized, and currently licensed by the state of [Florida][_____], and have a minimum of five years experience as an approved Engineer for manufacturers of similar roof systems. Engineer of Record must supply the names and locations of five projects of similar size and scope for which he has provided engineering calculations using the manufacturer's products submitted for this project within the previous three years. Engineer of Record must provide certified engineering calculations for:

] [Wind uplift requirements][in accordance with [Local and State codes]

ASCE 7-16,in accordance with International Building Code.

[Seismic requirements per [local] [and state] building codes]

[Seismic requirements per ICC IBC Chapter 16, Section 1608.3

][Snow load requirements per ICC IBC Chapter 16 Section 1608.3 and Section 7 of ASCE 7-16

]]1.4.6 Fire Resistance

Complete roof covering assembly must:

****

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

****

a. Be Class A [or B] 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.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.4.7 Wind Uplift Resistance

****

NOTE: Determine the required wind uplift resistance based on ASCE 7-16 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 2.2 kPa 45 psf. When a rated system is specified, ensure the specified roof system is capable of meeting the wind uplift resistance specified. Where non-rated systems may be permissible, include the bracketed option.

Delineate calculated values in the roof specification or 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 7-16] 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 7-16 and other applicable building code requirements.

1.4.8 Preroofing Conference

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

a. Drawings, including Roof Plan, 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 roof structure, and 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

e. Quality control, (ARMA PMBRG98) plan for the roof system installation

f. Field inspection and existing conditions report identifying all fire safety issues including exposed or concealed combustible materials, which may require additional protection during roof installation

g. Safety requirements

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing [and insulation], [torch operator,] flashing and sheet metal work, [[mechanical] [and] [electrical] work], other trades interfacing with the roof work, designated safety personnel trained to enforce and comply with ASSP A10.24,[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

****

NOTE: Include bracketed requirement when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.

****

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container must bear the specification number, type, and class, as applicable. [Labels or bill of lading for roofing asphalt must indicate asphalt type, FP, FBT, and 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.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or

closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 10 degrees C 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

Maintain a minimum distance of 10.67 meters 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper or tarps from all torch/welding applications.

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 in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 4.44 degrees C 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

[1.7 [TORCH][HOT-MOPPED ASPHALT] APPLIED [(HEAT WELD)] MODIFIED BITUMEN MEMBRANE SAFETY

****

NOTE: Retain the respective brackets and paragraphs indicating a "Torch Applied" system from the following requirements when membrane or flashing is torch applied.

Retain the respective brackets and paragraphs indicating a "Hot-Mopped Asphalt" application from the following requirements when membrane or flashing is hot-mopped applied.

If a combination of both torch applied and hot mopped applied systems is used, retain both sets of paragraphs and brackets.

****

1.7.1 Property Protection

Take all precautions necessary to prevent ignition of combustible materials during [torch application][hot-mopped asphalt application] of roofing. Immediately call the fire department if a fire commences.

Review all fire safety procedures as outlined at the pre-roofing conference.

****
NOTE: The following two paragraphs apply to both torch and hot-mopped application methods.
****

Install materials using the techniques recommended by CERTA NRCA/MRCA Certified Roofing Torch Applicator Program available from the National Roofing Contractors Association (NRCA) and the Midwest Roofing Contractors Association (MRCA) as endorsed by the Asphalt Roofing Manufacturers Association (ARMA) and the United Union of Roofers, Waterproofers and Allied Workers. Application procedures must comply with NFPA 241, OSHA 29 CFR 1910 and 29 CFR 1910.12, 29 CFR 1926.16, 29 CFR 1926 Subpart F.[, UL Fire Resistance Directory Volume No. 1, NRCA R&W Manual, and Florida Building Code Volume 2004.]

Do not store flammable liquids on the roof.

****
NOTE: Torch Applied
****

Provide a minimum of two 10 liter 2.65 gallon containers of water and two fully charged minimum [9.072 kg 20 pound CO2][9.072 kg 20 pound ABC (dry chemical)] fire extinguishers in separate, easily accessible locations on the roof and within [9.144 meters 30 foot][3.048 meters10 foot] of each [torch work area][hot-mopped kettle] at all times.

****
NOTE: Hot-Mopped Applied
****

No AsphaltKettles are allowed on roofs. Locate kettles and supply LP-Gas Cylinders safely and secured per NFPA 241 outside of the building's perimeter a minimum of 6.096 m 20 foot from the structure and any combustible materials.

Maintain a minimum separation of 6.096 m 20 foot between LP-Gas Cylinders and kettle. Provide protective fire retardant blanket barrier or shield between any building structure to a minimum height of 8 foot and a clear surround distance of 2.44 m 4 foot if operations force placement of kettle within a distance of 6.096 m 20 foot. Do not obstruct or place kettles or Cylinder storage within 3.048 m 10 foot of exits, means of egress, gates, roadways, entrances. Locate kettles downwind and away from any building air intakes.

