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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07550

WHITE EPDM MEMBRANE ROOFING SYSTEM

12/05

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SECTION 07550

WHITE EPDM MEMBRANE ROOFING SYSTEM

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PART 1 GENERAL

1.1 REFERENCES

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 7-02-GUIDE (2004) Guide to the Use of the Wind Load Provisions of ASCE 7-02

ASTM INTERNATIONAL (ASTM)

ASTM D 412 Rubber Properties in Tension
ASTM D 471 Resistance to Water Absorption
ASTM D 624 Rubber Property - Tear Resistance
ASTM D 746 Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 1149 Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 4637 (2004) Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D 4811 (2004) Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing
ASTM D 6369 (1999) Design of Standard Flashing Details for EPDM Roof Membrane
ASTM E 108 (2004) Standard Test Methods for Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM AS 4470 (1986; R 1992) Class I Roof Covers
FM P7825 (2003) Approval Guide
FM P7825c (2003) Approval Guide Building Materials

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405 (2001, 5th Ed) Roofing and Waterproofing Manual (2 Vol)

UNDERWRITERS LABORATORIES (UL)

- UL 790 (2004) Test Methods for Fire Tests of Roof Coverings
- UL RMSD (2004) Roofing Materials and Systems Directory

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEMS

Fully adhered white EPDM roof membrane system applied over insulation, protection board and concrete and metal roof deck substrate.

Fully adhered white EPDM roof membrane system applied over insulation, protection board and concrete and metal roof deck substrate.

1.3 SUBMITTALS

The following shall be in accordance with Section 01330 SUBMITTALS, in sufficient detail to show full compliance with the specifications:

SD-02 Shop Drawings

Roof Plan Drawing

Wind Load Calculations

Boundaries of Enhanced Perimeter

Corner Attachments of Roof System Components

Spacing of Perimeter, Corner, and Infield Fasteners

Slopes and Drain Locations

SD-03 Product Data

Cement

EPDM Sheet

Seam Tape

Insulation and Bonding Adhesive

Water Cutoff Mastic/Water Block

Lap Cleaner, Lap Sealant, and Edge Treatment

Flashings

Flashing Accessories

Flashing Tape

Fasteners and Plates

Energy Star

Roof Insulation

Protection Board

Pre-Manufactured Accessories

Sample warranty certificate

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-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."

FM Class I-90 Wind Uplift

Fire Resistance classification

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

Energy Star Roof: Provide all information in the appropriate format as required by LEED.

SD-08 Manufacturer's Instructions

Application

Application Method, 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

Seam Tape

Tape Seams

Adhesive Seams

Perimeter Attachment

Primer

Fasteners

Precast Walkway Pads

Pre-Manufactured Accessories

Cold Weather Installation

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 Material Safety Data Sheets 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. The drawing must reflect the project roof plan of each roof level and conditions indicated. Provide all slopes and drain locations.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

EPDM sheet roofing membrane manufacturer must have at least 15 years experience in manufacturing EPDM roofing products.

1.4.2 Qualification of Applicator

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 Fire Resistance

Complete roof covering assembly must:

- a. Be Class A rated in accordance with ASTM E 108, FM AS 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 P7825.

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

1.4.4 Wind Uplift Resistance

Complete roof covering assembly, including insulation, must be rated Class I-90 in accordance with FM P7825 capable of withstanding an uplift pressure of 90 psf. Do not install non-rated systems, except as approved by the Contracting Officer. Provide wind load calculations and submit engineering calculations and substantiating data to validate wind resistance of any non-rated roof system. Measure wind uplift calculations based on a design wind speed in accordance with ASCE 7-02-GUIDE.

1.4.5 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's technical representative. The conference shall be attended by the Contractor, the Contracting Officer's technical representative, 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 shall 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 60 degrees F. Insulated hot boxes or other enclosed warming devices must be required 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 40 degrees F or within 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. Application of roofing must immediately follow 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.

1.8.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 15 year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system

construction. The warranty must run 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 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 shall not void the warranty.
- c. Damage to the roof system caused by sustained winds having a velocity of 55 miles per hour or less shall be covered by this warranty.

1.8.2 Roofing System Installer Warranty

Warrant for a period of not less than 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. The warranty shall run directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The 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, as required, 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

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 general accordance with recommendations of the [NRCA 0405](#), membrane manufacturer published recommendations and details, [ASTM D 6369](#), and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Basis of Design: Carlisle Syntec Systems Sure-White ~~Fleece Back~~ Design A Adhered

Other Acceptable Manufacturers subject to compliance with requirements

1. ~~Firestone Building Products Company~~ RPI
2. Versico, Inc.

2.2 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.

