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USACE / NAVFAC / AFCEC / NASA | UFGS-07 53 23 (May 2012)
Change 2 - 08/18

Preparing Activity: NAVFAC | Superseding
UFGS-07 53 23 (November 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

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SECTION 07 53 23

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05/12, CHG 2: 08/18

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SECTION 07 53 23

ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING
05/12, CHG 2: 08/18

****
NOTE: This guide specification covers the requirements for ethylene propylene diene terpolymer (EPDM) elastomeric sheet roofing, with associated elastomeric sheet flashing, for installations with the insulation below the membrane on both existing and new roof systems with slopes from 6 mm to 76 mm 1/4 inch to 3 inches per foot.

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

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

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

****
NOTE: Standard application methods include loose-laid ballasted, fully adhered, and mechanically fastened systems. Also included is a special combined fully adhered and mechanically fastened system for excessive wind loading conditions. This guide specification does not include the structural roof deck, insulation, sheet metal fascias, gravel stops, flashings, nor use of elastomeric sheets for roofing located adjacent to kitchen or food service exhaust system discharge ducts. Grease and oil attack EPDM. Exhaust fumes must be directed away from the roofing system.

Coordinate this section with other roof system components specifications such as rough carpentry, insulation and sheet metal flashing. Also coordinate this section with the criteria contained in UFC 3-110-03, "Roofing" as it relates to the specific project and Service Exceptions indicated therein.

Specify membrane attachments that are compatible with the insulation specified. Do not adhere membrane directly to polystyrene, perlite or standard wood fiber, insulation. Ensure facer on polyisocyanurate insulations is compatible with the adhesive of a fully adhered membrane application. Glass mat, moisture resistant gypsum roof board can be used as an underlayment over insulation for adhesive application of roof membrane with approval of the membrane manufacturer. Utilize wood fiberboard, perlite, or glass mat, moisture resistant gypsum roof board as top insulation layer under ballasted roofing systems.
****

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

ASTM INTERNATIONAL (ASTM)

ASTM D448	(2012; R 2017) Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D4637/D4637M	(2015) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D4811/D4811M	(2016) Standard Specification for Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing
ASTM D6369	(1999; R 2006) Design of Standard Flashing Details for EPDM Roof Membranes
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/

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2020) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1	(2019) Performance Standard for Retrofit Drains

U.S. DEPARTMENT OF ENERGY (DOE)

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

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.

Select the application method required. Delete

other options.

Where EPDM systems are utilized, fully adhered systems applied over minimum two layers of rigid board roof insulation is the preferred norm.

Do not specify stone ballasted systems along flight lines, in wind zones exceeding 160 km/h 100 mph, within 8 km 5 miles of coastline, within 457 m 1500 feet of open body of water, and on or adjacent to critical facilities such as hospitals. Where ballasted systems are required, utilize interlocking pavers designed to resist the required wind loads. Ballasted systems on air permeable decks (e.g., metal decks, precast concrete panels or planks) must incorporate an air barrier in the assembly.

Also incorporate an air barrier in the roof assembly for mechanically fastened systems. Use reinforced membrane in wind zones exceeding 160 km/h 100 mph, within 8 km 5 miles of coastline or within 457 m 1500 feet of open body of water.

Specify combination attachment only for isolated geographic locations that experience extreme and extended wind conditions such as portions of Alaska and Iceland, or as otherwise required by the Government.

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) or area of the building or project where each system is to be applied.

****

[Fully adhered][Mechanically fastened][Ballasted][Combination fully adhered and mechanically fastened] EPDM roof membrane system applied over [insulation][recovery board][concrete roof deck] substrate.

[_____]: [Fully adhered][Mechanically fastened][Ballasted][Combination fully adhered and mechanically fastened] EPDM roof membrane system applied over [insulation][recovery board][concrete roof deck] substrate.

