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USACE / NAVFAC / AFCEC **UFGS-07 54 23 (August 2025)**

Preparing Activity: USACE **New**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025
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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 54 23

THERMOPLASTIC-POLYOLEFIN ROOFING

08/25

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SECTION 07 54 23

THERMOPLASTIC-POLYOLEFIN ROOFING
08/25

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NOTE: This guide specification covers the requirements for thermoplastic polyolefin (TPO) thermoplastic sheet roofing, with associated thermoplastic 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 1/2 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 items(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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NOTE: Standard application methods include fully adhered systems. This guide specification does not include the structural roof deck, insulation, sheet metal fascias, or flashings.

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

therein.

Specify membrane attachments that are compatible with the insulation specified. 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.

****

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 7-22	(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 D751	(2019) Standard Test Methods for Coated Fabrics
ASTM D1204	(2014; R 2020) Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D6878/D6878M	(2021) Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing

ASTM E96/E96M	(2024a) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E108	(2025) Standard Test Methods for Fire Tests of Roof Coverings
ASTM E1980	(2024) Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

COOL ROOF RATING COUNCIL (CRRC)

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

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 https://www.approvalguide.com/

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2025) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

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

UL SOLUTIONS (UL)

UL 790	(2022) UL Standard for Safety Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2012) Roofing Materials and Systems Directory

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEM

****

NOTE: Coordinate with PART 2, select the application method required and delete other options.

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

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.

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

****

Fully adhered TPO roof membrane system applied over [insulation][cover 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 and Air Force projects.

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

****

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

SD-02 Shop Drawings

Roof Plan Drawing

Wind Load Calculations

Boundaries of Enhanced Perimeter

Corner Attachments of Roof System Components

Location of Perimeter Half-Sheets

Slopes and Drain Locations

SD-03 Product Data

TPO Sheet; G, [_____]

Heat Island Reduction; S

Recycled Content for TPO Roofing Membrane; S

Bonding Adhesive

Water Cutoff Mastic/Water Block

Lap Cleaner, Lap Sealant, and Edge Treatment

Flashings

Flashing Accessories

Roof Insulation

Protection Mat

Pre-Manufactured Accessories

Sample warranty certificate; G, [_____]

SD-05 Design Data

Wind Uplift Calculations; G, [_____]

SD-07 Certificates

Qualification of Manufacturer

Qualification of Applicator

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

Fire Resistance classification; G, [_____]

SD-08 Manufacturer's Instructions

Application; G, [_____]

Application Method; G, [_____]

Membrane Flashing; G, [_____]

Perimeter Attachment

Fasteners

Protection Mat

Pre-Manufactured Accessories

Cold Weather Installation; G, [_____]

SD-09 Manufacturer's Field Reports

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

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government Personnel

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] as applicable. The drawing must reflect the project roof plan of each roof level and conditions indicated. Provide all slopes and drain locations.

1.4 QUALITY CONTROL

****

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

****

1.4.1 Qualification of Manufacturer

****

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

****

TPO sheet roofing membrane manufacturer must have at least [20][_____] years experience in manufacturing TPO roofing products. Submit certification that the manufacturer of the roof membrane meets this requirement.

1.4.2 Qualification of Applicator

****

NOTE: Specify 5 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 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. Provide proof of this qualification in written form from the manufacturer of the roofing system. Submit the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 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. Submit the roof system assembly fire rating classification listings.

1.4.4 Wind Uplift Resistance

****

NOTE: Determine appropriate pressures that apply to various portions of roof using UFC 3-301-01 "Structural Engineering" for structural design and wind load information. Use criteria of local building code when their provisions exceed UFC 3-301-01 criteria.

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 are permissible, include the bracketed portion of the second sentence and the third sentence.

