

OKLAHOMA STATE UNIVERSITY - BUILDING DESIGN STANDARDS

DESIGNER NOTE: SPECIFIC APPROVAL MUST BE OBTAINED FROM OSU ARCHITECTURE SERVICES STAFF PRIOR TO SPECIFYING THIS ROOFING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION:

- A. Scope: To install a fully adhered Single-Ply Thermoplastic (PVC) Roofing Membrane with flashings and other components to comprise a roofing system.

- B. Related Work: The work includes but is not necessarily limited to the installation of:
 - 1. Removal of Existing Roofing and Insulation
 - 2. Substrate Preparation
 - 3. Roof Drains
 - 4. Vapor Retarder
 - 5. Wood Blocking
 - 6. Insulation
 - 7. Separation Layers
 - 8. Roof Membrane
 - 9. Fasteners
 - 10. Adhesive for Flashings
 - 11. Roof Membrane Flashings
 - 12. Walkways
 - 13. Metal Flashings
 - 14. Sealants

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1.02 REFERENCES:

A. Codes/Standards:

1. Roof system shall comply with all I.C.B.O. requirements, match FM I-90 wind up-lift resistance and 2006 FM Global Property Loss guidelines as minimum criteria and be compatible with application on specified deck.
2. UL Listed Products: Provide materials that have been tested and listed by UL for Class A.
3. Conform to International Building Code Requirements to resist wind velocities indicated within Chapter 16 for pitch, height, orientation and site conditions, including corner and edge conditions. Provide approval documentation and, if necessary, design calculations for building and site conditions.

B. SUBMITTALS:

1. Submit complete description, specifications, and details of total roof system.
2. Shop Drawings:
 - a. Submit shop drawings showing sheet layout, seam locations, penetrations, special conditions and details not standard with the manufacturer.
 - b. For tapered insulation systems, furnish layout shop drawings showing thickness, slopes, valleys, ridges, top elevations, straight and tapered unit locations, as required to provide uniform drainage pattern and meet thermal performance requirements.
3. Submit samples.
4. Submit certification or test data substantiating aged thermal performance of insulation.

C. QUALITY ASSURANCE:

1. Qualifications:
 - a. Roof applicator shall have minimum of five years satisfactory continuous experience under the same company name and shall be approved in writing by roof system manufacturer for application of roof for which warranty will be issued. Submit satisfactory evidence of conformance.

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- b. Roof system manufacturer shall have roofing systems installed in the project area with a minimum of five years satisfactory continuous performance. All components of proposed system shall be the same as system that has had five years satisfactory performance.

D. Pre-Roofing Conference:

1. Meet at the project site and review requirements for the work and conditions that could possibly interfere with successful performance of the work. Require every party who is concerned with the work, or required to coordinate with it or to protect it thereafter, to attend the conference.
2. Confirm that the applicator and manufacturer accepts the roofing substrate. Coordinate with appropriate party any remedial action required to make substrate acceptable.
3. Where roofing is required to be guaranteed by the manufacturer, require manufacturer's technical representative to participate in the conference.

1.03 WARRANTY:

- A. Provide a written minimum five year complete system warranty. The system warranty shall provide for the roof membrane, all accessories that comprise the roof system and all contractor labor for the first five years of the roof system. The Warranty shall be non-prorated, provide for no dollar limit and shall not exclude any portions of the system due to acts of nature or use by the Owner.
- B. Warranty to cover entire system and signed by both the applicator and manufacturer.
- C. Warranty shall include the entire roofing system including but not limited to: Roof Drains, Vapor Retarder, Blocking, Insulation, Separation Layers, Roof Membrane, Fasteners, Adhesive for Flashings, Roof Membrane Flashings, Cants, Substrate materials, Walkways, Metal Flashings, Sealants, and Roofing appurtenances.
- D. Warranty shall not require removal of snow or ice in order for the manufacturer/installer to conduct failure/leak investigation.
- E. Warranty shall not negate wind design conditions listed within this standard.

THESE STANDARDS ARE BASED UPON A FULLY ADHERED MEMBRANE SYSTEM, BUT OTHER ROOFING SYSTEMS WILL BE CONSIDERED FOR SPECIFIC APPLICATIONS. DESIGN CONSULTANT MUST GET SPECIFIC UNIVERSITY APPROVAL FOR ALL PROPOSED ROOFING SYSTEMS.