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 Drawing

Wind Load Calculations

Boundaries of Enhanced Perimeter

Corner Attachments of Roof System Components

Location of Perimeter Half-Sheets

Spacing of Perimeter, Corner, and Infield Fasteners

Slopes and Drain Locations

SD-03 Product Data

Cement

EPDM Sheet; G[, [_____]]

[Heat Island Reduction; S

][Energy Star Label for Top Coating; S

] Seam Tape

Bonding Adhesive

Lap Splice Adhesive

Water Cutoff Mastic/Water Block

Lap Cleaner, Lap Sealant, and Edge Treatment

Flashings

Flashing Accessories

Flashing Tape

Fasteners and Plates

[Ballast

] Roof Insulation

[Protection Mat

][Pre-Manufactured Accessories

] Sample Warranty Certificate; G[, [_____]]

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 to be provided. List products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-05 Design Data

****
NOTE: Incorporate this paragraph for ballasted systems and anytime non-FM rated systems are permissible. Coordinate with requirements of "Wind Uplift" paragraph.
****

Wind Uplift Calculations; G[, [_____]]

[Engineering calculations validating the wind resistance of roof system.

] SD-07 Certificates

Qualification of Manufacturer

Certify that the manufacturer of the roof membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

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

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.
****

Application; G[, [_____]]

Application Method; G[, [_____]], including pattern and frequency of mechanical attachments required in the field of roof, corners, and perimeters to provide for the specified wind resistance

Membrane Flashing; G[, [_____]]

Seam Tape

Tape Seams / Lap Splices

Adhesive Seams / Lap Splices

Perimeter Attachment

Primer

Fasteners

[Pavers

][Protection Mat

][Pre-Manufactured Accessories

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

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's printed instructions and the specified requirements.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government Personnel

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

1.3.1 Shop Drawings

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.

1.4 QUALITY ASSURANCE

****
NOTE: All projects with more than 15,000 square feet 1400 square meters 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 5 years manufacturer experience unless directed otherwise by the Government
****

EPDM sheet roofing membrane manufacturer must have at least [5][_____] years experience in manufacturing EPDM roofing products.

1.4.2 Qualification of Applicator

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

Roofing system applicator must be approved, authorized, or licensed in writing by the roof membrane manufacturer and must have a minimum of [three][_____] 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 5 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 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.

1.4.4 Fire Resistance

Complete roof covering assembly must:

a. Be Class A rated in accordance with ASTM E108, FM 4470, or UL 790; and

b. Be listed as part of Fire-Classified roof deck construction in the UL RMSD or Class I roof deck construction in the FM APP GUIDE.

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

1.4.5 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 approval rating incorporates a safety factor of 2 over the maximum calculated uplift pressure in inch-pound units. Therefore, a FM approval rating of 1-90 correlates to a maximum uplift calculation of 2.2 kPa 45 psf. When specifying an FM rated system, ensure the designed roof system is capable of providing the specified FM approval rating. Where non-rated systems may be permissible, include the bracketed portion of the second sentence and the third sentence.

Design ballast for loose-laid ballasted application in accordance with ANSI/RMA/SPRI RP-4. Where ballasted systems are specified include the bracketed option at the end of the paragraph.

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 based on a design wind speed of [_____] km/h [_____] mph in accordance with ASCE 7-16 and other applicable building code requirements

1.4.6 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, specifications and submittals related to the roof work;

b. Roof system components installation;

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

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

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

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, the labels must 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. Do not use polyethylene as a covering. 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. Remove unused materials from the roof at the end of each days work.

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 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 REQUIREMENTS

Do not install EPDM sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface, or when condensation develops on surfaces during application. Unless recommended otherwise by the EPDM sheet manufacturer and approved by the Contracting Officer, do not install EPDM sheet when air temperature is below 4 degrees C 40 degrees F or within 3 degrees C 5 degrees F of the dewpoint. Follow manufacturer's printed instructions for installation during cold weather conditions.

1.7 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 counterflashing 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.]

1.8 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.

1.8.1 Roof Membrane Manufacturer Warranty

****

NOTE: Insulated and routinely occupied facilities or facilities containing sensitive equipment or operations require a warranty of not less than 15 years. 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 potential water intrusion. Environmentally controlled interiors require minimum 10 year warranty regardless of small size.

****

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 and commence 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, splits, tears, cracks, delaminates, separates at the seams, shrinks to the point of bridging or tenting membrane at transitions, 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 is the responsibility of the roof membrane manufacturer. The roof membrane manufacturer is responsible for all costs associated with the repair or replacement work.

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.

1.8.2 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.

1.8.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplish 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.

1.9 CONFORMANCE AND COMPATIBILITY

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 must be in general accordance with recommendations of the NRCA RoofMan, membrane manufacturer published recommendations and details, ASTM D6369, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

1.10 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.