Provide a minimum of two portable fully charged [9.072 kg 20 pound CO2] [9.072 kg 20 pound ABC (dry chemical)] fire extinguishers no closer than 1.524 m 5 foot and no further than 7.62 m 25 foot of horizontal travel distance from each kettle at all times while kettle is in operation, in easily accessible and identifiable locations. Also provide [a minimum of one][two] multipurpose 2-A:20-B:C portable fire extinguisher on the roof being covered or repaired.

Comply with the following safety procedures:

a. Fuel containers, burners, and related appurtenances of roofing

equipment in which liquefied petroleum gas is used for heating must comply with the requirements of NFPA 58.

b. Fuel containers having capacities greater than one pound must be located a minimum of 3.048 m 10 foot clear distance from the burner flame.

c. Clearly label all LP-Gas Cylinders as "Flammable Gas", and secure to prevent accidental tip-over.

d. Check all pressure regulators and hoses prior to use for proper functioning and integrity.

e. Turn off fuel supply at LP Gas Cylinder when kettle is not in use.

f. Equip all kettles with a functioning temperature measuring device to ensure no heating in excess of 10 degrees C 50 degrees F below the flash point.

g. Provide covers, lid, or top which are close fitting, constructed of minimum No.14 manufacturer's gauge steel, and can be gravity closed on all kettles.

h. Clean all roofing mops and rags free of excess asphalt and store safely away from all combustible materials. Store discarded roofing mops and rags in a non-combustible container and remove from site each day.

i. Position all pump lines handling hot asphalt securely and equip all pump lines with a shut-off valve on each with a coupler which may be opened when lines are full. Do not subject pump lines to pressures in excess of safe and recommended NRCA and ARMA working pressures. Station an operator near the equipment to cut off flow and care for other emergencies while conducting heating, pumping and application operations.

j. Asphalt bucket used by roofers or workers in similar trades must be constructed of minimum No. 24 gauge or heavier sheet steel and have a metal bail of no less than 6.35 mm 1/4 inch diameter material. The bail is to be fastened to offset ears or equivalent which have been riveted, welded, or otherwise safely and securely attached to the bucket. Soldered bail sockets are prohibited. Position workers and other employees to avoid being struck by bucket or other roofing materials, which may accidentally fall while being hoisted, lowered, or used in the roofing operation. Provide safety barriers and caution signs at all skylights or other roof holes.

k. Do not use flammable liquids with a flash point below 37.78 degrees C 100 degrees F (gasoline and similar products) for cleaning purposes.

Do not use solid fuel or Class I liquids as fuel for roofing asphalt kettles. Provide a minimum of one employee fully knowledgeable of kettle operations and hazards to maintain constant surveillance during kettle operation within a minimum distance of 7.62 m 25 foot of the kettle.

****

NOTE: Torch Applied and Hot-Mopped Applied

****

Check all fire extinguishers prior to commencement of work, and upon completion of the day's work, to ensure fullness and operability.

Project supervisor must make daily inspections with the facility manager of all conditions and operations which could present hazards during [torching][hot-mopped] applications and issue directives to address all such concerns and items of the work and existing conditions.

Identify and protect all combustible roof components, possible fire traps, and hidden hazards. Seal off voids or openings in the substrate with non-combustible materials prior to installing [torch-applied][hot-mopped applied] materials in the area. Install protective fire retardant blankets and shields at building walls, eaves, parapets and equipments curbs constructed of combustible materials within 0.9144 meter 3 foot radius of the area of [torch work][hot-mopped kettle] prior to commencement of the work.

When working around intakes and openings, temporarily disconnect and block to prevent [flame of torch][fumes from kettle] from being drawn into the opening.[Provide non-combustible shielding or flame guard protection where gaps or voids occur in the construction in area of torch work.]

1.7.2 Fire Watch

****
NOTE: Torch Applied and Hot-Mopped Applied
****

All personnel on the roof during [torch application][hot-mopped application] must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of [two 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 160x120 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 two 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. Camera must have a manufacturer's certificate of calibration, and the use of the camera must be in compliance with Installation security policies.]

****
NOTE: Torch Applied
****

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: Torch Applied and Hot-Mopped Applied
****

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.

****
NOTE: Torch Applied
****

1.7.3 Open Flame Application (Torch) Equipment and Personnel Safety

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.

****
NOTE: Torch Applied and Hot-Mopped Applied
****

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 must 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, be made of non-flammable materials. No polyester allowed.

d. Heavy leather gloves and flame retardant gauntlets which must be worn during all handling of a torch, whether operating or not.

e. OSHA and ANSI/ISEA Z87.1 approved face shields, goggles or safety glasses to be worn during torching and any other applicable roofing functions.

f. OSHA and ANSI approved hard hats.

1.7.4 Wind Conditions

Use side shields with all torching operations when winds are occurring to

prevent flame distortion of end burners. Use torch machine equipment with bottom shield plate to prevent flame spread on to roof deck and substrate. When high wind gusts are present, notify the safety officer and cease all use of torching equipment until wind conditions lower and authorization from the safety officer to proceed is received.

]1.8 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counter flashing, per NRCA CONDET, and are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials.[Apply roofing 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 with roof membrane installation the same day.]

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years.