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PART 2 PRODUCTS

2.01 MANUFACTURERS:

- A. Carlisle SynTec Systems
- B. Firestone Industrial Products Co.
- C. Sarnafill
- D. An approved equal.

2.02 MATERIALS:

A. EPDM Sheet System:

- 1. EPDM synthetic rubber (ethylene propylene diene monomer) in 60 mil thick sheet with white top finish, widths (up to 40 ft.) suited to application, complying with ASTM D4637, Type I, Class U. Sheet polymer must be 100% by weight EPDM and sheet must contain at least 30% by weight EPDM polymer.

SUBSTITUTION OF 45 MIL "REINFORCED EPDM" IS NOT ACCEPTABLE.

- a. Membrane shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing," Classification: Type III.
- b. As Manufactured, membrane shall conform to the following physical properties:
 - i. Color to be White
 - ii. Thickness to be 60 mil.

Parameters Properties	ASTM Test Method	Minimum ASTM Requirement	Prefered Physical
Reinforcing material non-woven fiberglass			
Overall Thickness, min., inches	D638	0.070	0.072 inches
Tensile Strength, min., psi (MPa)	D638	1500	1600
Elongation at Break, min. (machine x transverse)	D638	250% / 230%	270% / 250%
Seam strength*, min. (% of tensile strength)	D638	75	80

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Retention of Properties After Heat Aging	D3045	-	-
Tensile Strength, min., (% of original)	D638	90	95
Elongation, min., (% of original)	D638	90	90
Tearing Resistance, min., lbf (N)	D1004	10	14
Low Temperature Bend, -40° F (-40° C)	D2136	Pass	Pass
Accelerated Weathering Test (Xenon Arc)	D2565	5,000 Hours	10,000 Hours
Cracking (7x magnification)	-	None	None
Discoloration (by observation)	-	Negligible	Negligible
Crazing (7 x magnification)	-	None	None
Linear Dimensional Change	D1204	0.10 %	0.02%
Weight Change After Immersion in Water	D570	± 3.0%	2.5%
Static Puncture Resistance, 33 lbf (15 kg)	D5602	Pass	Pass
Dynamic Puncture Resistance, 7.3 ft-lbf (10 J)	D5635	Pass	Pass

*Failure occurs through membrane rupture not seam failure.

- c. Provide 60 mil uncured EPDM flashings and rubber pipe penetration boots.
- d. Produced and recommended specifically by manufacturer for use in a roofing system.

2.03 Vapor Retarder:

- A. Laminated, reinforced polyethylene sheet as manufactured by Griffolyn Division of Reef Industries or an approved equal.
- B. Include adhesives, tapes, flashing, and accessories as recommended by manufacturer to maintain vapor rating.

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- C. Provide for roofs over pools, shower rooms, kitchens, and other high humidity areas.
- D. Thermal Barrier: ASTM C 442 Densdeck, 5/8" type X or ASTM C 36 gypsum board, 0.625" thick, Type X, 4 feet wide, square edge.

2.04 FLASHING MATERIALS

A. Wall/Curb Flashing:

1. Flashing Membrane: A fiberglass reinforced membrane adhered to approved substrate using adhesive.
2. Clad: A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Clad is a 25 gauge, G90 galvanized metal sheet with a 20 mil unsupported membrane laminated on one side. The dimensions of Clad are 4 feet x 8 feet or 4 feet x 10 feet.

B. Perimeter Edge Flashing

1. Clad: A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Clad is a 25 gauge, G90 galvanized metal sheet with a 20 mil unsupported membrane laminated on one side. The dimensions of Clad are 4 feet x 8 feet or 4 feet x 10 feet.
2. Non-Typical Edge: Project-specific perimeter edge detail reviewed and accepted for one-time use by the Manufacturer's Technical Department. Consult Manufacturer's Regional Technical Manager prior to job start for review and consideration for acceptance.

C. Miscellaneous Flashing

1. Flash: A prefabricated expansion joint cover made from membrane. Flash is designed for securement to wall or horizontal surfaces to span and accommodate the movement of new and existing expansion gaps from 1 inch to 4 1/2 inches across. Available in 40 foot rolls.
2. Reglet: A heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs. Reglet is produced from 6063-T5, 0.10 inch - 0.12 inch thick extruded aluminum. Reglet has a 2 1/4 inch deep profile and is provided in 10 foot lengths. Use prefabricated reglet mitered inside and outside corners where walls intersect.
3. Stack: A prefabricated vent pipe flashing made from 0.048 inch thick G 410 membrane. Available in five different sizes.