****

1.10.1 Fall Protection

[_____]

PART 2 PRODUCTS

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 EPDM Sheet

****

NOTE: Refer to Designer Note in PART 1 - DESCRIPTION OF ROOF MEMBRANE SYSTEM for guidance regarding membrane attachment method and in editing the membrane materials requirements.

Specify minimum 2.3 mm 0.090 inch membrane for all application. Reinforced membrane for mechanically fastened applications in wind zones exceeding 160 km/h 100 mph, within 8 km 5 miles of coastline or within 457 m 1500 feet of open body of water.

Typically specify 2.3 mm 0.090 inch non-reinforced membrane for fully adhered or ballasted application. When Type III membrane is required the adhesive is typically a spray applied compound, spray foam adhesive, or hot asphalt. Modify related portions of this specification for proper adhesive and application parameters when Type III membrane is specified.

****

Ethylene Propylene Diene Terpolymer (EPDM), ASTM D4637/D4637M, [Type I, non-reinforced][Type II, scrim or fabric reinforced][Type III, fabric or fleece backed], 2.3 mm 0.090 inch nominal thickness for [mechanically fastened] [fully adhered] [loose-laid ballasted] [combined fully adhered and mechanically fastened] application. Provide membrane with minimum thickness not less than minus 10 percent of the specified thickness value. EPDM membrane thickness specified is exclusive of backing material on the EPDM membrane. Principal polymer used in manufacture of the membrane sheet must be greater than 95 percent EPDM. Width and length of sheet must be [as recommended by the manufacturer.][maximum width attainable as recommended by the manufacturer to minimize field formed seams in the field of the roof.]

2.1.2 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 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 design of 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.]]

2.1.3 Seam Tape

****

NOTE: Seam tapes have proven most effective in maintaining long term seal of field seams of roof membrane. Seam tapes can be difficult to apply to membrane flashing situations. As such, lap splice adhesive or self-adhering flashing membrane are used as alternatives in difficult membrane flashing areas.

Seam tapes must be minimum 75 mm 3 inch wide. Some specific situations may require wider seam tapes as recommended by the membrane manufacturer.

****

Double-sided synthetic rubber tape, minimum 0.76 mm 0.03 inch thick, minimum 75 mm 3 inch wide. Utilize seam tape as recommended by the manufacturer's printed data for forming watertight bond of EPDM sheet materials to each other for the application specified and conditions encountered. 150 mm 6 inch wide tape is required for seam seals along lines of mechanical attachment of membrane.

2.1.4 Lap Splice Adhesive

****

NOTE: Lap splice adhesive is used for some membrane to membrane bond applications.

Include bracketed options as applicable.

Low VOC materials may be required in some geographic locations and on occupied buildings to minimize potential irritation to occupants.

Include second and third brackets options at end of paragraph when lap splice adhesive is prohibited for field seams of roof membrane.

****

[Low volatile organic compound (VOC)] synthetic rubber adhesive as supplied by roof membrane manufacturer and recommended by the manufacturer's printed data for forming watertight bond of EPDM sheet membrane materials to each other [in areas of membrane flashing]. [Do not use splice adhesive to form membrane seams in field of roof or at standard base flashing conditions.]

2.1.5 Bonding Adhesive

****

NOTE: Bonding adhesive is used for adhering EPDM membrane to materials other than EPDM.

Low VOC materials may be required in some geographic locations and on occupied buildings to minimize potential irritation to occupants.

When Type III (fleece-backed) membrane is specified, include the first bracketed option as applicable, delete the second bracketed option, and write in a description of the adhesive required as the third bracketed option. When hot asphalt is the specified adhesive, in Part 3, include parameters for heating of asphalt and application similar to those found in Section 07 51 13 BUILT-UP ASPHALT ROOFING.
****

[Low volatile organic compound (VOC)] [synthetic rubber][_____] adhesive as supplied by roof membrane manufacturer and recommended by the manufacturer's printed data for bonding EPDM membrane materials to insulation, wood, metal, concrete or other substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

2.1.6 Lap Cleaner, Lap Sealant, and Edge Treatment

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.7 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.8 Membrane Flashings and Flashing Accessories

Provide membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations, and prefabricated pipe seals, that is minimum 1.1 mm 0.045 inch cured EPDM, as recommended by the roof membrane manufacturer or minimum 1.4 mm 0.055 inch thick uncured EPDM sheet in compliance with ASTM D4811/D4811M, Type I. Use cured EPDM membrane to the maximum extent recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flash scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical.