1.9.1 Roof Membrane Manufacturer Warranty

****

NOTE: 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 intrusion and any time a one-ply modified bitumen membrane system is specified. Environmentally controlled interiors with one-ply membrane require a minimum 10 year warranty.

****

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation in compliance with [ASTM C1289], and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

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. When the manufacturer or his approved applicator fail to perform the

repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

c. Upon completion of installation, and acceptance by the [Contracting Officer] [, Architect][, Construction Manager] and Roofing System Engineer of Record, the manufacturer must supply the appropriate warranty to the Owner.

d. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the [Contracting Officer] [, Architect][, Construction Manager] and Roofing System Engineer of Record.

1.9.2 Roofing System Installer Warranty

The roof system installer must warrant for a period of two 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 roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.9.3 Continuance of Warranty

Repair or replacement work, ARMA 410BUR88, NRCA C3701 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.

1.10 CONFORMANCE AND COMPATIBILITY

Provide the entire roofing and flashing system in accordance with specified and indicated requirements, including fire and wind resistance (ANSI/SPRI/FM 4435/ES-1) requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA Roofing and Waterproofing Manual, 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.

1.11 ELIMINATION, PREVENTION OF FALL HAZARDS

****

NOTE: Any part or component of the building, facility, structure, or equipment requiring future maintenance work must incorporate in the design fall prevention methods or techniques to eliminate fall hazards, 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.

****

1.11.1 Fall Protection

[_____]

PART 2 PRODUCTS

****

NOTE: Edit the materials specification requirements as necessary for the system(s) specified in PART 1 - DESCRIPTION OF ROOF MEMBRANE SYSTEM.

See the Note in PART 1 - DESCRIPTION OF ROOF MEMBRANE SYSTEM 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 are prohibited on combustible roof decks or when combustible materials are used in the roofing installation; torch applied systems may not require asphalt in the installation; granule surfaced cap sheets do not require gravel or coating surfacing).

****

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

2.1.1 Energy [and Cool Roof] Performance

****

NOTE: Standards such as UFC 1-200-02 promote the use of cool roofing, and increased energy conservation through additional insulation. Design cool roofs following the requirements in UFC 3-110-03 "Roofing" Chapter 1, Cool Roofs. 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. Design mechanically-fastened single-ply roof systems in accordance with the requirements in UFC 3-110-03 Roofing, Chapter 2. 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 four years of service. See Appendix B of UFC 3-110-03 for more information. Inadequate 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 as a result 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: Facilities with dominant cooling loads or in mild or warm climate zones are required to meet "cool roofing" requirements of FEMP. Design cool roofs following the requirements in UFC 3-110-03 Roofing, Appendix B and ASHRAE 90.1 Chapter 5, for the insulation and energy performance of the building.

NOTE: If a cool roof is not selected in ASHRAE zones 1 thru 3, design must 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. Coordinate these requirements with insulation design and specifications.

Retain the next to last bracketed note for project 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.[The roofing system will need to include 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 MODIFIED BITUMEN SHEETS AND FIBERGLASS FELT MATERIALS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Provide materials suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must comply with ARMA PMBRG98 and be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

****

NOTE: Select the base sheet option required and delete other base sheet options. Specify base

sheets under insulation in the insulation specification section.

Specify modified bitumen base sheet for two-ply membrane systems and incorporate in three-ply membrane systems.

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.

****

[a. Venting Base Sheet: ASTM D4897/D4897M, Type II, [without][with] perforations and as approved by the modified bitumen roof membrane manufacturer.

][b. Fiberglass Felt Base Sheet: ASTM D4601/D4601M,ASTM D1668/D1668M Type II, [without][with] perforations and as approved by the modified bitumen roof membrane manufacturer.

]

****

NOTE: When specifying a two-ply membrane system or application over a fiberglass felt base sheet, delete any reference to Interply sheet. Use modified bitumen base sheet and cap sheet.

Specify polyester-reinforced membrane for high traffic roofs and where enhanced puncture resistance and overall durability are required. Where polyester reinforced sheet is required, delete any reference to ASTM D6163/D6163M.

Do not specify fiberglass membrane layer over a polyester-reinforced membrane layer.

Specify Type II modified bitumen materials for all two-ply membrane installations, heavy-duty or high traffic service conditions and for all instances where fiberglass reinforced modified bitumen cap sheets are permitted.

****

[c. SBS Base Sheet: [ASTM D6162/D6162M] [or] [ASTM D6164/D6164M] [or] [ASTM D6163/D6163M], Type [I or] II, Grade S, minimum 2.0 mm 80 mils thick.

][d. SBS Interply Sheet: [ASTM D6162/D6162M] [or] [ASTM D6164/D6164M] [or] [ASTM D6163/D6163M], Type [I or] II, Grade S, minimum 2.0 mm 80 mils thick.

]

****

NOTE: Specify Grade S cap sheet only with the approval of the Government and when gravel surfacing or field applied coating is required in lieu of factory-applied mineral granule surfacing.

Specify 3.7 mm 145 mils minimum thickness for SBS cap sheet unless directed otherwise by the Government.

