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USACE / NAVFAC / AFCEC **UFGS-07 55 00 (August 2025)**

Preparing Activity: USACE **Superseding**
UFGS-07 55 00 (August 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2026
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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 55 00

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08/25

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SECTION 07 55 00

PROTECTED MEMBRANE ROOFING
08/25

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NOTE: This guide specification covers the requirements for protected membrane roof system.

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).

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PART 1 GENERAL

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NOTE: This specification covers a roofing system in which the membrane is protected by an overlay of extruded polystyrene insulation, a filter fabric, and a layer of ballast on top. The surface of overhangs must be sealed to prevent leakage of air and, therefore, uplift. For additional guidance on PMR, the designer should consult the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual.

Roof must be constructed with a minimum slope of 1 to 48, and a maximum slope of 1 to 6. Drainage is critical as the insulation will float if submerged and not adequately ballasted. Where internal drains are not used, ice dams may occur at eaves and

scuppers. For guidance on flashings and drainage details, the designers should consult the SMACNA "Architectural Sheet Metal Manual."

Undersides of the deck, including overhangs, should be sealed when using loose-laid protected membrane to prevent wind from pressurizing the underside of the membrane.

Bituminous membranes should be flood-coated and not surfaced with aggregate. Polystyrene should not be placed in contact with asphalt.

Except where exposed drain baskets pose a safety hazard, there must be an opening in the insulation, filter fabric, and ballast above each drain basket. Pavers above hidden drains will be marked so that the drains can be inspected periodically.

Designer should require materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage of recycling and conserve natural resources.

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1.1 REFERENCES

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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.

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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. Refer to publications latest published version / edition with most recent changes and edits.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2023) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C578	(2023) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C726	(2024) Standard Specification for Mineral Wool Roof Insulation Board
ASTM C1177/C1177M	(2024) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1396/C1396M	(2024) Standard Specification for Gypsum Board
ASTM D448	(2012; R 2017) Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D751	(2019) Standard Test Methods for Coated Fabrics
ASTM D4073/D4073M	(2006; E 2019; R 2019) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D5034	(2009; R 2017) Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide https://www.approvalguide.com/

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2025) 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	(2024; TIA 24-2) Liquefied Petroleum Gas Code
NFPA 241	(2022; ERTA 22-1) Standard for Safeguarding Construction, Alteration, and

	Demolition Operations

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2025) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI/FM 4435/ES-1	(2017) Test Standard for Edge Systems Used with Low Slope Roofing Systems
SPRI RP-4	(2013) Wind Design Standard for Ballasted Single-Ply Roofing Systems

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

UL SOLUTIONS (UL)

UL 790	(2022) UL Standard for Safety Test Methods for Fire Tests of Roof Coverings

1.2 SEQUENCING

Coordinate the work with other trades to ensure that components which are secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials.

1.3 SUBMITTALS

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

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for

Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

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

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

SD-02 Shop Drawings

Roof Plan Drawing

SD-03 Product Data

Underlayment

Roof membrane

Insulation

Separation Layer

Drainage Mat

Filter Fabric

Pavers

Ballast

Sample Warranties Certificates; G, [_____]

SD-05 Design Data

Wind Uplift Calculations; G, [_____]

SD-07 Certificates

Material and Equipment

Qualification of Manufacturer

Qualification of Applicator

SD-08 Manufacturer's Instructions

Cold Weather Installation; G, [_____]

SD-11 Closeout Submittals

Warranty; G, [_____]

Instructions To [Government][Contractor] Personnel

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment

Submit material supplier's or equipment manufacturer's statement that the supplied insulation, filter fabric, and membrane materials meet specified requirements. Provide certificates signed by an official authorized to certify on behalf of material supplier or product manufacturer and identifying quantity and date or dates of shipment or delivery to which the certificates apply. Submit certificates of compliance for material and equipment, as specified.

1.4.2 Qualification of Manufacturer

****
NOTE: Specify 5 years manufacturer experience unless directed otherwise by the Government
****

Submit information certifying the roofing membrane manufacturer has at least [5][_____] years experience in manufacturing these roofing products.

