

SECTION 07540
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

- A. The general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 General Requirements, apply to work specified in this Section.

1.02 SUMMARY

- A. This Section specifies adhered thermoplastic membrane (TPO) roofing over insulated concrete deck (main roof) and over insulated steel deck (stair penthouse).

- B. Roofing Work includes the following:

1. Adhered sheet roofing
2. Vapor retarder.
3. Roof insulation and cover board.
4. Walkway pads.

- B. Related Work Specified in Other Sections:

1. Removal of existing roof covering over third floor deck and penthouses: Section 01732.
2. Wood nailers, curbs, cants, and blocking: Section "Rough Carpentry"
3. Cutting and patching roofing on EPDM roofing on existing roof as part of Alternate No. 5: Section 07530.
4. Metal roof edge flashing and fascia: Section 07720.
4. Joint sealants: Section 07920.
5. Roof drains: Division 15 Section.

1.03 PERFORMANCE REQUIREMENTS

- A. General: Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

- C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist design wind uplift pressures calculated in accordance with BOCA National Building Code 1999 edition for wind speed of 90 mph, I = 1.0, exposure B. Basic uplift pressures are as follows:

1. Design Wind Uplift: 21 lbf/sq. ft. in field and 27 lbf/sq. ft. within 4' of roof edge.

2. Design and install the system to resist increased uplift pressure at perimeter and corners in accordance with the recommendations of the Single Ply Roofing Institute (SPRI) publication "Wind Design Guide for Low-Sloped Flexible Membrane Roofing Systems," 2001 edition, or of the roofing system manufacturer, whichever is more stringent.

1.04 SUBMITTALS

- A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Include plans, sections, and details of the following:
 1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Sheet metal work.
- C. Samples for Verification: Of the following products:
 1. 12-by-12-inch (300-by-300-mm) square of sheet roofing, of color specified, including T-shaped side and end lap seam.
 2. 12-by-12-inch (300-by-300-mm) square of roof insulation.
 3. 12-by-12-inch (300-by-300-mm) square of cover board.
 4. 12-by-12-inch (300-by-300-mm) square of walkway pads.
 5. 12-inch (300-mm) length of metal termination bars.
 6. 6 insulation and roof cover board fasteners of each type, length, and finish.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that the roofing system complies with requirements specified in the "Performance Requirements" Article. Upon request, submit evidence of meeting requirements.
- F. Qualification Data: For installer and manufacturer. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.
- H. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- I. Sample Warranty: Sample copy of standard roofing system manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.
- J. Closeout Submittals:
 1. Maintenance Data: For roofing system to include in the maintenance manuals specified in Division 1.

2. Actual warranty.
3. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing roofing similar to that required for this Project and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product.
- B. Source Limitations: Obtain components for membrane roofing system from same manufacturer as roofing membrane or from a supplier approved by roofing membrane manufacturer.
- C. Fire-Test-Response Characteristics: Class A, as determined by testing identical products per ASTM E108 for application and slopes indicated by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
- D. Preinstallation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Notify participants at least 5 working days before conference.
 1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 4. Review loading limitations of deck during and after roofing.
 5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
 6. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
 7. Review temporary protection requirements for roofing system during and after installation.
 8. Review roof observation and repair procedures after roofing installation.
 9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid materials from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.07 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements.

1.08 WARRANTY

- A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Roofing Manufacturer's Warranty: Submit a written total system warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks resulting from defects in materials or workmanship for the following coverage and warranty period:
 - 1. Warranty shall cover roofing membrane, base flashings, vapor retarder, roof insulation, adhesives, cover boards, walkway products, sheet metal flashing and fascias, and all other components of membrane roofing system furnished under this Section.
 - 2. Warranty Period: 15 years from Date of Substantial Completion.
 - 3. Wind Speed Enhancement: 90 MPH

PART 2 - PRODUCTS

2.01 THERMOPLASTIC POLYOLEFIN SHEET

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carlisle SynTec Incorporated.
 2. Firestone Building Products Company.
 3. GenFlex Roofing Systems.
 4. Stevens Roofing Systems; Div. of JPS Elastomerics.
- B. Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible elastomer sheet formed from a thermoplastic polyolefin, reinforced, of the following thickness, exposed face color, and physical properties:
1. Thickness: 60 mils (1.5 mm), nominal.
 2. Exposed Face Color: Light Gray.
 3. Physical Properties: Provide reinforced thermoplastic polyolefin sheets with the following properties as determined per ASTM test method indicated:
 - a. Breaking Strength: 225 lbf (1 kN); ASTM D 751, grab method.
 - b. Elongation at Break: 15 percent; ASTM D 751.
 - c. Tearing Strength: 55 lbf (245 N) minimum; ASTM D 751, Procedure B.
 - d. Resistance to Heat Aging: No reduction in breaking strength, elongation at break, and tearing strength after 168 hours at 240 deg F (116 deg C); ASTM D 573.
 - e. Ozone Resistance: No cracks after 168 hours' exposure of 50 percent elongated sample at 100 deg F (38 deg C) and 100-pphm (100-MPa) ozone; ASTM D 1149, Procedure B.
 - f. Water Absorption: Less than 4 percent mass change after 168 hours immersion at 158 deg F (70 deg C); ASTM D 471.
 - g. Weather Resistance: No cracks or crazing after 4000 hours exposure to xenon-arc; ASTM G 26.
- C. Unreinforced Thermoplastic Polyolefin Sheet: Uniform, flexible elastomer sheet formed from a thermoplastic polyolefin, unreinforced, which physical properties as listed below.
1. Thickness: Same as reinforced membrane.
 2. Exposed Face Color: Same as the roofing membrane.
 3. Physical Properties: Provide unreinforced thermoplastic polyolefin sheets with the following properties as determined per ASTM test method indicated:
 - a. Tensile Strength: 1740 psi (12 MPa); ASTM D 412, Die C.
 - b. Ultimate Elongation: 500 percent; ASTM D 412, Die C.
 - c. Tensile Set: 10 percent, maximum; ASTM D 412, Die C, 50 percent elongation.
 - d. Tear Resistance: 340 lbf/in. (60 kN/m); ASTM D 624, Die C.