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 rated and installed to resist wind loads [indicated][calculated in accordance with ASCE 7-22] and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems except as approved by the Contracting Officer. Submit licensed engineer's wind uplift calculations

and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed of [_____] km/h [_____] mph in accordance with ASCE 7-22 and other applicable building code requirements. Submit the roof system assembly wind uplift classification listings.

1.4.5 Solar Reflectance Index (SRI)

****

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

****

SRI measures the roof's ability to reject solar heat, defined such that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100.[Provide roof finishes for more than 75 percent of the roof surface having a minimum 3-year aged solar reflectance of 0.55, and a minimum 3-year aged thermal emittance of 0.75 when tested in accordance with ANSI/CRRC S100, or, a minimum 3-year aged Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 6.62 W per m^2 2.1 BTU per h ft^2.][Use roofing materials having minimum 3-year aged SRI for more than 75 percent of roof surface (less than or equal to 2:12 slope, SRI greater than 64; greater than 2:12 slope, SRI greater than 25).] SRI values are based on a minimum three-year aged solar reflectance and thermal emittance, as measured in accordance with ANSI/CRRC S100.

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. Insulated hot boxes or other enclosed warming devices are required in cold weather. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover 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 day's 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 TPO 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 TPO sheet manufacturer and approved by the Contracting Officer, do not install TPO 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. Submit detailed cold weather

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.

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.[Application of roofing must immediately follow application of insulation[and cover boards] as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane 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 minimum manufacturer warranty with no dollar limit, covering full system water-tightness, and having a minimum duration of 20 years.

Submit a sample warranty certificate during the pre-construction phase to prove all warranty requirements will be achieved. 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.

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 20-year warranty regardless of small size.
****

Provide 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 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 must be 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 Contractor's Warranty

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

The Contractor must warrant for a 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.

1.8.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplish in a manner 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

The entire roofing and flashing system must be 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 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.

1.10 COOL ROOFS

****
NOTE: Facilities with dominant cooling loads or in mild or warm climate zones are required to meet "cool roofing" requirements of FEMP. Cool roof design must follow the requirements in UFC 3-110-03 "Roofing" and ASHRAE 90.1 Chapter 5, for the design of insulation and energy performance of the building. If a cool roof is not selected in climate

zones 1-3, meet one of the exception requirements listed in ASHRAE 90.1 Chapter 5 or provide thermal insulation above the deck with an R value of 33 or greater. Consider that when cool roofing is used with insulation R values greater than 24, the 'cool roof' surface has little if no influence on the energy performance of the building. Additionally, designers should be aware of the possible negative impacts of using cool roofing that may result in unintended consequences. Poor design of cool roofs in ASHRAE climate zones 4 and higher have resulted in the unintended consequence of condensation below the membrane-a result of the material's inability to warm and drive moisture downward. Roofs that experience this condensation have had to be replaced. Other unintended consequences include the overheating of masonry walls, interior spaces, roof top piping and mechanical equipment because of the reflected UV rays.

****

Install a roof system that meets an overall performance as specified on the drawings or by insulation specified in other Sections.[The roofing system must meet 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.]

1.11 RECYCLED MATERIALS

****

NOTE: Research shows the product is available from US national manufacturers above the minimum recycled content stated. Some manufacturers and regions have higher percentages.

****

Roofing membrane materials must contain a minimum of [5][10] percent total recycled content. Provide data identifying percentage of recycled content for TPO roofing membrane product.

PART 2 PRODUCTS

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Provide 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 Elimination, Prevention Or Control Of Fall Hazards

****

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

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

****

2.1.1.1 Fall Protection Systems

[_____]

2.1.2 TPO 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.

Typically specify 2.3 mm 0.080 inch thickness over fleece, Fleece-back reinforced membrane for fully adhered. Three major manufacturers have products at this thickness or greater. If greater include the thickness in the bracketed option. Total thickness including membrane and fleece-backing may be between 135 mil to 175 mil with the thicker fleece compatible with asphalt adhesive. Include total thickness in bracketed option.

