

SECTION 07 54 23
THERMOPLASTIC MEMBRANE (TPO) ROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes fully adhered thermoplastic membrane roofing system including rigid insulation, flashings, walkways, and accessories.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Wood Protection Association (AWPA): U1, Use Category System: User Specification for Treated Wood.
 2. ASTM International (ASTM):
 - a. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - b. D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - c. D312, Standard Specification for Asphalt Used in Roofing.
 - d. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - e. D471, Standard Test Method for Rubber Property—Effect of Liquids.
 - f. D573, Standard Test Method for Rubber—Deterioration in an Air Oven.
 - g. D751, Standard Test Methods for Coated Fabrics.
 - h. D1149, Standard Test Methods for Rubber Deterioration-Cracking in an Ozone Controlled Environment.
 - i. D1204, Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - j. D4601, Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - l. E108, Standard Test Methods for Fire Tests of Roof Coverings.
 - m. E408, Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
 - n. E1980, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

3. FM Global (FM):
 - a. DS 1-28, Design Wind Loads.
 - b. DS 1-29, Roof Deck Securement and Above-Deck Roofing Components.
 - c. 4450, Approval Standard for Class I Insulated Steel Deck Roofs.
4. International Code Council (ICC): International Building Code (IBC).
5. Intertek Testing Services (Warnock Hersey Listed) (WH), Certification Listings.
6. National Roofing Contractors Association: NRCA Roofing and Waterproofing Manual.
7. Single Ply Roofing Institute (SPRI): ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
8. UL:
 - a. 790, Standard Test Methods for Fire Tests of Roof Coverings.
 - b. 1256, Fire Test of Roof Deck Constructions.
 - c. 1897, Uplift Tests for Roof Covering Systems.
9. U.S. Department of Defense Military Standard (MIL): 3010, Test Procedures for Packaging Materials.
10. U.S. Environmental Protection Agency (EPA): ENERGY STAR - ENERGY STAR Voluntary Labeling Program.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Layout of tapered insulation.
 - b. Project-specific details of roof penetrations and perimeter conditions.
 - c. Layout and details of fully adhered system.
 - d. List of materials proposed for use; include roofing materials, accessories, insulation, and fasteners.
 - e. Manufacturer's specifications selected for use; include description of complete system from deck up.
 - f. Documentation that anchoring system meets uplift requirements.

B. Informational Submittals:

1. Manufacturer's installation instructions.
2. Letter or other documentation from roofing materials manufacturer stating that installer has been trained and approved to apply roof system.
3. Sample copy of guarantee to be provided.
4. Record of Preroofing Conference.
5. Inspection reports for inspections conducted by membrane manufacturer's representative; include written instructions or recommendations as conditions to special guarantee.

6. Operation and Maintenance Data:
 - a. As specified in Section 01 78 23, Operation and Maintenance Data.
 - b. Include sketches where applicable, recommendations for periodic inspection, care, and maintenance.
 - c. Identify common causes of damage with instructions for temporary patching until permanent repair can be made.
7. Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services, (or alternately, test results or calculations) that assure item's and its anchorage's design criteria meets requirements of Section 01 88 15, Anchorage and Bracing, for loads as shown in General Structural Notes.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.
- B. Roof Assembly Fire Classification: Minimum Class A when tested in accordance with ASTM E108 or UL 790.
 1. Roof Assembly with Foam Insulation: Passes FM 4450 or UL 1256.
- C. Surface Burning Characteristics:
 1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- D. Apply label from agency approved by authority having jurisdiction to identify each roof assembly component.

1.05 QUALITY CONTROL

- A. Installer Qualifications:
 1. Trained and approved by roof membrane manufacturer.
 2. Experience: 3 years, minimum, in the installation of the specific roofing and flashing system specified.
- B. Materials, including insulation used in roofing system shall be furnished by or approved by manufacturer whose roofing system is selected for use.

1.06 PREROOFING CONFERENCE

- A. Conference Requirements:
 1. Attendees: Contracting Officer, roofing installer, roofing manufacturer, installers of related Work, and other entities concerned with roofing

performance included, where applicable, insurer, test agencies, and governing authorities.

2. Agenda: Follow outline in NRCA's Waterproofing Manual. Include acceptability of deck, roofing system, materials, manufacturer's specifications selected, flashing details, roof guarantee, and protection of furnished roofing system.
3. Documentation: Record discussion and agreements. Furnish copy to each attendee invited.