****

[e. SBS Cap Sheet: [ASTM D6162/D6162M] [or] [ASTM D6164/D6164M] [or] [ASTM D6163/D6163M]; Type II, Grade [G][S], minimum [3.7 mm 145 mils] [_____] thick, and as required to provide specified fire safety rating.

]

[f. APP Base Sheet: ASTM D6222/D6222M, Type I or II; or ASTM D6223/D6223M; Grade [G][S], minimum 3.5 mm 140 mils thick.

]

****

NOTE: Specify Grade S cap sheet only with the approval of the Government and when gravel surfacing or field applied coating is required in lieu of factory-applied mineral granule surfacing.

Specify minimum 4 mm 160 mil APP cap sheet thickness unless directed otherwise by the Government.

****

[g. APP Cap Sheet: ASTM D6222/D6222M, Type II; or ASTM D6223/D6223M; Grade [G][S], minimum 4.0 mm 160 mils thick.

]2.3 BASE FLASHING MEMBRANE

****

NOTE: Include metal clad flashing membrane option only where the foil surfacing will not create an aesthetic issue and reflectance of no concern. Do not specify foil surfaced materials for facilities along flight line or adjacent to telemetry or tracking equipment.

Metal clad membrane flashing should not be considered effective grease protection for the flashing or roof membrane in areas where the roof may be exposed to cooking grease release. Lap areas remain susceptible to degradation from exposure to grease and solvents.

****

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Provide flashing membranes that meet or exceed the properties of the material standards specified for the modified bitumen [base][, interply] and cap sheet, except that flashing membrane thickness must be as recommended by the membrane manufacturer.[Provide metal clad flashing membrane that complies with ASTM D6298].

[2.4 ASPHALT

****

NOTE: Include paragraph or bracketed requirement when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

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

][2.5 COLD-APPLIED MEMBRANE ADHESIVE

****
NOTE: Materials standards and application requirements vary for cold applied membrane adhesives. Ensure product data and application instructions are included under "Submittals" when cold-process membrane applications are specified. This information will be referenced by the field personnel in monitoring the application process.

Consider low VOC adhesives for cold-process applications on occupied buildings and when otherwise necessary.
****

Membrane manufacturer's recommended [low volatile organic compound (VOC)] cold process adhesive for application of the membrane plies.

][2.6 MEMBRANE SURFACING

****
NOTE: Coordinate surfacing requirements with the type of system specified in paragraph DESCRIPTION OF ROOF MEMBRANE SYSTEM. Specify factory-applied granule surfaced membrane except under non-typical conditions where aggregate or coating applications may be considered. Factory-applied granules or aggregate surfacing should be used where possible. Specify required finished membrane surfacing. Delete other options.
****

Provide modified bitumen roof membrane cap sheet with factory-applied granule surfacing of [light][_____] color [as selected from membrane manufacturer's standard colors].[Provide modified bitumen membrane manufacturer's recommended field-applied protective coating of [white][light gray][_____] color.[Provide aluminized coating that complies with ASTM D2824/D2824M, Type I or III, as recommended by the modified bitumen roof membrane manufacturer].][Light colored, opaque water-worn gravel aggregate surfacing material conforming to ASTM D1863/D1863M, or other aggregate as recommended by the membrane manufacturer and approved by the Contracting Officer[, and applied in flood coat of hot asphalt].]

]2.7 PRIMER

ASTM D41/D41M, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.8 MODIFIED BITUMEN ROOF CEMENT

ASTM D4586/D4586M, Type II for vertical surfaces, Type I for horizontal surfaces, compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.9 CANT AND TAPERED EDGE 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).

The use of wood cants on new NASA projects is not allowed.

If wood cants and/or tapered edge strips are used in the installation of the roof, torch application of the system is prohibited.

****

Provide standard cants and tapered edge strips of [perlite conforming to ASTM C728][the same material as the roof insulation][or when roof insulation material is not available, provide pressure preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the manufacturer.] [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. Cant strips must be minimum [38.1 mm 1-1/2 inch thick and provide for minimum 127 mm 5 inch face and 88.9 mm 3-1/2 inch vertical height when installed at 45 degree face angle][101.6 mm 4 inch vertical height with 45 degree cant angle], except where clearance restricts height to lesser dimension. Taper edge strips at a rate of 25.4 mm to 38.1 mm per 304.8 mm one to 1-1/2 inch per foot to a minimum of 3.175 mm 1/8 inch of thickness. Provide kiln-dried preservative-treated wood cants, in compliance with requirements of Section 06 10 00 ROUGH CARPENTRY at base of wood nailers set on edge and wood curbing and where otherwise indicated.

2.10 FASTENERS AND PLATES

****

NOTE: If fastening of membrane or felts to wood materials is required, torch application of the roofing system is prohibited.

****

Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 25.4 mm 1 inch diameter metal discs, or one piece composite fasteners with heads not less than 25.4 mm 1 inch in diameter or 25.4 mm 1 inch square with rounded or 45 degree tapered corners.

2.10.1 Masonry or Concrete Walls and Vertical Surfaces

Use hardened steel nails or screws with flat heads, diamond shaped points,

and mechanically deformed shanks not less than 25.4 mm 1 inch long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fastenersonly when approved in writing by the Contracting Officer.