1.4.3 Qualification of Applicator

****
NOTE: Specify 3 years as an approved Contractor unless directed otherwise by the Government
****

Submit information certifying the roofing system applicator is approved, authorized, or licensed in writing by the roof membrane manufacturer and is required to 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 is required to 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.

1.4.4 Fire Resistance

Ensure the completed roof system is rated Class A as determined by UL 790 or Class I as determined by FM APP GUIDE. Prove compliance of each component of the roofing system by providing a label or written certification from the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, ensure labels bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.5.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's printed instructions, except as specified otherwise. Keep materials clean and dry. Store and maintain adhesives, sealants, primers, and other liquid materials above 15 degrees C 60 degrees F. Utilize insulated hot boxes or other enclosed warming devices in cold weather. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover material materials stored outdoors. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction.

Store insulation away from areas where welding is being performed or where contact with open flames is possible. Shield insulation from extended exposure to sunlight. Remove materials damaged by moisture from the site. Do not store ballast on the roof.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials. Select and operate material handling equipment so as not to damage materials or applied roofing. Do not use materials contaminated by exposure or moisture. Remove contaminated materials from the site. When hazardous materials are involved, adhere to the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 4 degrees C 40 degrees F, or when there is ice, frost, moisture or visible dampness on roof deck.[Restriction on application of roofing materials below 4 degrees C 40 degrees F may be waived if Contractor devises a means, satisfactory to Contracting Officer, of: (1) maintaining surrounding temperature above 4 degrees C 40 degrees F; (2) maintaining application temperature of heated materials without exceeding maximum specified heating temperature; and follows other recommendations of the membrane manufacturer for application in cold weather conditions.] Do not commence with the application if the ambient air or surface temperature is outside the minimum and maximum temperature ranges recommended by the manufacturer for application and curing. The substrate and material must be greater than 5 degrees F above dew point.

Submit cold weather installation instructions and standard manufacturer drawings altered by these specifications. Explicitly identify in writing, differences between manufacturer's printed instructions and the specified requirements.

1.7 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty 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.

Submit all data required together with requirements of this section. Include a written acceptance by the roof membrane manufacturer of the insulation and other products and accessories provided. List products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer. Submit sample warranties certificates during the pre-construction phase to prove all warranty requirements will be achieved.

1.7.1 Roof Membrane Manufacturer Warranty

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

****

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

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. The warranty remains in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification.

1.7.2 Contractor's Warranty

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NOTE: Select five years for Army and Air Force projects and two years for all other projects.
****

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

1.7.3 Continuance of Warranty

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

PART 2 PRODUCTS

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NOTE: Place Insulation beneath the membrane as described in Section 07 22 00 ROOF AND DECK INSULATION.

NOTE: Avoid including any system that has a ponding water exclusion.
****

2.1 SYSTEM DESCRIPTION

Provide roof membrane in accordance with Section[07 53 23 ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING][07 54 19 POLYVINYL CHLORIDE ROOFING][or][07 18 16 COLD LIQUID-APPLIED REINFORCED POLYMETHYL METHACRYLATE ROOFING SYSTEM].

Insulation placed above the membrane must be[extruded polystyrene][, or][extruded polystyrene] with a mortar face. Provide[screened gravel][, screened crushed stone][, precast concrete pavers][, or][extruded polystyrene insulation with integral mortar topping] ballast.

2.1.1 Conformance and Compatibility

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NOTE: Design should be in accordance with SPRI RP-4. Fully adhered protected membranes have performed well in hurricane areas when ballasted as specified in SPRI RP-4. Roof deck must be adequate to support weight of ballast as dead load.
****

Provide the entire roofing and flashing system in accordance with

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

2.1.2 Pre-Roofing Conference

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

a. Roof Plan Drawing, specifications, Wind Uplift Calculations and submittals related to the roof work.

   Submit roof plan drawing depicting wind load calculations and boundaries of enhanced perimeter and corner attachments of roof system components, [location of perimeter half-sheets][, spacing of perimeter, corner, and infield fasteners,] as applicable. Include the project roof plan of each roof level and conditions indicated. Provide all slopes and drain locations.