- B. Membrane manufacturer's inspections as required to meet conditions of guarantee.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in their original, unopened containers, clearly labeled with manufacturer's name, brand name, and such identifying numbers as are appropriate.
- B. Storage:
1. Store materials at temperatures between 60 degrees F and 80 degrees F. Should they be exposed to lower temperatures, restore to 60 degrees F prior to use.
 2. Store rigid roof insulation materials on clean, raised platform.
 3. Do not store uncured flashing membrane on roof or at temperatures exceeding 75 degrees F.
- C. Protect materials against wetting, moisture absorption, and construction traffic.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Weather: Do not install roofing during precipitation or when it is probable.
- B. Temperature:
1. Install roofing when ambient temperature is 50 degrees F or above.
 2. When temperature is below 50 degrees F, install only with approval or and under supervision of membrane manufacturer.

1.09 COORDINATION

- A. Coordinate Work with installation of associated roof penetrations, HVAC equipment, and metal flashings, as Work of this section proceeds.

1.10 SPECIAL GUARANTEE

- A. Product: Furnish manufacturer's extended guarantee or warranty, with Government named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Contracting Officer, removal and replacement of roofing membrane, flashing, insulation, and accessories found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.
- B. Coverage and Conditions:
 - 1. Costs for repairs required to maintain roofing system, and flashing in watertight condition.
 - 2. Full system, no dollar limit, not prorated, water-tight and weather-tight with normal usage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Johns Manville.
- B. Or equal.

2.02 GENERAL ROOFING SYSTEM MATERIAL CHARACTERISTICS

- A. Physical Characteristics:
 - 1. Roofing system shall meet these Specifications, and approval and warranty of membrane manufacturer to provide a fully adhered complete TPO system including the following:
 - a. Membrane.
 - b. Roof insulation.
 - c. Flashing.
 - d. Adhesives.
 - e. Fasteners.
 - f. Accessory materials.
 - 2. Design Requirements:
 - a. Low Slope Membrane Roof Edge Securement: Conform to SPRI ES-1 for wind speeds determined from applicable edition of ICC IBC code.

- B. Functional Characteristics: As specified for each item below.
- C. Performance Characteristics: Roof Assembly Classification: FM Class 1 Construction, windstorm classification of I-90, in accordance with FM DS 1-28.
- D. Refer to Section 07 70 01, Roof Specialties and Accessories, for roof curbs, roof access hatches, and other related items.

2.03 MEMBRANE MATERIALS

- A. Manufacturers and Products:
 - 1. Johns Manville; JM TPO, 80-mil membrane.
 - 2. Or equal.
- B. Physical Characteristics:
 - 1. Reinforced thermoplastic polyolefin sheet, 0.080 inch thick.
 - 2. Membrane Sheet Size: Minimum width 60 inches by length of largest sheet possible, determined by project conditions.
 - 3. Color: White.
- C. Functional Characteristics: None.
- D. Performance Characteristics:

Properties	Test Method	Specification
Thickness Tolerance	ASTM D751	Plus or minus 10%
Breaking Strength (min)	ASTM D751, Grab Method	300 pounds
Elongation at Break	ASTM D412	30%
Tear Strength (min)	ASTM D751	60 pounds
Ozone Resistance	ASTM D1149, 70 hours at 100 degrees F	No cracks or other affect
Heat Aging	ASTM D573, 28 days at 212 degrees F retention of tensile	Maintain 100% of original breaking strength
Water Absorption (change in mass)	ASTM D471, 158 degrees F for 7 days	1%
Hydrostatic Resistance (min)	ASTM D751, Method A	430 psi

Properties	Test Method	Specification
Puncture Resistance	MIL Std 3010	380 pounds
Dimensional Stability (% change max.)	ASTM D1204	+ 0.4%

1. Energy and Environment:
 - a. Roof Surface: Minimum solar reflectance index (SRI) for 75 percent of roof area, in accordance with ASTM E1980. Emissivity in accordance with ASTM E408.
 - 1) ENERGY STAR: Reflectivity 0.78, emissivity 0.90.

2.04 RIGID ROOF INSULATION BOARD

A. Manufacturers and Products:

1. Johns Manville; ENRGY.
2. Or equal.

B. Physical Characteristics:

1. Average Aged R-value for Total Thickness of Rigid Insulation: R-35 minimum.
2. Polyisocyanurate Foam Board:
 - a. Minimum Size: 2 feet by 4 feet.
3. Tapered Board System:
 - a. Factory precut or field tapered insulation board, minimum 1 inch thick with top surface cut to a uniform, continuous slope as shown.
 - b. Fabricate miters and edges to match abutting blocks.

C. Functional Characteristics: None.

D. Performance Characteristics:

1. Polyisocyanurate Foam Board: ASTM C1289, Type II with FM Class I approval.

2.05 ROOF WALKWAY

- A. Physical Characteristics: Molded rubber walk pads, slip-resistant surface, approved for on-roof traffic by membrane manufacturer.
- B. Functional Characteristics: None.
- C. Performance Characteristics: None.