2.10.2 Metal Plates

Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 50.8 mm 2 inch in diameter. Form discs to prevent dishing or cupping.

[2.11 PRE-MANUFACTURED ACCESSORIES

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

Pre-manufactured accessories must be manufacturer's standard for intended purpose,[comply with applicable specification section,] compatible with the membrane roof system and approved for use by the modified bitumen membrane manufacturer.

[2.11.1 Pre-fabricated Curbs

Provide [_____] gauge [G90 galvanized][AZ55 galvalume][_____] curbs with minimum 101.6 mm 4 inch flange for attachment to roof nailers. Curbs must be minimum height of 254 mm 10 inch above the finished roof membrane surface.

][2.11.2 Elevated Metal [Walkways] [and] [Platforms]

As specified in Section[05 50 13 MISCELLANEOUS METAL FABRICATIONS][05 51 33 METAL LADDERS][05 52 00 METAL RAILINGS][05 51 00 METAL STAIRS].

]][2.12 WALKPADS

****
NOTE: Use walkpads as walkways and 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 roof walkpads that are polyester reinforced, granule-surfaced modified bitumen membrane material, minimum [_____] [5 mm] [_____][197] mils thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels must not exceed 1.219 meters 4 foot in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

][2.13 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 38.1 mm 1-1/2 inch thick, minimum 457 mm 18 inch square for walkways and minimum 152.4 mm by 304.8 mm 6 inch by 12 inch for use in supporting surface bearing components but extending not less than 50.8 mm 2 inch beyond all sides of surface bearing bases. Install walkpad material under all paver blocks.

][2.14 ROOF INSULATION BELOW MODIFIED BITUMEN 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 to be 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 and meeting all the requirements of [ASTM C552][ASTM C578][ASTM C726] as specified in Section 07 22 00 ROOF AND DECK INSULATION.

]2.15 MEMBRANE LINER

Provide self-adhering modified bitumen underlayment conforming to ASTM D1970/D1970M, EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material as approved by the Contracting Officer.

[2.16 TOP COATING

****
NOTE: Top coatings can provide Energy Star classification when applied as final surface. Typical colors are white, tan, and other light colors. In review of the overall performance of the roof, color and materials specified earlier in this specification, the designer has the option to include Energy Star rating by including the paragraph below.
****

Provide a top coating product that is Energy Star labeled and is produced and compatible with the roof material of this specification. Provide data identifying Energy Star label for top coating product. Install to the manufacturer's written installation methods. Provide written confirmation that installation of a top coat will not modify or void the required roof warranty.

]2.17 PHOTOVOLTAIC (PV) SYSTEMS - RACK MOUNTED SYSTEMS

****

NOTE: The installation of a PV roof system over existing roof systems should be undertaken with extreme caution. Do not install PV systems on roofs with a shorter expected service life than the new PV system. Prior to the design of such systems the following must be undertaken:

a. Determine if the existing roof structure can handle the anticipated roof load increase.

b. Inspect and determine that the existing roof system has at least 10 years of service life remaining. If not, remove the existing roof and provide a new replacement roof system design in tandem with the photovoltaic system.

c. If 10 years remaining service life remains, ensure the design of the intersecting details, required roof protection, re-inspections, and warranty requirements for maintaining the roof system has been coordinated with the installation and manufacturers' warranties.

d. Design the roof related details for anticipated roof replacement work. Coordinate with the PV system designer to anticipate and plan for future roof replacement.

e. PV equipment on a rooftop creates additional roof protection requirements during initial installation and throughout the PV life-cycle. Ensure a roof protection program is specified during the PV system installation.

f. Permanently affix PV supports to stanchions which are anchored to the building structure.

****

Adhere to the following guidelines:

a. Building Owners Guide to Roof-mounted PV Systems, published by NRCA.

b. Guidelines for Roof-Mounted PV Systems, published by NRCA.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

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 from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.

d. The plane of the substrate does not vary more than 6.35 mm 1/4 inch within an area 3.048 by 3.048 meters 10 by 10 foot when checked with a 3.048 meter 10 foot straight edge placed anywhere on the substrate.

e. Substrate is sloped as indicated to provide positive drainage.

f. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.

g. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 203.2 mm 8 inch above finished roofing surface.

h. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.

i. Verify all Fire Watch personnel assignments.

****

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.

****

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

****

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

****

k. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 88.9 mm 3-1/2 inch.

****

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

****

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

[(1) Edge Venting: Perimeter nailers are kerfed across the 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.

]]m. Exposed nail heads in wood substrates are properly set. Warped and split [boards] [sheets] have been replaced. There are no cracks or end joints 6.35 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 or otherwise sealed to prevent air leakage from the underside.]

[n. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6.35 mm 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

][o. Cast-in-place substrates have been allowed to cure and the surface dryness requirements specified under paragraph FIELD QUALITY CONTROL have been met.

][p. Joints between precast concrete deck units are grouted, leveled, and stripped in with felt or bituminous stripping membrane set in bituminous cement prior to applying other roofing materials over the area.

