

SECTION 07 54 16
ETHYLENE INTERPOLYMER (KEE) ROOFING

SPEC WRITER NOTES:

1. Delete or edit text within // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
2. KEE (Ketone ethylene ester) also known as ethylene interpolymer (EIP)-based membranes may be selected by designers for projects where a single ply membrane may require added chemical resistance including grease resistance. Review manufacturer's recommendations and warranty terms.
3. This specification is for use over concrete, cellular insulating concrete decks, or insulation. Insert additional text when installed systems not specified in Section 07 22 00, ROOF AND DECK INSULATION.
4. Coordinate with Section 07 22 00, ROOF AND DECK INSULATION for roof insulation under the membrane. Decrease "R" value 5 percent when mechanical fasteners are used through the insulation to compensate for parallel heat flow.
5. Do not use over polystyrene, urethane, or wood fiberboard insulation under the membrane.
6. Do not use over bituminous materials where direct contact occurs, including grease, oil, or other substances not compatible with KEE. Use a thin layer of insulation, slip sheet or separator sheet depending upon method of attachment or felt back sheet when minimum amount of asphalt occurs.
7. Slopes: Do not use on slopes over 1:12 (1 inch per foot). Provide 1:50 (1/4 inch per foot) minimum slope to drains without any "Gutters" (no slopes between drains. NO EXCEPTIONS TO MINIMUM SLOPE. Slope crickets 1:50 (1/4-inch per foot).
8. Coordinate details and systems used to provide for code required fire rated roofing system. Do not use unsurfaced membranes over combustible insulation on decks.

PART 1 - GENERAL**1.1 DESCRIPTION:**

- A. This section specifies Ethylene Interpolymer (ketone ethylene ester (KEE)) sheet roofing //adhered// //mechanically fastened// to roof deck.

1.2 RELATED WORK:

SPEC WRITER NOTE: Edit Related Work to reflect other sections relating directly to this section or referenced in this section.

- A. Protection of Interior Spaces: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Environmental Controls: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- //C. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS. //
- B. Treated wood framing, blocking, and nailers: Section 06 10 00, ROUGH CARPENTRY
- C. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.
- D. Sheet Metal Components and Wind Uplift Requirements for Roof-Edge Design: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Roof Hatches, Equipment Supports, Dome Type Skylights, and Gravity Ventilators: Section 07 72 00, ROOF ACCESSORIES.
- F. Miscellaneous Items:
1. Section 07 71 00, ROOF SPECIALTIES.
 2. Section 07 72 00, ROOF ACCESSORIES.

1.3 PERFORMANCE REQUIREMENTS:

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

SPEC WRITER NOTE: Retain one or more paragraphs below for typical roofing applications based upon current Federal mandates, which may include one or more of the following:

- 1) Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings incorporated in Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management, dated January 24, 2007;
- 2) Energy Policy Act of 2005 (EPA 2005);

- 3) Energy Independence and Security Act of 2007 (EISA 2007);
- 4) Conformance with locally-applicable requirements.

B. Roofing System Energy Performance Requirements: Provide a roofing system identical to components that that have been successfully tested by a qualified independent testing and inspecting agency to meet the following requirements:

SPEC WRITER NOTE: Retain paragraph below for roofs that must comply with DOE's ENERGY STAR requirements:
www.energystar.gov.

//1. Energy Performance, Energy Star: Provide roofing system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products. //

//2. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980 based on testing identical products by a qualified testing agency. //

SPEC WRITER NOTE: Retain paragraph below for roofs that must comply with California Energy Commission CEC-Title 24: www.coolroofs.com.

//3. Energy Performance, CRRC-1: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1. //

SPEC WRITER NOTE: Typically retain below for VA new construction and reroofing projects in ASHRAE Climate Zones 1 through 3 and elsewhere where cool roof technology is indicated as cost-effective. Also refer to Exceptions in ASHRAE 90.1 Appendix F that address ballasted, vegetated, and ventilated roofs.