2.2.1 EPDM Sheet

~~Sure Seal and Sure White Fleece Back~~ Membranes shall be are factory fabricated with a patented hot melt adhesive technology providing consistent bond strength and selvage edges for splicing. Membrane shall be 60 mil nonreinforced. Membrane must meet "Spec. (Pass)" below. ~~The total finished sheet thickness is 100 or 115 mill (2.54 or 2.92 mm) resulting in a very thick, sturdy and durable EPDM sheet.~~

Physical Property	Test Method	Spec. (Pass)	Sure White Typical
Tolerance on Nominal Thickness, %	ASTM D 412 <u>751</u>	<u>+10</u>	+10
Thickness over Fleece, min. in. (mm)	ASTM D 4637 Annex		
100 mil (2.54 mm)	.030 (.762)	.045 (1.143)	
115 mil (2.92 mm)	.030 (.762)	.060 (1.524)	
Weight, lbm/sq ft (kg/sq m)			
100 mil (2.54 mm)		0.33 (1.6)	
115 mil (2.92 mm)		0.42 (2.1)	
Breaking Strength, min. lbf (N)	ASTM D 751 Grab Method	90 (400)	200 (890)
Elongation, Ultimate, min. %	ASTM D 412	300**	500**
Tearing <u>Resistance</u> Strength min. lbf (N)	ASTM D 624 <u>751</u>	<u>150 (26.3)</u>	10 (-45) 45 (-200)
Brittleness point max. deg F (deg C)	ASTM D 746 <u>2137</u>	-49 (-45)	-67 (-55)
Resistance to Heat Aging* Properties after 1 week	ASTM D 573		

@240 deg F (116 deg C)			
Breaking Strength,			
min. lbf (N)	ASTM D 751	80 (355)	200 (890)
Elongation, Ultimate			
min. %	ASTM D 412	200**	250**
Linear Dimensional			
Change, max. %	ASTM D 1204	+1.0	-0.7
Ozone Resistance*	ASTM D 1149	No Cracks	No Cracks
Condition after exposure to 100 pphm			
Ozone in air for 168 hours @104 deg F (40 deg C)			
Specimen wrapped around 3 inch (7.5 cm) mandrel			
Resistance to Water			
Absorption*	ASTM D 471	<u>+8 -2.0</u>	4.0** 3.6**
After 7 days immersion @ 158 deg F (70 deg C)			
Change in mass, max. %			
Resistance to Outdoor (Ultraviolet) Weathering*	ASTM G 155	No Cracks	No Cracks
Xenon-Arc, 7560 kJ/sq m total radiant exposure at .70 W/sq m irradiance, 80 deg C black panel temperature	<u>ASTM D 4637</u>	Conditions	No Crazing No Crazing

* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.

** Specimens to be prepared from coating rubber compound, vulcanized in a similar method to the reinforced product.

2.2.2 Energy Star

White roof shall meet Energy Star and LEED requirements of high reflectance and high emissivity roofing (initial reflectance of at least 0.65 and three year aged reflectance of at least 0.5 when tested in accordance with ASTM E 903 and emissivity of at least 0.9 when tested in accordance with ASTM E 408-71).

2.2.3 Seam Tape

Double-sided synthetic rubber tape, minimum 0.03 inch thick, minimum 3 inch wide. The roof membrane manufacturer must supply seam tape 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. 6 inch wide tape is required for seam seals along lines of mechanical attachment of membrane.

2.2.4 Insulation and Membrane Adhesive

Two-component construction grade insulating polyurethane adhesive as supplied by roof membrane manufacturer and recommended by the manufacturers

printed data for adhering both membrane and insulation.

2.2.5 Lap Cleaner, Lap Sealant, and Edge Treatment

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

2.2.6 Water Cutoff Mastic/Water Block

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

2.2.7 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 0.045 inch minimum cured EPDM, as recommended by the roof membrane manufacturer or minimum 0.055 inch thick uncured EPDM sheet in compliance with ASTM D 4811, 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.

2.2.7.1 Flashing Tape

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

2.2.8 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended by the roof membrane manufacturer and meeting the requirements of FM AS 4470 and FM P7825c 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.

2.2.8.1 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 AS 4470; not less than 2 inch in diameter. Form discs to prevent dishing or cupping.

2.2.8.2 Auxiliary Fasteners

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

2.2.8.3 Powder-Driven Fasteners

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

2.2.8.4 Metal Disks

Provide flat metal disks of minimum 1 inch in diameter. Metal disks must

be of nonferrous material compatible with the nails or fasteners.

2.2.9 Pre-Manufactured Accessories

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.

2.2.10 Precast Concrete Paver Block Walkways

2.2.10.1 Precast Concrete Paver Block

Precast concrete blocks, 18 inch by 18 inch 24 inch by 24 inch, without sharp edges and projections, and weighing no more than 45 pounds 80 pounds each.

2.2.11 Roof Insulation Below EPDM Sheet

Insulation system and facer material must be compatible with membrane application specified and as approved by the roof membrane manufacturer and as specified in Section 07220 - Roof and Deck Insulation.