] q. Roof deck and framing are sloped as indicated to provide positive drainage.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

****
NOTE: Include bracketed requirement when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

Install protective coverings at paving and building walls adjacent to hoists[, tankers][, and kettles] prior to starting the work. Lap protective coverings not less than 15.24 cm 6 inch, 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.

[#### 3.2.1.2 Bitumen Stops

****
NOTE: Include paragraph when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

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.

][3.2.2 Equipment

****
NOTE: Select equipment references as applicable to the project. Delete paragraphs that are not applicable.
****

[3.2.2.1 Mechanical Application Devices

Mount mechanical application devices on pneumatic-tired wheels. Use devices designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

][3.2.2.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

][3.2.2.3 Open Flame Application Equipment

****
NOTE: Include this requirement when torch-applied modified bitumen sheet roofing is specified or when torch application of base flashing is permitted.

Remove this requirement when the roof deck or materials associated with the installation of the roofing system are combustible and have the potential to ignite in torch applications.
****

Utilize torches and other open flame equipment specifically designated for use in application of modified bitumen materials and approved by the modified bitumen sheet manufacturer. Open flame equipment must not be ignited (burning) when left unattended. Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof. Specific requirements for fire watches and burn permits exist. These requirements will be reviewed at the preroofing conference.

]3.2.2.4 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

][3.2.3 Heating of Asphalt

****
NOTE: Include paragraph when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

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. Utilize kettles with visible working thermometer and

thermostatic controls set to the temperature limits specified herein. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus one degree C 1.8 degrees F, to check temperatures of the asphalt frequently. When temperatures exceed maximums specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

[3.2.3.1 Temperature Limitations for Asphalt

****
NOTE: Include paragraph when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

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 between 260 and 274 degrees C 500 and 525 degrees F for longer than four consecutive hours. Do not heat asphalt to 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) but not less than 204 degrees C 400 degrees F. 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.

]]3.2.4 Priming of Surfaces

Prime all surfaces to be 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 modified bitumen sheet 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 applications.

3.2.4.1 Priming of Concrete and Masonry Surfaces

****
NOTE: Include this paragraph when roofing and 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 membrane materials uniformly with primer.

3.2.4.2 Priming of Metal Surfaces

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

3.2.5 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of

30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.6 Substrate Preparation

Apply membrane to clean, dry surfaces only. Do not apply membrane to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application. Torches may not be used to ensure clean, dry surfaces prior to membrane applications if the roof deck or materials used in the installation of the roofing system are combustible.

3.3 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. 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 temperatures for asphalt. [Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.]

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. If cap sheet installation is delayed, thoroughly clean the applied membrane material surface and dry immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.

3.3.2 Temporary Roofing and Flashing

****

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

****

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing [cooling towers,] [antennas,] [pipes,] [ducts,] [_____,] is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's 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.

[3.3.2.1 Removal

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

]3.3.3 Application Method

****
NOTE: Specify the applicable application method(s) and distinguish any varying requirements or options related to membrane and base flashing (e.g., in general manufacturer may allow base flashing membrane to be torched provided that the roof deck and materials used in the installation of the roofing system are non-combustible, or set in cold adhesive on hot mopped roof membrane installations; however, this may or may not be desirable for a specific project installation.).
****

[3.3.3.1 Hot Asphalt Application of Modified Bitumen Membrane

****
NOTE: Include paragraph when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

Apply membrane immediately following application of hot asphalt. Apply hot asphalt within 1.829 m 6 foot of roll. Do not work ahead with asphalt. Asphalt must be completely fluid, with mop temperatures within the asphalt's EVT range, but not less than 204.4 degrees C 400 degrees F, at the instant membrane comes into contact with asphalt. Apply bitumen between layers to provide full, continuous, uniform coverage and complete contact of hot asphalt with the sheet above and below. Embed sheets in asphalt. As sheets are being rolled into hot asphalt, immediately and thoroughly apply uniform positive pressure by squeegee, roll, or broom to ensure full adhesion and lap seal, eliminate trapped air and to provide tight, smooth laminations. Avoid excessive extrusion of asphalt at lap areas. Control asphalt bleed out to approximately 25.4 mm 1 inch maximum.

]3.3.3.2 Torch Applied [Heat Welded] Modified Bitumen Membrane [Flashing]

****
NOTE: Include the first bracketed sentence if base flashing may be torch-applied on hot mopped membrane work. Include requirement to roll lap areas with weighted roller when heat welding technique is specified.

Delete the first bracketed sentence and the bracketed references to "either" and "torch" when the roof deck or materials used in the installation of the roofing system are combustible.

Where heat welding is specified, coordinate with language in "Description of Roof Membrane System" and other parts of this specification.
****

[Base flashing membrane may be torch applied.] Ensure substrate membrane surfaces are warmed[either] naturally[or by torch] during the installation. Apply heat evenly to underside of roll membrane being installed and exposed side lap area of previously installed sheet. Provide for slight, uniform flow of bitumen in front of roll and full width of roll as the material is being rolled or set into place. Apply uniform positive pressure to ensure membrane is fully adhered and all laps are sealed. Prior to forming lap over granulated surfaces, embed granules of the receiving sheet by heating and troweling-in the granules to form a uniform black compound surface. [Roll all lap areas with a weighted roller immediately after forming lap. Provide for visual bleed out of compound in lap areas.][Avoid overheating the membrane or burning through to membrane reinforcement. Inspect and ensure all lap areas are fully sealed.