2.1.8.1 Flashing Tape

EPDM-backed synthetic rubber tape, minimum 150 mm 6 inch wide as supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.9 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended by the roof membrane manufacturer and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. As supplied and warranted for the substrate type(s) by EPDM sheet manufacturer and recommended by EPDM sheet manufacturer's printed data.

2.1.9.1 Stress Plates for Fasteners

Flat corrosion-resistant round stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements

of FM 4470; not less than 50 mm 2 inch in diameter. Provide pre-formed discs to prevent dishing or cupping.

2.1.9.2 Auxiliary Fasteners

Corrosion resistant screws, nails, or anchors suitable for intended attachment purpose and as recommended by the roof membrane manufacturer.

2.1.9.3 Powder-Driven Fasteners

Powder-driven fasteners may be used only when approved in writing.

2.1.9.4 Metal Disks

Provide flat metal disks of minimum 25 mm 1 inch in diameter, made of nonferrous material compatible with the nails or fasteners.

[2.1.10 Ballast

****

NOTE: Delete these paragraphs unless loose-laid ballasted system is specified. Normally specify stone ballast for a ballasted system. Specify paver ballast when:

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

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

c. In wind zones exceeding 160 km/h 100 mph, within 8 km 5 miles of coastline, within 457 m 1500 feet of open body of water, and on or adjacent to critical facilities such as hospitals.

d. Heavy foot traffic over large areas of roof is expected.

****

[2.1.10.1 Stone Ballast

Smooth, rounded, river-washed stone graded in accordance with ASTM D448, sizes 1, 2, 24, 3, and 4, nominal 19 mm to 38 mm 3/4 inch to 1-1/2 diameter, except as recommended otherwise by the roof membrane manufacturer and approved by the Contracting Officer.

][2.1.10.2 Ballast Pavers

****

NOTE: Specify paver weight based on calculated wind load conditions and ANSI/RMA/SPRI RP-4.

Lightweight interlocking paver ballast may be used in lieu of heavier weight non-interlocking pavers in wind zones in excess of 160 km/h 100 mph, within 8 km 5 miles of coastline or within 457 m 1500 feet of open body of water. Non-interlocking pavers should weigh not less than 88 kg per square meter 18 pounds

per square foot.

Elevated paver systems and pavers intended to support pedestrian traffic, such as plaza decks or observation decks, should be minimum 50 mm 2 inch thick, 600 mm 24 inch square, and minimum 51,700 kPa 7500 psi compressive strength.

Specify paver pedestals for pavers without drainage channels. Specify adjustable pedestals for systems required to be elevated to a level plane such as a plaza or observation deck.

****

Provide weather resistant, precast [interlocking] concrete roof pavers [with drainage channels on the underside], and as recommended by the roof membrane manufacturer. Provide pavers of minimum 20,680 kPa 3000 psi 51,700 kPa 7500 psi compressive strength, weigh not less than 58 kg per square meter 12 pounds per square foot 88 kg per square meter 18 pounds per square foot [_____], not less than 30 mm 1-1/4 inch 50 mm 2 inch thick and nominal 600 mm 24 inch [_____] in length and width and without sharp edges and projections. [Elevate pavers above the roof membrane surface with paver manufacturer's recommended [adjustable] pedestal system [to provide for level walking surface] as required by the roof membrane manufacturer.]

]][2.1.11 Protection Mat / Slip Sheet

****

NOTE: Specify protection mat for application between roof membrane and ballast when ballasted systems are specified.

****

Minimum 154 gram per square meter 4.5 ounce per square yard 200 gram per square meter 6 ounce per square yard ultraviolet resistant polypropylene, non-woven, needle punched fabric for use as protection mat under ballast system and as recommended by the roof membrane manufacturer.

][2.1.12 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 roof membrane manufacturer.

[2.1.12.1 Pre-fabricated Curbs

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

]][2.1.13 [Rubber Walkboards] [and] [Precast Concrete Paver Block Walkways]

****
NOTE: Use pavers or rubber walkboards as walkways where the roof or areas of the roof are intended to bear foot traffic for maintenance or other purposes once per month or more frequently.
****

Provide [either of] the following:

[2.1.13.1 Rubber Walkboards

Preformed reprocessed rubber, compatible with the EPDM sheet, 6 mm 1/4 inch minimum thickness, and weighing not less than .68 kg per square meter 1-1/2 pounds per square foot.