- e. Resistance to Heat Aging: No reduction in breaking strength, elongation at break, and tearing strength after 168 hours at 240 deg F (116 deg C); ASTM D 573.
- f. Ozone Resistance: No cracks after 168 hours' exposure of 50 percent elongated sample at 100 deg F (38 deg C) and 100-pphm (100-MPa) ozone; ASTM D 1149, wrapped around a 3-inch- (75-mm-) diameter mandrel.
- g. Water Absorption: Less than 4 percent mass change after 168 hours' immersion at 158 deg F (70 deg C); ASTM D 471.
- h. Weather Resistance: No cracks or crazing after 4000 hours' exposure to xenon-arc; ASTM G 26.

2.02 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing material.
 - 1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, thickness, and color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- D. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch (25 mm) wide, roll formed and prepunched.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, seam calk, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.

2.03 VAPOR RETARDER

- A. Polyethylene Vapor Retarder: 3-ply, fiber reinforced polyethylene sheet; perm rating 0.05 or less, measured per ASTM E-96. Furnish vapor retarder intended for use under single-ply roofing, approved by Factory Mutual for use in Class 1 construction, and acceptable to the roofing membrane manufacturer.
 - 1. Product: One of the following:
 - a. Reef Industries, "Griffolyn" Type 65 or Type -55 FR
 - b. Raven Industries, "Dura-Skrim"

2.04 INSULATION MATERIALS AND ACCESSORIES

- A. Insulation Manufacturer: Provide insulation of the type specified, either furnished by the roofing membrane manufacturer, or acceptable to the roofing membrane manufacturer as a component of the specified total system warranty.
- B. General: Provide preformed roof insulation boards that comply with requirements, selected from manufacturer's standard sizes and of thicknesses indicated.
 - 1. Provide preformed, tapered insulation boards where indicated for sloping to drain. Fabricate with a taper of 1/8 inch per 12 inches (1:96), unless otherwise indicated.
 - 2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, classified by facer type as follows:
 - 1. Facer Type: Type II, felt or glass-fiber mat on both major surfaces.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick; "Dens-Deck" manufactured by Georgia-Pacific Corporation.
- E. Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.
 - 1. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

2.05 WALKWAYS

- A. Walkway Pads: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, of materials acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.
- B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- C. Verify that wood nailers are in place and secured and match thicknesses of insulation required.

- D. Do not proceed with installation until after the minimum concrete curing period recommended by roofing system manufacturer.
- E. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate to remove dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.03 VAPOR-RETARDER INSTALLATION

- A. Loosely lay vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.
 - 1. Seal laps with tape or with roofing membrane manufacturer's standard adhesive.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations.

3.04 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings.
- D. Install two or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Loosely butt cover boards together and fasten to roof deck according to roofing system manufacturer's written instructions.
1. Fasten cover boards and insulation according to requirements of FM's "Approval Guide" for 1-90 Windstorm Resistance Classification and the insulation and roofing system manufacturers' written instructions, whichever is most stringent.

3.05 ADHERED SHEET INSTALLATION

- A. Install reinforced thermoplastic sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax for a minimum of 30 minutes.
- B. Start installation of sheet in presence of roofing system manufacturer's technical personnel.
- C. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Apply bonding adhesive to substrate and underside of sheet at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to seam area of sheet.
- E. Mechanically fasten sheet securely at terminations and perimeter of roofing.
- F. Apply roofing sheet with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap sheets, and hot-air weld side and end laps of sheets and flashings according to manufacturer's written instructions to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity. Apply seam calk to seal cut edges of sheet membrane.
 2. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
- H. Roof Drains: Spread sealant bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.
- I. Install adhered thermoplastic sheet and auxiliary materials to tie in to existing roofing.
- J. Expansion Joints: Fabricate and install in accordance with the Drawings and with the roofing membrane manufacturer's standard details. Support bellows type joints formed from roofing or flashing membrane by installing closed cell foamed plastic tube under the bellows.

3.06 FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.
 - 1. For forming field-fabricated flashing for vent stacks, pipe, drains and corner, and at other locations specifically identified by the roofing membrane manufacturer, use the unreinforced TPO flashing sheet. Prefabricated pipe boots and corners may also be used, where permitted by the membrane manufacturer.
 - 2. For flashing at other locations, use the reinforced roofing membrane sheet.
- B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.
- D. Clean seam areas, overlap sheets, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Test lap edges with probe to verify seam weld continuity. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.07 WALKWAYS

- A. Walkways: Install walkway pads in locations indicated. Heat weld or adhere walkway pads to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.08 FIELD QUALITY CONTROL

- A. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.

3.09 PROTECTING AND CLEANING

- A. Protect sheet membrane roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

- B. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures required by manufacturer of affected construction.

END OF SECTION 07540