][3.3.3.3 Cold Adhesive Applied Modified Bitumen Membrane

Apply cold adhesive with airless sprayer or 6.35 mm 1/4 inch saw-toothed rubber squeegee to prepared surfaces in accordance with membrane manufacturer's application instructions. Fully cover substrate with adhesive. Roll or lay membrane in adhesive in accordance with manufacturer's recommendations and within the time limitations of adhesive application. Broom the membrane to ensure full contact with adhesive. Seal laps with adhesive or by heat fusing with hot air welder as required by membrane manufacturer. Minimize traffic on installed membrane during the adhesive cure and set time.

][3.3.4 Ventilating Base Sheets

****

NOTE: Include this paragraph when ventilating base sheets are specified in the paragraph DESCRIPTION OF ROOF MEMBRANE SYSTEM and in the absence of rigid board roof insulation. Include mechanical attachment or top mop requirements as applicable. Where rigid board roof insulation is a component of the roof system, ventilating base sheets should be specified in the roof insulation section 07 22 00 ROOF AND DECK INSULATION.

****

Apply ventilating base sheets with 76.2 mm 3 inch side laps and 152.4 mm 6 inch end laps in accordance with manufacturer's printed application instructions for substrate [and wind uplift conditions]specified. [Provide mechanical attachments as required for wind resistance specified and to include increased frequency of attachment at corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate.][Top mop perforated sheet with a full, continuous mopping of hot asphalt.]

]3.3.5 [Fiberglass Felt][Modified Bitumen] Base Sheet

****

NOTE: Select the applicable application method. Delete other options. Delete requirements for adhered base sheets where the sheet is to be 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 one 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.] [Spot adhere base sheets with hot asphalt applied in 304.8 mm 12 inch diameter spots installed in two staggered rows, centered 304.8 mm 12 inch in from edge of the base sheet.][Apply cold adhesive with airless sprayer or a 6.35 mm 1/4 inch saw-toothed rubber squeegee and at application rate recommended by the membrane manufacturer. Fully cover substrate with cold adhesive. Ensure laps areas of base sheet are fully sealed.] Roll and broom in the base sheet to ensure full contact with the [hot asphalt][adhesive] 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, mechanically fasten base sheet 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 50.8 mm 2 inch unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 152.4 mm 6 inch and staggered a minimum of 914.4 mm 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 457.2 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 50.8 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. Application must be free of ridges, wrinkles, and buckles.

3.3.6 Modified Bitumen Membrane Application

****
NOTE: On slopes up to 1:6 (2 inches per foot), specify membrane application perpendicular to slope of roof. On slopes greater than or equal to 1:6 (2 inches per foot), specify membrane application parallel to roof slope.
****

Ensure proper sheet alignment prior to installation. [Apply membrane layers perpendicular to slope of roof in shingle fashion to shed water, including application on areas of tapered insulation that change slope direction.][Apply membrane layers parallel to slope of roof.] Bucking or backwater laps are prohibited. Fully adhere membrane sheets to underlying substrate materials. Provide minimum 76.2 mm 3 inch side laps and minimum 152.4 mm 6 inch end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 914.4 mm 36 inch. Offset side laps between membrane layers a minimum of 304.8 mm 12 inch. Offset end

laps between membrane layers a minimum of 914.4 mm 36 inch. Install all membrane layers the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application must be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.3.6.1 Cap Sheet Installation

****

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 provided that the roof deck and materials used in the installation of the roofing system are non-combustible. Torch application of cap sheet may reduce instances of cap sheet blistering.

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

****

Underlying applied membrane must be inspected and repaired 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. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. [Set cap sheet in hot asphalt or torch apply as recommended by the modified bitumen membrane manufacturer when the roof deck and materials used in the installation of the roofing system are non-combustible.] Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. [Apply matching granules in any areas of [bitumen][adhesive] bleed out while the [asphalt is still hot][adhesive is still tacky].] Minimize traffic on newly installed cap sheet membrane.

[3.3.6.2 Backnailing of Cap Sheet

****

NOTE: Include this paragraph for roof slopes greater than or equal to 1:6 (2 inches 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 modified bitumen membrane manufacturer and approved by the Contracting Officer, provide minimum 88.9 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 4.88 m 16 foot on center unless approved otherwise by the Contracting Officer. Coordinate the nailer installation with insulation requirements. 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 25.4 mm 1 inch of each edge of the sheet and at 203.2 mm to 215.9 mm 8 inch to 8-1/2 inch on center across the width of the sheet in a staggered fashion. Nails must have 25.4 mm 1 inch diameter metal cap or be nailed through 25.4 mm 1 inch diameter caps. Cover nails by overlapping adjacent upslope sheet at the end lap area.

