075423 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Adhered thermoplastic polyolefin (TPO) roofing system.
 - 2. Mechanically fastened, thermoplastic polyolefin (TPO) roofing system.
 - 3. Loosely laid and ballasted, thermoplastic polyolefin (TPO) roofing system.
 - 4. Substrate board.
 - 5. Roof insulation.
 - 6. Cover board.
 - 7. Walkways.

1.2 PRE-INSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
 - 1. For insulation and roof system component fasteners, include copy of SPRI's Directory of Roof Assemblies listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness of insulation.
 - 2. Base flashings and membrane termination details.
 - 3. Flashing details at penetrations.
 - 4. Tapered insulation layout, thickness, and slopes.
 - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 - 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 - 7. Tie-in with adjoining air barrier.
- C. Samples: For the following products:
 - 1. Roof membrane and flashings, of color required.
- D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Manufacturer's maintenance requirements.

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1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates:
 - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
 - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- C. Research reports.
- D. Field Test Reports:
 - 1. Concrete internal relative humidity test reports.
 - 2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- E. Field quality-control reports.
- F. Sample warranties.
- 1.5 CLOSEOUT SUBMITTALS
 - A. Maintenance data.
- 1.6 QUALITY ASSURANCE
 - A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- 1.7 WARRANTY
 - A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

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- B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
 - 1. Zone 1 (Roof Area Field).
 - 2. Zone 2 (Roof Area Perimeter).
 - a. Location: From roof edge to <Insert dimension> inside roof edge.
 - 3. Zone 3 (Roof Area Corners).
 - a. Location: in each direction from building corner.
 - 4. Fire/Windstorm Classification: [Class 1A-60].
- D. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for [low] slope roof products.
- E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than [0.70] and an emissivity of not less than [0.75] when tested according to CRRC-1.
- F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, [Class A] for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2	THERMO	OPLAS	TIC POLYOLEFIN (TPO) ROOFING	1))	
А.	MAN	MANUFACTURERS			
•	1.	Acceptable manufacturers:			
		a.	Tremco	1	
		b.	SIKA)))	
		c.	Carlisle	1))	
В.	TPO	TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, [fabric-backed] TPO sheet.			
	 Thickness: [60 mils (1.5 mm)] nominal. Exposed Face Color: White. 		kness: [60 mils (1.5 mm)] nominal.	1	
•			osed Face Color: White.)	
2.3	AUXILIA	RY RO	OFING MATERIALS)))	
A.	Gene	eral: Ai patible	uxiliary materials recommended by roofing system manufacturer for intended use and a with other roofing components.		

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

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- Β. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, [55 mils (1.4 mm)] > thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard[, water based].
- E. Slip Sheet: ASTM D2178/D2178M, Type IV; glass fiber; asphalt-impregnated felt.
- F. Slip Sheet: Manufacturer's standard, of thickness required for application.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- Η. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, ١. preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

SUBSTRATE BOARDS 2.4

- Α. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.
 - 1. Thickness: 5/8 inch (16 mm).
- Β. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.
 - 1. Thickness: [1/2 inch (13 mm)] thick.
 - 2. Surface Finish: [Unprimed].
- C. Substrate Board: ASTM C728, perlite board, seal coated.
 - 1. Thickness: [3/4 inch (19 mm)].
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

- Α. Extruded-Polystyrene Board Insulation: ASTM C578, [Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength] [Type V, 3.00-lb/cu. ft. (48-kg/cu. m), minimum density, 100-psi (690-kPa) minimum compressive strength], square edged.
 - 1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
 - 2. Size: [48 by 96 inches (1219 by 2438 mm)].
 - 3. Thickness:

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- a. Base Layer: [1-1/2 inches (38 mm)].
- b. Upper Layer:
- B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.
 - 1. Thermal Resistance: R-value of 3.8 per inch (25.4 mm).
 - 2. Size: [48 by 96 inches (1219 by 2438 mm)].
 - 3. Thickness:
 - a. Base Layer: [1-1/2 inches (38 mm)].
 - b. Upper Layer:

2.6 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosionresistance provisions in FM Approvals 4470, designed for fastening roof insulation[and cover boards] to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway [pads] [or] [rolls], approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
 - 1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
 - 2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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3.2 PREPARATION

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 - 1. Submit test result within 24 hours after performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, [FM Approvals' RoofNav] [SPRI's Directory of Roof Assemblies] listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition[and to not void warranty for existing roofing system].
- D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under [Section 072713 "Modified Bituminous Sheet Air Barriers."] [Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers."] [Section 072726 "Fluid-Applied Membrane Air Barriers."]

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.
 - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
 - 2. Tightly but substrate boards together.
 - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 4. Fasten substrate board to top flanges of steel deck according to recommendations in [FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification] [SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity] and FM Global Property Loss Prevention Data Sheet 1-29.
 - 5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
 - 6. Loosely lay substrate board over roof deck.

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3.5 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Decking:
 - 1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to [wood] [wood panel] decks.
 - a. Fasten slip sheet according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install base layer of insulation with [joints staggered not less than 24 inches (610 mm) in adjacent rows] [end joints staggered not less than 12 inches (305 mm) in adjacent rows].
 - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1. Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - g. Loosely lay base layer of insulation units over substrate.
 - 3. Mechanically attach base layer of insulation[and substrate board] using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to decks.
 - a. Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - b. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

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- 4. Install upper layers of insulation[and tapered insulation] with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
 - b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
 - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - f. Trim insulation so that water flow is unrestricted.
 - g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - i. Loosely lay each layer of insulation units over substrate.
 - j. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
 - 2. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 3. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel[and Owner's testing and inspection agency].
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

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- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer, and install fabric-backed roof membrane. Do not apply to splice area of roof membrane.
- G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- I. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- J. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- K. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- 3.7 INSTALLATION OF MECHANICALLY FASTENED ROOF MEMBRANE
 - A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
 - B. Unroll roof membrane and allow to relax before installing.
 - C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.
 - D. Start installation of roofing in presence of roofing system manufacturer's technical personnel[and Owners testing and inspection agency].
 - E. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
 - F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
 - G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

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- H. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.
- I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- 3.8 INSTALLATION OF LOOSELY LAID AND BALLASTED ROOF MEMBRANE
 - A. Loosely lay roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
 - B. Unroll roof membrane and allow to relax before installing.
 - C. Comply with requirements in ANSI/SPRI RP-4 for [System 1] [System 2] [System 3].
 - D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.
 - E. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
 - F. Mechanically fasten or adhere perimeter of roof membrane according to requirements in ANSI/SPRI RP-4.
 - 1. At corners and perimeters, adhere a second layer of roof membrane.
 - G. Apply roof membrane with side laps shingled with slope of deck where possible.
 - H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
 - I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

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3.9 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 INSTALLATION OF WALKWAYS

- A. Flexible Walkways:
 - 1. Install flexible walkways at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - f. Locations indicated on Drawings.
 - g. As required by roof membrane manufacturer's warranty requirements.
 - 2. Provide 6-inch (76-mm) clearance between adjoining pads.
 - 3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 PROTECTING AND CLEANING

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

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

END OF SECTION 07 5423