//4. Energy Performance, Aged: Provide roofing system with minimum three-year-aged solar reflectance not less than 0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and in addition, a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408.

- a. Where tested aged values are not available for proposed product, submit calculations to adjust initial solar reflectance to

demonstrate compliance as indicated in ASHRAE 90.1-2013 Addendum F.

- b. Alternatively, provide roofing system with minimum three-year aged Solar Reflectance Index of not less than 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of $12 \text{ W/m}^2\text{K}$ (2.1 BTU/h-ft^2).
- C. Roofing system design standard requirements:
1. Recommendations of the NRCA applicable to sheet roofing for storage, handling and application.
 2. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
 3. Recommendations of ANSI/SPRI ES-1 for roof edge design.

SPEC WRITER NOTE: Retain paragraph below and enter required uplift pressures if roofing system is required to be designed per ASCE 7 by local building code.
 4. Roofing System Design: Provide roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.
 - a. Corner Uplift Pressure: // // kPa/sq. m (// // lbf/sq. ft.)//.
 - b. Perimeter Uplift Pressure: // // kPa/sq. m (// // lbf/sq. ft.)//.
 - c. Field-of-Roof Uplift Pressure: // // kPa/sq. m (// // lbf/sq. ft.)//.

SPEC WRITER NOTE: Retain and edit FM Approvals Listing requirement for VA facilities.
 5. FM Approvals Listing: Provide roofing membrane, base flashing, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a roofing system and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

SPEC WRITER NOTES:

1. Select one option in first subparagraph below based on windstorm classification of Project. Utilize calculation based upon FM Approvals Loss Prevention Data Sheet 1-28 to

determine the number that establishes the minimum FM Approvals approval rating.

2. Verify availability of roofing systems that meet these classifications. Other options for classifications increase in increments of 15, e.g., Class 1A-135, 1A-150, 1A-165, and higher.
3. "Class 1A" signifies meeting ASTM E108, Class A fire performance for FM-approved Class 1 roof coverings.
4. For areas having three or more hailstorms annually, FM recommends roofing systems rated SH (severe hail) instead of MH (moderate hail).

a. Fire/Windstorm Classification: Class 1A-//60// //75// //90//
//105// //120//.

b. Hail Resistance: //MH// //SH//.

SPEC WRITER NOTE: Consider retaining requirement below in addition to FM Approval Listing requirement above for high windstorm classification areas (1A-105 or greater) to allow for broader participation in bidding.

6. High Wind Zone Design Requirement: Contractor Option: In lieu of FM Approval Listing windstorm classification, provide roofing membrane, base flashing, and component materials that comply with Miami-Dade County requirements.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications:

1. A firm with a minimum of three (3) years' experience in type of work required by this section.
2. A firm licensed or approved in writing by manufacturer to perform work under warranty requirements of this Section.
3. Employ full-time supervisors who have worked on roofing projects of similar types and scopes for a minimum of three (3) years.

- ##### B. Inspector Qualifications:
- Inspection of work by inspector or manufacturer technical representative experienced in the installation and maintenance of the specified roofing system who is, qualified to perform roofing observation and inspection specified in Field Quality Control Article. Inspector is to determine Installer's compliance with the requirements of this Project, and be approved by the manufacturer

to issue warranty certification. The Roofing Inspector to be one of the following:

1. An authorized full-time technical employee of the manufacturer, not engaged in the sale of products.
2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute (RCI), retained by the Contractor or the Manufacturer and approved by the Manufacturer.

C. Product/Material Requirements:

1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.