]3.3.7 Membrane Flashing

Apply two-ply modified bitumen 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. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. 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 modified bituminous base flashing 150 mm (6 inches) on center through minimum 25.4 mm 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate.[Apply matching granules in any areas of [asphalt][adhesive] bleed out while the [asphalt is still hot][adhesive is still tacky].] 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. Metal flashing per SMACNA 1793 guidelines and standards is specified under Section 07 60 00 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

3.3.7.1 Membrane Strip Flashing

Set primed flanges of metal flashing in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 101.6 mm 4 inch beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 101.6 mm 4 inch beyond edge of previous ply.

[3.3.7.2 Membrane Flashing at Roof Drain

****
NOTE: Include this paragraph when roof drains are indicated.
****

Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, is specified in Section 07 60 00 FLASHING AND SHEET METAL. Extend membrane sheets to edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp membrane sheets and metal roof drain flashing and strip flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds. Trim stripping must be flush with inside of clamping ring.

][3.3.7.3 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flash with modified bitumen membrane.

]3.3.7.4 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.

3.3.7.5 Lightning Protection

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

3.3.8 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 152.4 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.

[3.3.9 Elevated Metal [Walkways] [and] [Platforms]

Install over completed roof system in accordance with [Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS]. Provide for protection of roof membrane by placing walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

]3.3.10 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 cap sheet] applied over the completed roof membrane.

[3.3.11 Field Applied Surfacing

****
NOTE: Delete FIELD APPLIED SURFACING and associated paragraphs if factory-applied granule surfaced membrane is specified. Otherwise, include only the applicable surfacing, delete all others.
****

After completion of roof membrane and flashing installation, and correction of tears, gouges, and other deficiencies in the installed work, apply specified surfacing.

[3.3.11.1 Aggregate

Uniformly flood coat the surface with hot asphalt at a rate of approximate 27.2 kg 60 pounds per square. While asphalt is still hot, apply gravel aggregate surfacing material at a rate of 181.4 kg 400 pounds per square or 136.1 kg 300 pounds per square for slag or other approved aggregate surfacing. Provide for full and uniform coverage of the roof surface. Solidly adhere approximately 50 percent of the aggregate in the asphalt.

][3.3.11.2 Coating Application

Apply surface coating materials to membrane and flashing in accordance with coating material manufacturer's recommendations.

]]3.3.12 Correction of Deficiencies

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.

3.3.13 Clean Up

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

3.4 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.

3.5 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

[3.5.1 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 cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

]3.5.2 Temporary Flashing for Permanent Roofing

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

3.5.3 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.

3.6 FIELD QUALITY CONTROL

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

[3.6.1 Test for Surface Dryness

****
NOTE: Include paragraph or bracketed requirement when hot-mopped membranes are used or base sheets are hot-mopped to non-nailable substrates.
****

Before application of membrane sheets and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to which membrane materials are to be applied, one pint of asphalt when heated in the range of 176 to 204 degrees C 350 to 400 degrees F, must not foam upon contact.

b. Strippability: On cementitious substrate surfaces, after asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be 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.

]3.6.2 Construction Monitoring

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

a. Materials comply with the specified requirements.

b. Materials are not installed in adverse weather conditions.

All materials are properly stored, handled and protected from moisture or other damages.

c. Equipment is in working order. Metering devices are accurate.

d. 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.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(2) The proper number, type, and spacing of fasteners are installed.

Membrane heating, hot mopping, or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials. Asphalt is heated and applied within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

(3) Lap areas of all plies are completely sealed.

Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

[3.6.2.1 Manufacturer's Inspection

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NOTE: Include this paragraph when manufacturer's inspection of work is required. Select desired frequency of manufacturer inspection and coordinate with text of optional second and third bracketed sentences.

****

Manufacturer's technical representative must visit the site a minimum of three [_____] times [once per week] during the installation for purposes of reviewing materials installation practices and adequacy of work in place.
[Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer.] After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

]3.6.3 Samples of Roofing

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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.

****

Take samples per ASTM D5147/D5147M, sized 101.6 mm by 1016 mm 4-inch by 40-inch cut across width of modified bitumen sheets as directed by the Contracting Officer. Cut samples will be examined by the Contracting Officer for specified number of plies, proper lap width, complete lap seal, full uniform adhesive compound application and adhesion, full bond between plies, harmful foreign materials, presence of moisture, and wet insulation. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area in bed of modified bitumen cement. Repair area of cut with new minimum two-ply modified bitumen membrane patch.

3.6.4 Roof Drain Test

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

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After completing roofing, but prior to Government acceptance, perform the following test for watertight integrity. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the 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 installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

[3.7 INFRARED INSPECTION

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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.

****

[Eight][_____] months after completion of the roofing system, the Contractor must inspect the roof surface using infrared (IR) scanning as specified in 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.]

]3.8 INSTRUCTIONS TO [GOVERNMENT][CONTRACTOR] PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen 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.

3.9 INFORMATION CARD

For each roof, furnish a typewritten information card for facility Records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm 0.039 inch thick aluminum card for exterior display. Card must be 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.

-- End of Section --