][2.1.13.2 Precast Concrete Paver Block

Precast concrete blocks, 450 mm by 450 mm 18 inch by 18 inch 600 mm by 600 mm 24 inch by 24 inch, without sharp edges and projections, and weighing no more than 20 kg 45 pounds 36 kg 80 pounds each.

]]2.1.14 Roof Insulation Below EPDM Sheet

****
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 is applied.

Do not fully adhere single ply membrane to perlite, polystyrene, or standard wood fiber insulation board. High density wood fiber board is acceptable if approved by the roof membrane manufacturer for the wind resistance condition specified.

Coordinate insulation system attachment with the wind resistance requirements. In many instances, insulation system must be adhered or mechanically fastened to deck in corner and perimeter areas, if not throughout the field of the roof, when specifying a ballasted roof system.
****

Ensure insulation system and facer material is compatible with membrane application specified and as approved by the roof membrane manufacturer.

[2.1.15 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.

]2.1.16 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 Page 20 roof system has at least 10 years of service life remaining. If not, remove the existing roof and design a new replacement roof system 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.

2.1.17 Wood Products

****
NOTE: Coordinate with Section 06 10 00 ROUGH CARPENTRY. Some fire retardant treatment (FRT) chemicals may affect EPDM materials. Submit SDS listing active ingredients for the FRT wood to EPDM manufacturer prior to applying EPDM materials in contact with FRT wood.
****

Do not allow fire retardant treated materials be in contact with EPDM membrane or EPDM accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.1.18 Membrane Liner

[Self-adhering]EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material as approved by the roof membrane manufacturer and the Contracting Officer.

2.2 FLASHING CEMENT

Provide a self-vulcanizing butyl compound flashing cement for splicing laps and for flashings workable at minus 7 degrees C 20 degrees F. Obtain a recommendation for such flashing cement from the roofing membrane manufacturer.

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. [Drins,a] [curbs,] [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.

d. The plane of the substrate does not vary more than 6 mm 1/4 inch within an area 3 by 3 meters 10 by 10 feet when checked with a 3 meter 10 foot straight edge placed anywhere on the substrate.

e. Substrate is sloped to provide positive drainage.

f. Walls and vertical surfaces are constructed to receive counterflashing, 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 200 mm 8 inch above finished roofing surface.

****

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

h. Pressure-preservative 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.]

i. Avoid contact of EPDM materials with fire retardant treated wood, except as approved by the roof membrane manufacturer and Contracting Officer.

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

j. 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 89 mm 3-1/2 inch.

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

[k. 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.

][(3) Vapor pressure relief vents: Holes equal to the outside diameter of vents are provided through the insulation where vents are required. Space vents in accordance with membrane manufacturer's recommendations.

]]l. Exposed nail heads in wood substrates are properly set. Warped and split [boards] [sheets] have been replaced. There are no cracks or end joints 6 mm 1/4 inch in width or greater.[Joints in plywood substrates are taped or otherwise sealed to prevent air leakage from the underside.]

][m. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6 mm 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

]3.2 APPLICATION

****
NOTE: Coordinate application method with paragraphs "Description of Roof Membrane System" and appropriate subparagraph under "EPDM Sheet Roofing".
****

Apply entire EPDM sheet utilizing [fully adhered] [loose-laid ballasted] [mechanically fastened] [combined fully adhered and mechanically fastened] application method[s]. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer.

3.2.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the materials manufacturer's printed application instructions. Do not thin liquid materials with cleaners used for cleaning EPDM sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 15 to 27 degrees C 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some elastomeric sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the EPDM sheet.

h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

3.2.2 EPDM Sheet Roofing

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Unroll EPDM sheet roofing in position without stretching membrane. Inspect for holes. Remove sections of EPDM sheet roofing that are damaged. Allow sheets to relax minimum 30 minutes before seaming. Lap sheets as specified, to shed water, and as recommended by the roof membrane manufacturer's published installation instructions for the application required but not less than 75 mm 3 inch in any case.