D. Pre-Roofing Meeting:

1. Upon completion of roof deck installation and prior to roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers' Technical Representative, Roofing Applicator, Contractor, and Contracting Officer Representative (COR).
2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
3. Inspect roof deck at this time to:
 - a. Verify that work of other trades which penetrates roof deck is completed.
 - b. Determine adequacy of deck anchorage, presence of foreign material, moisture and unlevel surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
 - c. Examine samples and installation instructions of manufacturer.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, SAMPLES.
- B. Product Data:
 1. Primer.
 2. Adhesive materials.
 3. Membrane sheet roofing and flashing membrane.
 4. Roofing cement.
 5. Roof walkway.

6. Fastening requirements.

7. Application instructions.

//C. Sustainable Design Submittals, as described below:

//1. Volatile organic compounds per volume as specified in

PART 2 - PRODUCTS. //

D. Samples:

1. Nails and fasteners, each type.

E. Shop Drawings: Include plans, sections, details, and attachments.

1. Base flashings and terminations.

F. Certificates:

1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.

SPEC WRITER NOTE: Retain paragraph below when retaining Miami-Dade County requirement under Quality Assurance article above.

//2. Indicating compliance with Miami-Dade County requirements. //

//3. Indicating compliance with energy performance requirement. //

G. Warranty: As specified.

H. Quality Assurance Submittals:

1. Installer qualifications.

2. Inspector qualifications.

I. Field reports of roofing inspector.

SPEC WRITER NOTE: Retain paragraph below for reroofing projects.

J. Temporary protection plan. Include list of proposed temporary materials.

K. Test reports.

L. Contract Close-out Submittals:

1. Maintenance Manuals.

2. Warranty signed by installer and manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Comply with the recommendations of the NRCA applicable to single ply membrane roofing for storage, handling and installation.

1.8 ENVIRONMENTAL REQUIREMENTS:

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed

according to manufacturer's written instructions and warranty requirements.

- B. Provide environmental controls in accordance with Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. Provide protection of interior spaces in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1.8 WARRANTY:

- A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".
- B. Manufacturer Warranty: Manufacturer shall warranty their ethylene interpolymer (KEE) roofing system for a minimum of ten (10) years // // from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.9 APPLICABLE PUBLICATIONS:

SPEC WRITER NOTES:

- 1. Update applicable publications to current issue at time of project specification preparation.
- 2. Update material requirements to agree with applicable requirements (types, grades, classes,) specified in the referenced Applicable Publications.

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
- B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
ANSI/SPRI ES-1-03.....Wind Design Standards for Edge Systems Used with Low Slope Roofing Systems
- C. American Society of Civil Engineers (ASCE):
ASCE 7-10.....Minimum Design Loads for Buildings and Other Structures
- D. ASTM International (ASTM):
C67-14.....Test Methods for Sampling and Testing Brick and Structural Clay Tile
C140/C140M-14a.....Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

- C1371-04a(R2011)e1.....Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
- C1549-09(R2014).....Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
- D4263-83(R2005).....Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
- D4434/D4434M-012.....Poly (Vinyl Chloride) Sheet Roofing
- D6754/D6754M-10.....Ketone Ethylene Ester Based Sheet Roofing
- E108-11.....Test Methods for Fire Tests of Roof Coverings
- E408-13.....Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
- E1918-06.....Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E1980-11.....Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- ASHRAE 90.1-2013.....Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix f.
- F. Cool Roof Rating Council:
- CRRC-1-08.....Product Rating Program, www.coolroofs.org
- G. FM Approvals:
- RoofNav.....Approved Roofing Assemblies and Products.
- 4450-89.....Approved Standard for Class 1 Insulated Steel Deck Roofs
- 4470-12.....Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction
- 1-28-09.....Loss Prevention Data Sheet: Design Wind Loads.
- 1-29-09.....Loss Prevention Data Sheet: Above-Deck Roof Components
- 1-49-09.....Loss Prevention Data Sheet: Perimeter Flashing
- H. National Roofing Contractors Association (NRCA):
- Roofing and Waterproofing Manual
- I. U.S. Department of Energy (DoE):