2.06 ACCESSORY MATERIALS

A. Adhesives and Fasteners:

1. Surface Conditioner: Compatible with membrane.
2. Membrane and insulation adhesives and fasteners as recommended by membrane manufacturer.
3. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

B. Flashing:

1. 0.060-inch roofing membrane.
2. Provide unreinforced 0.070-inch thick roofing membrane for field fabricated vent stacks, pipes, and corners.

C. Primer: ASTM D41 Asphalt.

D. Asphalt: ASTM D312, Type III steep asphalt.

E. Roofing Felt: ASTM D4601, Type IV or Type VI asphalt-coated glass fiber mat.

F. Nailers: Preservative treated wood as specified in Section 06 10 00, Rough Carpentry.

PART 3 EXECUTION

3.01 PREPARATION

A. Surfaces to be adhered shall be dry before and throughout entire application.

B. Notify Contracting Officer at least 48 hours before installation of vapor retarder, insulation, membrane, and roofing system.

C. Inspection:

1. Verify work of other trades that penetrates roof deck or requires roof access has been completed.
2. Ensure deck is firm, dry, free of foreign material, and reasonably smooth.
 - a. Differential height between adjacent roof deck members of more than 1/8 inch is not acceptable.
 - b. Repair joints greater than 1/4 inch wide.
3. Report immediately to Contracting Officer cracks, breaks, holes, or other unusual irregularities in surface.
4. Cover rough surface that would cause damage to membrane with protection board.

D. Nailers:

1. Install wooden nailers at drip edges on outside perimeter of building.
2. Anchor nailer with a suitable fastener with minimum withdrawal resistance of 100 pounds.
3. Stagger fasteners 6 inches on center within 8 feet of outside corner and 12 inches on center along other perimeter areas.
4. Nailer Thickness: Choose to match top surface of adjacent construction.

3.02 INSTALLATION

A. In accordance with membrane manufacturer's standard details for flashing and termination conditions not shown.

B. In accordance with applicable recommendations of FM DS 1-29.

C. Insulation:

1. Keep insulation dry before and during application.
2. Install rigid insulation where and to thickness necessary for R-value shown in two or more layers, staggering joints.
3. Lay insulation with longest dimension perpendicular to direction of membrane seams with joints staggered over roof area to be covered.
4. Butt boards as closely as possible with no gaps over 1/4 inch.
5. Mechanically fasten insulation to deck following roofing membrane manufacturer's instructions.
6. Do not install more insulation each day than can be covered with membrane before end of day or start of inclement weather.

D. Membrane:

1. Install membrane and flashing in accordance with manufacturer's recommendations and instructions.
2. Heat weld joints following manufacturer's instructions.
3. Fully adhere membrane to substrate.

E. Flashing:

1. Install perimeter, curb, vents, expansion joints, drains, and other detail flashing as shown on manufacturer's standard detail drawings and as follows:
 - a. Heat weld flashing to membrane and attach to other surfaces following manufacturer's instructions.
 - b. Install pipe flashing, expansion joints, and roof drains in accordance with manufacturer's standard details and instructions.

F. Temporary and Night Seals:

1. Provide water cutoffs under the following circumstances:
 - a. Where and when a danger exists that water caused by precipitation may get under new roofing membrane.
 - b. At end of each day.
2. Make by securely setting end of membrane in 6-inch wide continuous application of cement and weight adhered edge to prevent displacement of cutoff.
3. Remove temporary water cutoffs prior to proceeding with next work period by cutting off and disposing of portion of membrane that has been in contact with cement.

G. Walkways: Adhere to membrane with membrane manufacturer's bonding adhesive. Provide gaps to allow for drainage as required by membrane manufacturer. Provide at locations as shown and elsewhere as recommended by manufacturer.

3.03 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection and Certification of Proper Installation, equipment testing, startup assistance, and training of Contracting Officer's personnel for specified component, subsystem, equipment, or system.

3.04 CLEANING

- A. Remove spots and smears of asphalt or other material from flashings, gravel stops, and other surfaces not intended to be coated with such material. During removal, do not damage surfaces. Use solvents, if necessary, to clean surfaces.
- B. Sweep to remove all foreign material including sand, leaves, roofing debris, and other loose particles.
- C. Remove all loose materials from drains, drain sumps and the entire roofing surface.

3.05 PROTECTION

- A. Limit traffic of personnel and equipment on completed roof to that deemed essential for completion of Project.

END OF SECTION