3.2.3 Application Method

[3.2.3.1 Combined Fully Adhered and Mechanically Fastened Application

****

NOTE: Delete this paragraph unless a combined fully adhered and mechanically fastened application is specified. Where this paragraph is included, include and edit the fully adhered and mechanically fastened membrane application paragraphs to remove redundancy of requirements.

****

Install combined fully adhered and mechanically fastened roof membrane system in the manner specified and including seaming, perimeter and infield fastening and half sheets.

][3.2.3.2 Fully Adhered Membrane Application

****

NOTE: Delete this paragraph unless a fully adhered or combined fully adhered and mechanically fastened application is specified.

Delete the bracketed option in the fourth sentence and delete the fifth sentence when non-standard adhesives are specified such as sprayed foam or hot asphalt used with fleece-backed membrane.

****

Layout membrane and side lap adjoining sheets in accordance with membrane manufacturer's printed installation instructions. Allow for sufficient membrane to form proper membrane terminations. Remove dusting agents and dirt from membrane and substrate areas where bonding adhesives are to be applied. Apply specified adhesive evenly and continuously to substrate [and underside of sheets] at rates recommended by the roof membrane manufacturer's printed application instructions. When adhesive is spray applied, roll with a paint roller to ensure proper contact and coverage. Do not apply bonding adhesive to surfaces of membrane in seam or lap areas. Allow adhesive to flash off or dry to consistency prescribed by manufacturer before adhering sheets to the substrate. Roll each sheet into adhesive slowly and evenly to avoid wrinkles; broom or roll the membrane to remove air pockets and fishmouths and to ensure full, continuous bonding of sheet to substrate. Form field lap splices or seams as specified. Check all seams and ensure full lap seal. Apply lap sealant to all adhesive formed seams and all cut edges of reinforced membrane materials.

][3.2.3.3 Mechanically Fastened Membrane Application

****

NOTE: Delete this paragraph unless a mechanically fastened or combined fully adhered and mechanically fastened application is specified.

Membrane side lap depends on method of mechanical attachment, wind resistance testing of the specific system provided, and requirements of the membrane manufacturer. Generally, position attachments such

that minimum 75 mm 3 inch seam width remains beyond the outer edge of the attachment plate or batten strip. Fastener and plate attachment typically requires 175 mm to 200 mm 7 to 8 inch membrane overlap. Batten attachment typically requires 100 mm to 150 mm 4 to 6 inch membrane overlap.
****

Layout membrane and lap adjoining sheets in accordance with membrane manufacturer's printed instructions such that a minimum 75 mm 3 inch [_____] seam width is maintained and seam width is as required by tested assembly meeting specified wind resistance requirements. Account for additional overlap required for placement of fasteners and plates or battens beyond the closed seam. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Mechanically secure the membrane sheet with specified fasteners in the lap area. Space fasteners as required to provide the wind uplift resistance specified and in accordance with submitted fastener patterns for the field, corner, and perimeter roof areas. Set fasteners firm to plate or batten. Form field lap splices or seams as specified. Check all seams and ensure full lap seal. Apply lap sealant to all adhesive formed seams and all cut edges of reinforced membrane materials.

][3.2.3.4 Ballasted Membrane Application

****
NOTE: Delete this paragraph unless a loose-laid ballasted application is specified.
****

Layout membrane and side lap adjoining sheets minimum 100 mm 4 inch and according to membrane manufacturer's printed instructions. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Form field lap splices or seams as specified and of width required by the membrane manufacturer's installation instructions. Check seams to ensure continuous seal before proceeding with further work. Apply continuous lap sealant to all adhesive formed seams and all cut edges of reinforced membrane materials.

]3.2.4 Tape Seams / Lap Splices

****
NOTE: Seam tape must be the primary seaming, or lap splice, technique. Only specify adhesive seaming in the field of the roof with Government approval. Adhesive seaming of flashing in limited areas may be required where tapes are difficult to apply.
****

Field form seams, or lap splices, with seam tape in accordance with membrane manufacturer's printed instructions and as specified. Clean and prime mating surfaces in the seam area. After primer has dried or set in accordance with membrane manufacturer's instructions, apply seam tape to bottom membrane and roll with a 75 mm to 100 mm 3 inch to 4 inch wide smooth silicone or steel hand roller, or other manufacturer approved rolling device, to ensure full contact and adhesion of tape to bottom membrane. Tape end laps must be minimum 25 mm 1 inch. Roll top membrane

into position to check for proper overlap and alignment. Remove release paper from top of seam tape and form seam splice. Ensure top membrane contact with seam tape as release paper is removed. Roll the closed seam with a smooth silicone or steel hand roller, rolling first across the width of the seam then along the entire length, being careful not to damage the membrane. Apply minimum 225 mm 9 inch long strip of membrane-backed flashing tape over T-intersections of roof membrane. Roll tape to ensure full adhesion and seal over T-joint.