Roof Products Qualified Product List, www.energystar.gov

J. Environmental Protection Agency (EPA):

40 CFR 59(2014).....National Volatile Organic Compound Emission
Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 KEE MEMBRANE ROOFING:

SPEC WRITER NOTES:

- 1. Use fabric-backed sheet for adhered systems to cellular insulating concrete, structural concrete, or when re-roofing over other incompatible substrates where the manufacturer recommends a fabric backing for separation.
- 2. Use sheets without fabric backing when adhering to rigid insulation board cover boards.
- 3. Grey and custom colors are available for special applications but do not meet Federal cool roof mandates.
- 4. Do not use KEE sheet in ballasted applications.
- 5. Use adhered systems over cover boards on new VA construction unless other application is specifically approved by VA.

A. KEE Sheet: ASTM D6754/D6754M, fabric reinforced, //1.5 mm (60 mils)//
//2.0 mm (80 mils)// thick, //with no backing// //with fabric
backing//.

1. Color: // White // // //

2.2 ACCESSORIES:

- A. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as KEE sheet membrane.
- B. Bonding Adhesive: Manufacturer's standard, water based.
- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 25 by 3 mm (1 by 1/8 inch) thick; with anchors.
- D. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 25 mm wide by 13 mm (1 inch wide by 0.05 inch) thick, prepunched.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening membrane to substrate.

- F. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resistant, surface-textured walkway pads or rolls, approximately 5 mm (3/16 inch) thick, and acceptable to membrane roofing system manufacturer.
- G. Miscellaneous Accessories: Provide primer, sealers, preformed flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories acceptable to manufacturer.

2.3 ADHESIVE AND SEALANT MATERIALS:

- A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.
1. Liquid-type auxiliary materials to comply with VOC limits of authorities having jurisdiction.

SPEC WRITER NOTE: Retain subparagraph below for low-emitting materials required for general project sustainable design requirements. Below applies to all materials located to interior of weather-proof barrier.

- //2. Adhesives and sealants that are not on the exterior side of weather barrier to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
- a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. PVC Welding Compounds: 510 g/L.
 - h. Adhesive Primer for Plastic: 650 g/L
 - i. Single-Ply Roof Membrane Sealants: 450 g/L.
 - j. Non-membrane Roof Sealants: 300 g/L.
 - k. Sealant Primers for Nonporous Substrates: 250 g/L.
 - l. Sealant Primers for Porous Substrates: 775 g/L. //

2.4 ROOF PAVERS:

SPEC WRITER NOTES:

1. Assure pavers are detailed showing size and shape.
2. Do not exceed 610 mm square (24 inches square) for non-

interlocking units with approximate weight of 23 kg (50 pounds) each.

3. Interlocking pavers are preferred over non interlocking pavers.
 4. Use interlocking type that has been tested in a wind tunnel for wind uplift meeting project requirements.
 5. Do not use light weight aggregate pavers.
 6. Extensive use of pavers is not appropriate for roof systems with solar reflective design requirements.
- A. Roof Pavers: Hydraulically pressed, concrete units, with top edges beveled, factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:
1. Weighing not less than 73 kg per square meter (15 pounds per square foot).
 2. Manufactured using normal weight aggregate.
 3. Units of size, shape, and thickness as indicated on construction documents.
 4. Ribbed on bottom surface or provided with legs approximately 6 mm (1/4 inch) high. Legs to distribute weight of paver so bearing does not exceed 69 kPa (10 psi) on the roofing membrane.
 5. Configuration: //Non-Interlocking// //Interlocking//.
 - //6. Solar Reflectance Index: Not less than 78 // //.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.
- B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

3.2 PREPARATION:

- A. Complete roof deck construction prior to commencing roofing work:
 1. Install curbs, blocking, edge strips, nailers, cants, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.