   Provide Engineering calculations, signed, sealed, and dated by a qualified Engineer validating the wind resistance per ASCE 7-22, ASTM D4073/D4073M, and ANSI/SPRI/FM 4435/ES-1 of non-rated roof system. Ensure the design of ballasted systems is in compliance with SPRI RP-4

b. Roof system components installation.

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer.

d. 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 plan for the roof system installation.

f. Safety requirements.

Coordinate pre-roofing conference scheduling with the Contracting Officer. Ensure the conference is attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing [and insulation], flashing and sheet metal work, [[mechanical][and][electrical] work], other trades interfacing with roof work , [Fire Marshall,] and 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.

2.1.3 Elimination, Prevention of Fall Hazards

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NOTE: Incorporate in the design fall prevention methods or techniques to eliminate fall hazards from any part or component of the building, facility, structure, or equipment requiring future maintenance work, in accordance with ANSI/ASSE A1264.1. Fall prevention methods may include identifying, designing, and installing anchorages (hard points) for safe use of fall arrest equipment and systems. Select materials for metal compatibility in order to minimize corrosion, type 316 stainless steel is recommended. Based on the design, include specifics of the system(s) and material(s) in the following subsection.

****

2.1.3.1 Fall Protection Systems

[_____]

[2.1.4 [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.

****

2.1.4.1 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 are to 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 meters 10 foot] of each [torch work area][hot-mopped kettle] at all times.

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

No Asphalt Kettles 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 are to comply with the requirements of NFPA 58.

b. Locate fuel containers having capacities greater than one pound 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. Ensure the asphalt bucket used by roofers or workers in similar trades is 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. Fasten the bail 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 is required 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 equipment 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.]

2.1.4.2 Fire Watch

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

Ensure all personnel on the roof during [torch application][hot-mopped application] are properly trained to use a fire extinguisher. Provide a fire watch for a minimum of [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. Ensure camera has a manufacturer's certificate of calibration, and the use of the camera is 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
****

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

a. Long-sleeved shirts buttoned at the collar and cuffs, made of non-flammable materials. Polyester materials are not allowed.

b. Work boots covering ankles with rubber or composite soles.

c. Long pants without cuffs to extend over the top of the work boots, made of non-flammable materials. No polyester allowed.

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

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

f. OSHA and ANSI approved hard hats.

2.1.4.4 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.

]2.2 MATERIALS

2.2.1 Underlayment

****
NOTE: Loose-laid membrane will not be placed directly on concrete or other hard, potentially rough deck.
****

Underlayment may be [concrete] [any insulation which is suitable for the

particular membrane] [mineral fiberboard in accordance with ASTM C726][or][gypsum board in accordance with ASTM C1396/C1396M, 16 mm 5/8 inch thick or glass mat gypsum roof board in accordance with ASTM C1177/C1177M, [6.35 mm 1/4 inch] [12.7 mm 1/2 inch] [15.87 mm 5/8 inch]].

2.2.2 Roof Membrane

****

NOTE: Specify EPDM,PVC, or TPO roof membrane, or allow Contractor to choose from these options. Delete each inapplicable roof membrane. When editing these paragraphs, delete aggregate surfacing, walkways, and types of insulation not used.

****

Ensure roof membrane are in accordance with Section [07 53 23 ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING] [07 54 19 POLYVINYL CHLORIDE ROOFING][or][07 54 23 THERMOPLASTIC POLYOLEFIN ROOFING].

2.2.3 [Separation Layer][Drainage Mat]

****

NOTE: In most cases a separation layer or drainage mat will be required between the membrane and insulation to prevent the insulation from bonding to the membrane or provide a drainage plane. The material will vary depending on roof type. Verify with the manufacturer on the type of separation or drainage layer required. Delete each inapplicable material. Polyethylene slip sheet is typically used with bitumen surfaces. Geotextile type materials are typically used with single ply membranes and drainage mats are typically used with liquid applied systems.

****

Provide a [slip sheet consisting of a single layer of 6 mil polyethylene film] [non-asphaltic, non-woven polypropylene felt separation layer] [prefabricated sheet drain consisting of a 3-dimensional propylene formed dimple core covered with a woven polypropylene filter fabric composite drainage system crush-proof drainage core and with a polypropylene membrane protection fabric on the substrate facing bottom side] between the roofing membrane and insulation layer.