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4. Drain-RAC: PVC-coated, heavy-duty aluminum roof drain insert that mechanically seals to the drainpipe interior. Drain-RAC is made of 0.080 inch thick 6063 aluminum with a urethane seal installed at the end of the drain pipe. The large 14 inch x 14 inch drain strainer is also made of 0.080 inch thick aluminum stock. The flange dimensions of Drain-RAC are 18 inches x 18 inches.
5. Circle-"G": Circular 0.048 inch thick membrane patch welded over T-joints formed by overlapping thick membranes.
6. Corner: Prefabricated outside and inside flashing corners made of 0.060 inch thick membrane that are heat-welded to membrane or clad base flashings. Corner is available in 2 outside sizes (5 inch and 8½ inch diameter) and 1 inside size. Consult Product Data Sheet for additional information.
7. Multi-Purpose Sealant: A sealant used at flashing terminations.
8. StaBond Adhesive: A solvent-based reactivating-type adhesive used to attach membrane to flashing substrate
9. Low-Rise Foam Adhesive: A two-component polyurethane, low rise expanding foam adhesive used to attach membrane to flashing substrate
10. Felt: A non-woven polyester or polypropylene mat cushion layer that is necessary behind flashing membrane when the flashing substrates are rough-surfaced or incompatible with the flashing membrane

2.05 INSULATION AND SEPARATION BOARD

SLOPE STRUCTURE TO ACHIEVE DRAINAGE ON NEW CONSTRUCTION AND USE TAPERED INSULATION FOR CRICKETS ONLY. ON EXISTING "FLAT" ROOFS, USE TAPERED INSULATION AS REQUIRED TO ACHIEVE ADEQUATE DRAINAGE

- A. Insulation: rigid isocyanurate foam insulation with black mat facers. Insulation is available in 4 feet x 4 feet or 4 feet x 8 feet sizes and various thicknesses.
- B. Dens-Deck[®]: A siliconized gypsum, fire-tested hardboard with glass-mat facers. Dens-Deck is provided in a 4 feet x 8 feet board size and in thicknesses of 1/4, 1/2 and 5/8 inch.
- C. Cellular Insulating Lightweight Concrete: An aerated insulating concrete slurry mixed on-site and poured in-place onto the roof deck. A surface sealant is used to improve the curing process and to reduce dusting at the surface. Cellular insulating lightweight concrete by Celcore, Ellastisile or an approved equal.

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2.06 ATTACHMENT COMPONENTS

- A. Membrane adhesive: A water-based adhesive used to attach the membrane to horizontal or near-horizontal substrates.
- B. Insulation Board Adhesive: A two component (Part A and B) polyurethane low-rise adhesive for bonding insulation to approved compatible substrates.
- C. Plate: Used with various Fasteners to attach insulation boards to roof deck. Plate is a 3 inch square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating.
- D. Plate-HD/CD: Used with Fastener-HD or Fastener-CD10 to attach insulation boards to wood or concrete roof decks. Plate-HD/CD is a 3 inch round stamping of SAE 1010 steel with an AZ 55 Galvalume coating.
- E. Fastener No. 12: Number 12 corrosion-resistant fastener used with Plates to attach insulation boards to steel or wood roof decks. Fastener No. 12 has a modified buttress thread, a shank diameter of approximately 0.168 inch and a thread diameter of approximately 0.214 inch. The driving head has a diameter of approximately 0.435 inch with a #3 Phillips recess for positive engagement.
- F. Fastener-HD: A #14 corrosion-resistant fastener used with Plate-HD/CD to attach insulation boards or with Disc and Bar to attach membrane to structural concrete or wood roof decks. Fastener-HD has a shank diameter of 0.190 inch, a thread diameter of 0.245 inch and a #3 Phillips drive head with a diameter of 0.435 inch.
- G. Fastener-XP: A #15, heavy-duty, corrosion-resistant fastener used with Plate to attach insulation or Stop and Bar to attach G410 roof membrane to steel or wood roof decks. Fastener-XP has a shank diameter of approximately 0.21 inch and the thread diameter is approximately 0.26 inch. The driving head has a diameter of approximately 0.435 inch with a #3 Phillips recess for positive engagement.
- H. Fastener-XPS: A specially designed, heavy-duty, corrosion-resistant fastener used with Stop or Bar to attach G410 roof membrane to steel roof decks. Fastener-XPS has a shank diameter of approximately 0.21 inch and a thread diameter of approximately 0.26 inch. The driving head has a diameter of approximately 0.435 inch with a #3 Phillips recess for positive engagement and simplicity of application.
- I. Fastener-CD10: A nail-in, corrosion-resistant fastener used with Plate-HD/CD, Stop or Bar to attach insulation or membrane to normal weight concrete roof deck. Fastener-CD10 has a shank diameter of 0.215 inch, a split diameter of 0.265/0.275 inch and a flat head with a 0.435 inch diameter.