****

Thermoplastic Polyolefin (TPO), meeting or exceeding the requirements of ASTM D6878/D6878M, scrim or fabric reinforced, 2.3 mm 0.080 inch thickness for fully adhered application. Membrane thickness over the reinforcing scrim (top-ply thickness) must be nominal 0.030 inch thick or greater. Total thickness with membrane and fleece backing is [_____]. Width and length of sheet must be[as recommended by the manufacturer][the maximum width attainable as recommended by the manufacturer to minimize field formed seams in the field of the roof]. In addition, TPO sheet must conform at a minimum to the following criteria:

****

NOTE: SRI value below is only achievable when selecting white as the roof color. Coordinate roof color with the Color Schedule. Other property values below are based on 80 mil thickness.

****

Physical Properties	Test Method	Test Result
Breaking Strength	ASTM D751	425 lbf
Elongation Break	ASTM D751	25 percent

Physical Properties	Test Method	Test Result
Tearing Strength	ASTM D751	65 lbf
Linear Dimensional Change, max percent (6 hours at 158 Degrees F)	ASTM D1204	.4
Water Vapor Permeance, Perms	ASTM E96/E96M	Less than 0.1 Perms
SRI, initial	N/A	94

2.1.3 Bonding Adhesive

****

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

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

Fleece-backed membrane can be adhered with hot applied modified asphalt if asphalt compatible, low VOC cold applied adhesives or two-part polyurethane foam adhesives. Include the bracketed option as applicable and write in a description of the adhesive required as the fourth 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)][Hot Asphalt][two-part polyurethane foam][_____] adhesive as supplied by roof membrane manufacturer and recommended by the manufacturer's printed data for bonding TPO membrane materials to insulation, cover board, wood, metal, concrete or other substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

2.1.4 Lap Cleaner, Lap Sealant, and Edge Treatment

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

2.1.5 Water Cutoff Mastic/Water Block

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

2.1.6 Membrane Flashings and Flashing Accessories

Membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations, and prefabricated pipe seals,

must be minimum 2.03 mm 0.080 inch thickness TPO, as recommended by the roof membrane manufacturer. Use TPO membrane to the maximum extent recommended by the roof membrane manufacturer.

[2.1.7 Protection Mat / Slip Sheet

****
NOTE: Specify protection mat for application between roof membrane and existing roof construction.
****

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.

][2.1.8 Pre-Manufactured Accessories

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

Provide pre-manufactured accessories of manufacturer's standard for intended purpose,[complying with applicable specification Section,] compatible with the membrane roof system and approved for use by the roof membrane manufacturer.

[2.1.8.1 Pre-fabricated Curbs

****
NOTE: Select Aluminum-zinc alloy coated steel (AZ 55) in humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5. Galvanized (zinc-coated) steel with G90 coating is also an option for ESC locations of C1 or C2. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.
****

Provide [_____] gauge [G90 galvanized][AZ55 galvalume][_____] curbs with minimum 100 mm 4 inch flange for attachment to roof nailers. Provide minimum height of 200 mm 8 inch above the finished roof membrane surface.

]][2.1.9 TPO Walkpads

****
NOTE: Use TPO Walkpads 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. Show walkpads on roof plans and indicate larger sizes as necessary.
****

Provide textured non-reinforced thermoplastic polyolefin material with minimum thickness of 0.150 inch. Minimum width and length of pad must be

30 inches by 30 inches and located at roof mounted mechanical equipment and other machinery requiring periodic maintenance [and as indicated on the drawings]. Install in accordance with manufacturer's recommendations. Minimize installation over roof seams and membrane splices.

]2.1.10 Roof Insulation Below TPO 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.
****

Provide insulation system and facer material compatible with membrane application specified as approved and supplied by the TPO membrane roof manufacturer[and in accordance with Section 07 22 00 ROOF AND DECK INSULATION].