2.2.4 Insulation Above the Membrane

****

NOTE: Determine the required R-value and show the R-value at the appropriate detail on the drawings. The required R-value will never be less than that used in the Energy Budget Analysis.

Specify a vapor retarder only when required by calculations made as specified in ASTM Manual 18 "Moisture Control in Buildings" or in the CRREL-EC report "Vapor Retarders for Membrane Roofing Systems."

****

Provide insulation above the membrane which is[extruded polystyrene][, or extruded polystyrene with a mortar face]. Insulation must be a standard product of the manufacturer, and be factory marked with the manufacturer's name or trademark, the material specification number, the R-value at 24 degrees C 75 degrees F, and the thickness. Mark boards individually. Ensure the thermal resistance of the insulation is not less than the R-value shown on the drawings. Insulation must conform to ASTM C578, Type V, VI or VII and be intended by the manufacturer for use above a protected roof membrane. Bottom layer of insulation is to provide drainage paths, mostly parallel to the slope, between insulation and membrane. Ensure top surface of mortar-faced insulation is 10 mm 3/8 inch thick Portland cement latex mortar having minimum properties as follows: specific gravity: 2.0, compressive strength: 20.7 MPa 3000 psi and bond strength to insulation: 69 kPa 10 psi. Top layer of insulation may have ribbed top surfaces when flat-bottom pavers are used as ballast. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

2.2.5 Filter Fabric

Provide filter fabric that is [woven][or non-woven pervious sheet of long chain polymeric filaments][or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride, formed into a pattern with distinct and measurable opening]s. The filter fabric is required to provide an ASTM D4751 Apparent Opening Size (AOS) no finer than the 0.125 mm No. 120 sieve and no coarser than the 0.212 mm No. 70 sieve. Selvage edges of fabric or otherwise finished to prevent raveling. Fabric is to have minimum weight of 102 gms/sq. m 3 oz/sq. yard and conform to the following table:

Property	Test Procedure	Result
Tensile strength	ASTM D5034 Grab test method using 25 mm 1 inch square jaws and a travel rate of 55 mm per sec 12 inches per minute	29 kg/25 mm65 lbs/inch minimum in any principal direction
Puncture strength	ASTM D751 - Tension testing machine with ring clamp; steel ball replaced with an 8 mm 5/16 inch diameter solid steel cylinder with a hemispherical tip centered within the ring clamp	18 kg40 lbs minimum load

2.2.6 Ballast

****

NOTE: Pavers are preferred over aggregate ballast, and a combination of pavers and ballast is preferred over aggregate only.

Determine ballast or paver size and quantity using SPRI RP-4 and modify paragraph BALLAST INSTALLATION accordingly. SPRI RP-4 allows crushed stone over

protected membrane. Use light-colored aggregate when locally available. Small aggregate will not be used in vicinity of aircraft operations; however, rock or paver ballast may be used in such areas. Where ambient temperatures drop below freezing, avoid use of ballast or pavers that will break during freeze-thaw cycles.

Installations where this roofing system is used should be monitored; any problems or noteworthy benefits encountered in the use of this system should be brought to the attention of HQUSACE (CEMP-ET) WASH DC 20314-1000 for information and possible dissemination.

****

Provide ballast that is [screened gravel,][screened crushed stone,] [precast concrete pavers,] or [extruded polystyrene insulation with integral mortar topping]. Size and placement as indicated. Selected ballast exposed to sunlight is required to have an initial solar reflectance greater or equal to 0.65 and a solar reflectance greater or equal to 0.50 three years after installation under normal conditions.

2.2.6.1 Pavers

Ensure concrete pavers include air-entrained concrete, minimum 38 mm 1-1/2 inches thick, having 21 MPa 3000 psi minimum compressive strength. Rib pavers on the bottom for use over smooth topped insulation and flat on the bottom for use over insulation with ribbed top.

2.2.6.2 Aggregate Ballast

Gravel and crushed stone are required to conform to ASTM D448, Size 4 and 2, with less than 2 percent that passes through a 10 mm 3/8 inch screen. Ballast is to have minimum unit mass of 960 kg/cubic meter 60 pcf as determined by ASTM C29/C29M.