[3.2.5 Adhesive Seams / Lap Splices

****
NOTE: Include the bracketed option in the first sentence as the norm. Government approval required for adhesive formed seams in the field of the roof.
****

Use only field-applied adhesive formed seams [in flashing areas] where approved by the membrane manufacturer and the Contracting Officer. Do not use adhesive formed seams for field of roof membrane seaming[, except as approved by the membrane manufacturer and the Contracting Officer]. Thoroughly and completely clean mating surfaces of materials throughout the lap area. Remove all dirt, dust, and contaminants and allow to dry.

Apply primer as recommended by the membrane manufacturer. Apply splice adhesive with a 75 mm to 100 mm 3 inch to 4 inch wide, 13 mm 1/2 inch thick, solvent-resistant brush in a smooth, even coat with long brush strokes. Bleed out brush marks. Do not apply adhesive in a circular motion. Simultaneously apply adhesive to both mating surfaces in an approximate 0.63 mm to 0.75 mm 0.025 to 0.030 inch wet film thickness, or other thickness as recommended by the roof membrane manufacturer's printed instructions.

Allow the splice adhesive to set-up in accordance with membrane manufacturer's printed instructions. Perform manufacturer recommended field check to test for adhesive readiness prior to closing seam. Apply a 3 mm to 6 mm 1/8 inch to 1/4 inch bead of in-seam sealant approximately 13 mm 1/2 inch from the inside edge of the lower membrane sheet prior to closing the seam. Ensure the in-seam sealant does not extend onto the splice adhesive. Maintain the full adhered seam width required. Roll the top membrane onto the mating surface. Roll the seam area with a 50 mm to 75 mm 2 inch to 3 inch wide, smooth silicone or steel hand roller. A minimum of 2 hours after joining sheets and when the lap edge is dry, clean the lap edge with membrane manufacturer's recommended cleaner and apply a 6mm to 9 mm 1/4 inch to 3/8 inch bead of lap sealant centered on the seam edge. With a feathering tool, immediately feather the lap sealant to completely cover the splice edge, leaving a mound of sealant over the seam edge. Apply lap sealant to all adhesive formed seams.

]3.2.6 Perimeter Attachment

****
NOTE: All application methods of EPDM membranes require mechanical fastening of the membrane to wood nailers at the roof perimeters, at angular penetrations, or at circular penetrations, except roof drains greater than 457 mm 18 inch in diameter.
****

Adhesive bond or mechanically secure roof membrane sheet at roof perimeter in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond must be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

3.2.7 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angle greater than 4 degrees (1:12). Space fasteners a maximum of 300 mm 12 inch on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Flash over fasteners with a fully adhered layer of material as recommended by the roof membrane manufacturer's printed data.

3.3 FLASHINGS

3.3.1 General

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

Provide a one-ply flashing membrane, as specified for the system used, and install immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings must be stepped where vertical surfaces abut sloped roof surfaces. Provide sheet metal reglet in which sheet metal cap flashings are installed of not more than 400 mm 16 inch nor less than 200 mm 8 inch above the roofing surfaces. Exposed joints and end laps of flashing membrane must be made and sealed in the manner required for roofing membrane.

3.3.2 Membrane Flashing

****

NOTE: Coordinate flashing requirements with Section 07 60 00 FLASHING AND SHEET METAL and details. Ensure Section 07 60 00 FLASHING AND SHEET METAL is properly edited for application to EPDM roofing systems and for inclusion of flashing conditions of the project.

****

Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize cured EPDM membrane flashing and prefabricated accessory flashings to the maximum extent recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flashing scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical. Extend base flashing not less than 200 mm 8 inch above roofing surface and as necessary to provide for seaming overlap on roof membrane as recommended by the roof membrane manufacturer.