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- J. Fastener-King Con: A nail-in, corrosion-resistant fastener used with Plate to attach insulation or with Bar to attach membrane to poured structural concrete roof decks.
- K. Stop: An extruded aluminum, low profile bar used with certain Fasteners to attach to the roof deck or to walls/curbs at terminations, penetrations and at incline changes of the substrate. Stop is a 1 inch wide, flat aluminum bar 1/8 inch thick that has pre-drilled holes every 6 inches on center.
- L. Bar: An FM-approved, heavy-duty, 14 gauge, galvanized or stainless, roll-formed steel bar used to attach membrane to roof decks. The formed steel is pre-punched with holes every 1 inch on center to allow various fastener spacing options
- M. Cord: A 5/32 inch diameter, red-colored, flexible thermoplastic extrusion that is welded to the top surface of the membrane and against the side of the bar, used to hold the membrane in position.

2.07 WALKWAY PROTECTION:

- A. Heavily textured and profiled, rolled-out walkway protection mat used to protect roofing membrane from mechanical abuse. Produce from 9/16 inch thick flexible PVC. Walkway will be installed loose laid on top of membrane. Design must resist up to 94 mph winds without attachment. It should be able to be hot air welded to the roof membrane with membrane tabs to fit in place for wind speeds over 94 mph. Basis of Design: Sika Sarnafil Inc. Crossgrip Walkway or an approved equal.

2.08 VAPOR RETARDER

- A. A 10 mil thick polyethylene vapor retarder/air retarder. Vap-10 is supplied in a folded panel that is rolled onto a core. The core width is 5 feet. When unrolled off the core and unfolded, the sheet dimensions are 20 feet wide by 100 feet long.

2.09 MISCELLANEOUS FASTENERS AND ANCHORS

- A. All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors shall have a minimum embedment of 1 1/4 inch and shall be approved for such use by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings shall have a minimum embedment of 1 inch and shall be approved for such use by the fastener manufacturer.

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2.10 RELATED MATERIALS

- A. Wood Nailer: Treated wood nailers shall be installed at the perimeter of the entire roof and around such other roof projections and penetrations as specified on Project Drawings. Thickness of nailers must match the insulation thickness to achieve a smooth transition. Wood nailers shall be treated for fire and rot resistance (wolmanized or osmose treated) and be #2 quality or better lumber. Creosote or asphalt-treated wood is not acceptable. Wood nailers shall conform to Factory Mutual Loss Prevention Data Sheet 1-49. All wood shall have maximum moisture content of 19 percent by weight on a dry-weight basis.
- B. Plywood: When bonding membrane directly to plywood, a minimum 1/2 inch CDX (C side out), smooth-surfaced exterior grade plywood with exterior grade glue shall be used. Rough-surfaced plywood or high fastener heads will require the use of Felt behind the flashing membrane. Plywood shall have maximum moisture content of 19 percent by weight on a dry weight basis.

PART 3 EXECUTION

3.01 PRE-CONSTRUCTION CONFERENCE

- A. The Applicator, Owner's Representative/Designer and Manufacturer(s) shall attend a pre-construction conference.
- B. The meeting shall discuss all aspects of the project including but not limited to:
 - 1. Safety.
 - 2. Set-up.
 - 3. Construction schedule.
 - 4. Contract conditions.
 - 5. Coordination of the work.