[2.1.11 Photovoltaic (PV) Systems - Rack Mounted Systems

****
NOTE: Refer to UFC 3-110-03 for precautions and considerations for installation of PV Systems on roof systems. Delete this section where project does not include installation of PV systems.
****

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

]2.1.12 Wood Products

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

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

PART 3 EXECUTION

3.1 EXAMINATION

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

a. [Drains][, curbs][, control joints][, expansion joints][, perimeter walls][, roof penetrating components,][and][equipment supports] are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

c. 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.

d. Substrate is sloped to provide positive drainage.

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

f. Treated wood nailers are in place on non-nailable surfaces, to permit fastening 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.
****

g. 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.]

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

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

[i. 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.

][j. 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.]

][k. 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: UFC 3-110-03 requires fully adhered TPO systems and prohibits the use of the mechanical fasteners, except at roof perimeters and roof penetrations.
****

Apply entire TPO sheet, utilizing fully adhered application methods. 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 TPO 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 thermoplastic 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 TPO 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 TPO 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 TPO sheet roofing in position without stretching membrane. Inspect for holes. Remove sections of TPO 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.

3.2.3 Application Method

****

NOTE: Keep the bracketed option in the fourth sentence and the sixth sentence when a full application of adhesive is required on the substrate and membrane. Delete the bracketed option in the fourth sentence and delete the sixth sentence when a sprayed foam adhesive or hot asphalt adhesive is used with fleece-backed membrane and only applied to the substrate. Deleted the fifth sentence when hot asphalt adhesive is used.

****

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 a foam type adhesive is used, [spray][splatter][extrude] the adhesive at the required spacing, bead thickness or application rate required.][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 uniform bonding of sheet to substrate. Form field hot-air-welded laps or seams as specified and ensure that hot-air welded dimension is at width required by the membrane manufacturer's installation instructions. Check all seams and continuous hot-air-weld of all seams and lap seals. Apply lap sealant to seal cut edges of roofing membrane.

3.2.4 Perimeter Attachment

****

NOTE: All application methods of TPO 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.

3.2.5 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 angles greater than 4 degrees (1:12). Space fasteners a maximum of 12 inches on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Cover over fasteners with a layer of flashing material. Hot-air-weld all seams of flashing 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. Make and seal exposed joints and end laps of flashing membrane 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 TPO 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 TPO 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 insulation 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 flash with TPO membrane flashing materials.

3.3.5 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.

]3.5 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 take 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 TPO 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, or 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, 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.

d. Nailers and blocking are provided where and as needed.

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

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

g. Materials comply with the specified requirements.

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

i. 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.]

j. Membrane is properly overlapped.

k. Membrane seaming is as specified by TPO membrane manufacturer. All seams are checked at the end of each work day.

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

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

] n. Installer adheres to specified and detailed application parameters.

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

p. p. 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. Use bracketed option in second paragraph to specify minimum number of required visits. The minimum and default is three visits during installation. To help determine if more than three visits should be specified, divide the total project roof area in squares by 100 and round to the nearest whole number. Coordinate this requirement with Section 01 45 00 QUALITY CONTROL.

****

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

must be corrected and re-inspected by the manufacturer's technical representative.

3.8.2.1 Frequency

The manufacturer's technical representative must visit the work site to inspect and document ongoing work a minimum of [three][_____] separate occasions during the course of the installation. One visit must occur during the first 20 squares of installation, one at substantial completion of the roof work and all others during different periods of installation. Notify the Contracting officer a minimum of five working days prior to each visit by the manufacturer's technical representative.

3.8.2.2 Field Inspection Report

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

][3.8.3 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

Provide written and verbal instructions on proper maintenance procedures to designated Government personnel. Provide 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. Provide information on safety requirements during maintenance and emergency repair operations, including copies of Material Safety Data Sheets for maintenance/repair materials.

3.10 INFORMATION CARD

For each roof, provide a typewritten information card for facility records and a 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. Information card must identify 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 --