2. Complete deck and insulation to provide designed drainage to working roof drains.
 3. Document installation of related materials to be concealed prior to installing roofing work.
- B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates.
- C. Sweep decks to broom clean condition. Remove dust, dirt or debris.
- D. Remove projections that might damage materials.
- E. Concrete Decks, except Insulating Concrete:
1. Test concrete decks for moisture prior to application of roofing materials. Test for capillary moisture by plastic sheet method according to ASTM D4263. Submit test reports.
 2. Prime concrete decks, including precast units, with primer as specified. Keep primer back 101 mm (4 inches) from joints in precast units.
 3. Allow primer to dry before application of bitumen.
- F. Insulating Concrete Decks:
1. Allow to dry out for at least five (5) days after installation before the placement of materials.
 2. If rain occurs during or at end of drying period or during installation of roofing, allow additional drying time before the placement of the roofing materials.
- G. Poured Gypsum Decks: Dry out poured gypsum in accordance with manufacturer's printed instructions prior to application of roofing materials.
- H. Existing Membrane Roofs and Repair Areas:
1. Comply with requirements in Section 07 01 50.19, PREPARATION FOR REROOFING.
 2. At areas to be altered or repaired, remove loose, damaged, or cut sheet that is not firmly adhered only where new penetrations occur or repairs are required.
 3. Cut and remove existing roof membrane for new work to be installed. Clean cut edges and install a temporary seal to cut surfaces. Use roof cement and one layer of 7 Kg (15 pound) felt strip cut to extend 152 mm (6 inches) on each side of cut surface. Bed strip in roof cement and cover strip with roof cement to completely embed the felt.

4. At modified bituminous base flashing to be repaired, either bend up cap flashing or temporarily remove cap flashing. Brush and scrape away all deteriorated sheets or surface material of base flashing.

3.3 TEMPORARY PROTECTION:

- A. Install temporary protection at the end of day's work and when work is halted for an indefinite period, or work is stopped when precipitation is imminent. Comply with approved temporary protection plan.
- B. Install temporary cap flashing over the top of base flashings where permanent flashings are not in place to provide protection against moisture entering the roof system through or behind the base flashing. Securely anchor in place to prevent blow off and damage by construction activities.
- C. Provide for removal of water or drainage of water away from the work.
- D. Provide temporary protection over installed roofing by means of duckboard walkways, plywood platforms, or other materials, as approved by COR, for roof areas that are to remain intact, and that are subject to foot traffic and damage. Provide notches in sleepers to permit free drainage.

3.4 INSTALLATION, GENERAL:

- A. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FM 4450 and FM 4470 as part of a membrane roofing system as listed in FM Approval's "RoofNav" for fire/windstorm classification indicated. Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.
- B. NRCA Installation Standard: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations.
- C. Manufacturer Recommendations: Comply with roofing system manufacturer's written installation recommendations.
- D. Coordination with related work: Coordinate roof operations with roof insulation and sheet metal work so that insulation and flashings are installed concurrently to permit continuous roofing operations.
- E. Installation Conditions:
 1. Apply dry roofing materials. Apply roofing work over dry substrates and materials.
 2. Apply materials within temperature range and surface and ambient conditions recommended by manufacturer.

3. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:
 - a. Do not apply materials when the temperature is below 4 degrees C (40 degrees F).
 - b. Do not apply materials to substrate having temperature of 4 degrees C (40 degrees F) or less.