3.02 RE-ROOFING WITH REMOVAL OF EXISTING BITUMEN ROOFING GENERAL CRITERIA

- A. All existing roofing, base flashing, deteriorated wood blocking or deteriorated metal flashings shall be removed. Remove only that amount of roofing and flashing which can be made weathertight with new materials during a one-day period or before the onset of inclement weather.

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1. Steel Deck:
 - a. FM Approved Steel Deck: All rusted or deteriorated decking shall be brought to the attention of the Owner's Representative and FM to determine method of treatment or replacement. Surface-only rusted metal shall be sanded and treated with rust-inhibiting paint. Sections that have rusted deeper than the surface or are not structurally sound shall be removed and replaced. The use and type of steel roof deck construction shall conform to FM's recommendations as outlined in FM Loss Prevention data Sheet I-28 and local requirements.
 - b. Non-FM Approved Steel Deck: All rusted or deteriorated decking shall be brought to the attention of the Owner's Representative to determine method of treatment or replacement. Surface-only rusted metal shall be sanded and treated with rust-inhibiting paint. Sections that have rusted deeper than the surface or are not structurally sound shall be removed and replaced. Deck type shall match existing and the attachment shall conform to local code requirements.
2. Wood Deck:
 - a. FM Approved Wood Deck - All rotted or deteriorated wood shall be removed and replaced. The deck thickness shall be 2 inch minimum lumber or 3/4 inch plywood. The deck shall conform to FM's requirements for Class 1 wood decks. Deck attachment shall conform to FM and local code requirements. Fastener heads shall be recessed into the wood surface.
 - b. Non-FM Approved Wood Deck - All rotted or deteriorated wood shall be removed and replaced. The deck thickness shall be 1 1/2 inch lumber or 15/32 plywood or match existing deck if greater. Deck type and attachment shall conform to local code requirements. Fastener heads shall be recessed into the wood surface.
3. Poured Structural Concrete Deck: The roof deck shall be smooth, even, free of dust, dirt, excess moisture or oil and be structurally sound. Sharp ridges, other projections and accumulations of bitumen above the surface shall be removed to ensure a smooth surface before roofing. Any deteriorated decking shall be repaired.
4. Poured Lightweight Concrete Substrate: The roof deck shall be smooth, even, free of dust, dirt, excess moisture or oil and be structurally sound. Sharp ridges, other projections and accumulations of bitumen above the surface shall be removed to ensure a smooth surface before roofing. Any deteriorated decking shall be repaired.

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5. Reinforced Gypsum Deck:

Remove and replace cracked, broken, and planks damaged beyond repair. Reinforced gypsum planks shall meet ASTM C36, Type "X", 5/8 inch thick or match existing deck if greater.

Fill with grout and smooth damage to reinforced gypsum planks. Grout shall meet ASTM C317, Class A, 500 psi minimum compressive strength.

B. Re-roofing over Existing Bitumen Roofing

1. General Criteria: The Owner's Representative and Applicator shall determine the condition of the existing roof deck and old roof system. Areas with deteriorated decking or wet materials are to be removed and replaced.
2. On graveled surfaces, all loose gravel and debris shall be removed by power brooming or vacuuming. All blisters shall be removed and sealed or cut, fastened down and sealed. Any accumulation of bitumen or other irregularities shall be scratched and removed so as to produce a smooth surface.
3. On smooth surfaced roofs, the surface must be clean and dry. All blisters shall be removed and sealed or cut, fastened down and sealed. For Type III hot asphalt attachment of new insulation board, priming of the old roof surface after preparation is necessary.
4. Coal-tar pitch or heavily resaturated roofs may require removal. Contact Technical for coal-tar pitch or heavily resaturated reroof preparation requirements.

3.03 INSTALLATION

- A. Comply with roofing system manufacturer's written instructions and recommendations for attachment and installation procedures to achieve a 20 year roof with a five year all inclusive warranty, as listed in the Warranty section of this Standard.
- B. Flashing, terminations, and roof penetrations shall be one of the methods listed within the National Roofing Contractors Association's (NRCA) "Roofing and Waterproofing Manual," latest edition. Do not use pitch-pockets. No exceptions. If conflict between system manufacturer's details and the NRCA details, use the NRCA details if they will not invalidate the roofing system manufacturer's warranty.
- C. Protect 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 copiers to Architect and Owner.

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- D. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition

END OF SECTION 07530