2.2.12 Wood Products

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.

2.3 FLASHING CEMENT

Provide a self-vulcanizing butyl compound flashing cement for splicing laps and for flashings workable at 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. 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 1/4 inch within an area 10 by 10 feet when checked with a 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 nailing of base flashing at minimum height of 8 inch above

finished roofing surface.

- 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 EPDM materials with fire retardant treated wood, except as approved by the roof membrane manufacturer and Contracting Officer.
- i. 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 3-1/2 inch.
- j. Exposed nail heads in wood substrates are properly set. Warped and split boards have been replaced. There are no cracks or end joints 1/4 inch in width or greater.
- k. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

3.2 APPLICATION

Apply entire EPDM 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 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 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 3 inch in any case.

3.2.3 Application Method

3.2.3.1 Fully Adhered Membrane Application

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.

3.2.4 Tape Seams / Lap Splices

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 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 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 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 Perimeter Attachment

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.

3.2.6 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 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 16 inch nor less than 8 inch above the roofing surfaces. Exposed joints and end laps of flashing membrane shall be made and sealed in the manner required for roofing membrane.

3.3.2 Membrane Flashing

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 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 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 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

Provide a tapered insulation sump into the drain bowl area. Do not exceed tapered slope of 18 degrees for unreinforced membrane and 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 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. Insure membrane free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 3/4 inch of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes.

3.3.4 Base Flashing

Lay base flashing membrane in not more than 12 foot lengths into flashing cement applied in accordance with the roofing manufacturer's printed instructions. Flashing membranes may be applied in continuous lengths as working areas permit. Extend membrane at least 4 inch onto the roof, over the cant, and up the vertical surface to the sheet metal reglet or to the top of the curb where sheet metal reglets are not required. Secure flashing membrane at the top at 8 inch on center with nonferrous metal nails or fasteners.

3.3.5 Cants

Install cants in the angles formed at walls and other vertical surfaces as a backing for base flashings. Lay cants in a solid coat of adhesive immediately before laying the roofing membrane. Provide cants with a 5-1/2-inch face dimension that will be continuous and installed in lengths that are as long as practical. Installation of cants is not required at locations where cast-in-place cants have been integrally formed with the structural deck or roof fill.

3.3.6 Strip Flashings

Roof flanges of sheet metal flashings, such as fascias, base flashings, and plumbing flashings furnished and installed under other sections of the specifications, must be stripped with flashing membrane. After installation of metal flashings over the roofing membrane, strip flashing membrane centered longitudinally at edges of roof flanges must be installed into flashing cement applied in accordance with the roofing manufacturer's printed instructions to form a waterproof joint between the roofing membrane and the metal flashings.

3.3.7 Valleys

Apply roofing at valleys and waterways in the following manner:

Allow base sheets to continue across valleys and terminate at approximately 18 inch from the valley.

Lay roofing membrane across valleys to terminate at approximately 12 inch from the valley. Terminate exposed lap on a line approximately 12 inch from and parallel to the valley gutter and treat as an end lap.

Roofing membrane and the base sheet may be laid across or parallel to shallow valleys such as those formed by a reverse-slope roof, provided applications can be completed without wrinkles, buckles, or fishmouths and side laps do not face the direction of drainage.

3.3.8 Valley Application

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

Allow base sheets to continue across valleys and shall terminate at approximately 18 inch from the valley.

Allow felt plies to continue across valleys and terminate at approximately 12 inch from the valley. Terminate exposed laps on a line approximately 12 inch from and parallel to the gutter valley. Mop two plies of felt, 9 and 12 inch wide, in over each felt line-of-termination.

If the application can be completed without wrinkles, buckles, or fishmouths, and if side laps do not face the direction of drainage, roofing felts and base sheets may be laid continuously across or parallel to shallow valleys such as those formed by reverse-slope roofs. For this application, reinforce valleys with one ply of felt, 36-inch wide, centered on the valley gutter and lay in a solid mopping of asphalt over the top ply of roofing.

3.4 PRE-FABRICATED CURBS

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

3.4.1 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. Specific method of installing set-on accessories must 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.

3.4.2 Lightning Protection

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

3.4.3 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 6 inch separation between adjacent walkpads to accommodate drainage.

3.4.4 Correction of Deficiencies

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

3.4.5 Clean Up

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

3.5 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.

3.5.1 Water Cutoffs

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.

3.5.2 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.

3.5.3 Temporary Walkways, Runways, and Platforms

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

3.6 FIELD QUALITY CONTROL

3.6.1 Construction Monitoring

During progress of the roof work, Contractor shall 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.

3.6.2 Manufacturer's Inspection

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, a report, submit 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.

3.6.3 Roof Drain Test

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. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.7 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.

3.8 INFORMATION CARD

For each roof, furnish a typewritten minimum 8-1/2 inch by 11 inch information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. 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 --