Seal flashing membrane for a minimum of 75 mm 3 inch on each side of fastening device used to anchor roof membrane to nailers. Completely adhere flashing sheets in place. Seam flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Reinforce all corners and angle transitions by applying uncured membrane to the area in accordance with roof membrane manufacturer recommendations. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 300 mm 12 inch on center. Install sheet metal flashing over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

[3.3.3 Flashing at Roof Drain

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

Provide a tapered insulation sump into the drain bowl area. Do not exceed tapered slope of (4:12) 18 degrees for unreinforced membrane and (1:12) 5 degrees for reinforced membrane. Provide tapered insulation with surface suitable for adhering membrane in the drain sump area. Avoid field seams running through or within 600 mm 24 inch of roof drain, or as otherwise recommended by the roof membrane manufacturer. Adhere the membrane to the tapered in the drain sump area. Apply water block mastic and extend membrane sheets over edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Ensure membrane is free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 20 mm 3/4 inch of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes. Retrofit roof drains must conform to ANSI/SPRI RD-1.

]3.3.4 PRE-FABRICATED CURBS

Securely anchor prefabricated curbs to nailer or other base substrate and flashed with EPDM membrane flashing materials.

3.3.5 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, 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.

3.3.6 Lightning Protection

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

[3.4 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 roof membrane manufacturer's printed instructions. Provide minimum 150 mm 6 inch separation between adjacent walkpads to accommodate drainage.

3.4.1 Elevated Metal [Walkways] [and] [Platforms]

Provide for protection of roof membrane by placing reinforced membrane or walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

3.4.2 Isolated 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 reinforced membrane or walkpad applied over the completed roof membrane.

3.4.3 [Stone][Paver] Ballast [Paver System]

****
NOTE: Indicate the appropriate ballast type. Indicate ballast weight required based on wind loading conditions. In some instances paver ballast may be used in perimeter and corner areas in combination with stone ballast in the field of the roof. If so, include the [Paver] option in item "a". Where elevated paver system is required, refer to as "Paver System" in the paragraph title. Delete bracketed options related to protection mat installation, stone ballast, and coverage rates. The paver type and weight must be as specified in Part 2.
****

Complete all membrane and membrane flashing work, including inspection and repair of all membrane and seams in the area of [ballast][paver] application prior to applying [ballast][paver] system. [Install protection mat over roof membrane in accordance with roof membrane manufacturer's recommendations. Provide minimum 75 mm 3 inch side laps and 150 mm 6 inch end laps. Turn mat up vertical surfaces to extend 50 mm 2 inch above ballast. Immediately after placement of protection mat,][Install and level pedestal system in accordance with manufacturer's requirements and] apply [stone][and][paver] [ballast][system.] [at the following coverage rates:

a. [Pavers:] [_____] kg per square meter pounds per square foot for perimeter and corner areas of roof.

b. [_____] kg per square meter pounds per square foot for field of roof.

In no case apply ballast at a coverage rate less than 49 kg per square meter 10 pounds per square foot or more than [_____] kg per square meter pounds per square foot.]

]3.5 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.

3.6 CLEAN UP

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

3.7 PROTECTION OF APPLIED ROOFING

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

[3.7.1 Water Cutoffs

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

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane 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.

]3.7.2 Temporary Flashing for Permanent Roofing

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

3.7.3 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.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

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

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

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

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.

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

Materials comply with the specified requirements.

All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.

Membrane is allowed to relax prior to seaming. Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required[, including additional fastening of membrane in corner and perimeter areas as required.]

Membrane is properly overlapped.

Membrane seaming is as specified and seams are hand rolled to ensure full adhesion and bond width. [In-seam sealant is applied when adhesive seams are used in the field of the roof.] All seams are checked at the end of each work day.

Applied membrane is inspected and repaired as necessary prior to ballast installation.

[Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths.

] Installer adheres to specified and detailed application parameters.

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

Ballast is within the specified weight range.

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

[3.8.2 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 2nd and 3rd bracketed sentences.

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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. Do not exceed additional inspections 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 overall quality of work, deficiencies and any other concerns, and recommended corrective action.

][3.8.3 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 watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Retrofit roof drains must conform to ANSI/SPRI RD-1. 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.

]3.9 INSTRUCTIONS TO GOVERNMENT PERSONNEL

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

3.10 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records anda photoengraved 1 mm 0.032 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 --