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 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. Do not leave open flame equipment unattended while ignited (burning). Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof. Specific requirements for fire watches and burn permits exist. Review these requirements at the pre-roofing conference.

]3.2.2.4 Electric-Heated Equipment

Provide adequate electrical service 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 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 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. Ensure edges of seams are 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

3.3.1 Installation

Install roof membrane and flashing in accordance with Sections [07 53 23 ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING] [07 54 19 POLYVINYL CHLORIDE ROOFING][or][07 54 23 THERMOPLASTIC POLYOLEFIN ROOFING].

3.3.2 Flood Test

After the membrane and its flashings are installed, and before the insulation is placed above the membrane, plug the drains, and flood the roof with water for 24 hours. Remedy leaks before insulation is installed.

3.3.3 Insulation

****
NOTE: Specify a separation layer or drainage mat between the membrane and insulation to prevent the insulation from bonding to the membrane or provide a drainage plane. Delete each inapplicable material.
****

Loose-Lay insulation on the membrane after the membrane is completed and flood coat (if any) is cool. Install a [slip sheet][separation layer][drainage mat] over the membrane in accordance with manufacturer's instructions. Cut and closely fit around the perimeter, penetrations, and projections. Overlap fabric materials from adjacent sheets/rolls, and bond all overlaps with manufacturers recommended sealant. Install supplemental fabric as required to ensure continuity at flashing locations. Install the [slip sheet] [separation layer] [drainage mat] when it can be followed immediately by the insulation. Provide for drainage paths between the lower surface of the insulation and the membrane. Ensure as many of the drainage paths are parallel to the slope of the roof as possible. Unless otherwise specified by the manufacturer, stagger end joints. Joints between boards are not to exceed 6 mm 1/4 inch. Install insulation to within 19 mm 3/4 inch of projections and cant strips.

3.3.4 Filter Fabric Installation

Lay filter fabric loose over insulation, smooth and free of tension and stress. Lap edges and ends a minimum of 300 mm 1 foot and extended above the ballast 50 to 75 mm 2 to 3 inches at the perimeter and penetrations. Joints parallel to perimeter are not allowed within 1.8 meters 6 feet of the perimeter.

3.3.5 Ballast Installation

Place a weight of 479 Pa 10 psf of ballast on the roof area. Place a weight of 957 Pa 20 psf within 1.2 meters 4 feet of the roof perimeter. At approved intervals, weigh and correct ballast placement to within plus or minus 10 percent of specified weight. Install pavers where indicated.

Mark pavers above hidden drains so that drains are accessible for inspection. Surround interior roof drains with gravel or stone graded between 25 and 38 mm 1 and 1-1/2 inches to the level of ballast over insulation or to mid-height of drain bonnet, whichever is lower. During placement of aggregate ballast, cover drains and other openings to prevent inadvertent entry of ballast. Ballast buggy wheels are not allowed on the membrane.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspection

****

NOTE: Where justified by the amount or criticality of the insulation and roofing involved, and similar requirements are not established for the Contractor Quality Control Organization specified elsewhere, the following INSULATION TECHNICIAN and inspection requirements may be added:

"INSULATION TECHNICIAN

A roof insulation technician responsible directly to the Contractor and experienced in the installation of roof insulation and related work must perform the inspection functions and be on the site whenever roof insulation operations are in progress."

****

Establish and maintain an inspection procedure to ensure compliance of the installed roof with the contract requirements. Any work found noncompliant with the contract must be promptly removed and replaced or corrected in an approved manner. Inspection is to include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation, proper storage, and handling of insulation.

c. Inspection of mechanical fasteners; type, number, length, and spacing.

d. Coordination with other materials, cants, nailers, flashings, and penetrations.

e. Inspection of proper placement of insulation, joint orientation and laps between layers, joint widths and bearing of edges of underlayment on deck.

f. Inspection of proper placement of pavers and amount and leveling of ballast.

Submit procedures for approval, prior to start of roofing work including a checklist of points to be observed. Document inspections and furnish a copy of the documentation to the Contracting Officer at the end of each day.

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.

CLOSEOUT ACTIVITIES

3.6 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.

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

-- End of Section --