3.5 INSTALLATION OF ROOFING:

- A. Do not allow the membrane to come in contact with surfaces contaminated with asphalt, coal tar, oil, grease, or other substances which are not compatible with KEE and its adhesion to the substrate.
- B. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.
- C. Commence installation at the low point of the roof and work towards the high point. Lap the sheets so the flow of water is not against the edges of the sheet.
- D. Position the membrane so it is free of buckles and wrinkles.
- E. Roll sheet out on deck; inspect for defects as being rolled out and remove defective areas. Allow for relaxing before proceeding.
 1. Lap edges and ends of sheets 50 mm (2 inches) or more as recommended by the manufacturer.
 2. Heat weld laps. Apply pressure as required. Seam strength of laps as required by ASTM D4434/D4434M.
 3. Check seams to ensure continuous adhesion and correct defects.
 4. Finish edges of laps with a continuous beveled bead of sealant to sheet edges to provide smooth transition.
 5. Finish seams same day as the membrane is being installed.
 6. Anchor perimeter to deck or wall as specified.
- F. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.
- G. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 101 mm (4 inches) beyond cut.
- H. Membrane Perimeter Anchorage:
 1. Install metal fastening strip at the perimeter of each roof level, curb flashing, expansion joints and similar penetrations as indicated and in accordance with membrane manufacturer's instructions on top of roof membrane to deck or wall.

2. Mechanically Fastened Metal Fastening Strip:

- a. Set top of mechanical fastener flush with top surface of the metal fastening strip. Space mechanical fasteners a maximum 305 mm (12 inches) on center starting 25 mm (1 inch) from the end of the nailing strip.
- b. When strips are cut round corners and eliminate sharp corners.
- c. After mechanically fastening strip, cover and seal strip with a 152 mm (6 inch) wide roof membrane strip; heat weld to roof membrane and seal edges.
- d. At roof edge metal, turn the membrane down over the front edge of the blocking or the nailer to below blocking. Secure the membrane to the vertical portion of the nailer; or, if required by the membrane manufacturer, with fasteners spaced not over 305 mm (12 inches) on centers.
- e. At parapet walls, intersecting building walls and curbs, secure the membrane to the structural deck with fasteners 305 mm (12 inches) on centers or as shown on NRCA manual.

I. Adhered System:

1. Apply adhesive in quantities required by roof membrane manufacturer.
2. Fold sheet back on itself after rolling out and coat the bottom side of the membrane and the top of the deck with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturer's application instruction, roll the membrane into the adhesive in a manner that minimizes voids and wrinkles.
4. Repeat for other half of sheet. Cut voids and wrinkles to lay flat and clean for repair patch over cut area.

J. Mechanically-Attached System:

1. Secure the membrane to the structural deck with fasteners through stress plate or batten strips spaced and patterned in accordance with the membrane manufacturer's instructions to achieve specified wind uplift performance.
2. When fasteners are installed within the laps of adjoining sheets, position the fastener so that the stress plates are a minimum 13 mm (1/2 inch) from the edge of the sheets.
3. Where fasteners are installed over the membrane after the seams have been welded, cover the fasteners with a minimum 178 mm (7 inch) wide round KEE membrane cap centered over the fasteners. If batten strips

are used, cover the strip with a minimum 178 mm (7 inch) wide KEE strip centered over the batten. Heat weld to the roof membrane and finish edges with sealant as specified. Finish edges with sealant as specified.

4. Before installing fasteners into cast in place concrete, pre-drill the correct size hole into the deck. Drill the hole 9 mm (3/8 inch) deeper than the fastener penetration.

3.6 INSTALLATION OF FLASHING:

- A. Install flashings as the membrane is being installed. If the flashing cannot be completely installed in one (1) day, complete the installation until the flashing is in a watertight condition and provide temporary covers or seals.

B. Flashing Roof Drains:

SPEC WRITER NOTES:

1. Ensure roof drain flashing details are shown with a dish to depress notched clamping ring below roof surface to minimize ponding water created by clamping ring.
2. Offset drains in basin or dish to side of steel beams so drain is not above low point when roof slope terminates on top of beam.
3. Do not put drains at columns or on slopes.

1. Install roof drain flashing as recommended by the membrane manufacturer, generally as follows:
 - a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
 - b. Do not allow the roof cement to come in contact with the KEE roof membrane.
 - c. Adhere the KEE roof membrane to the metal flashing with the membrane manufacturer's recommended adhesive.
2. Turn down the metal drain flashing and KEE roof membrane into the drain body and install clamping ring and strainer.

C. Installing KEE Base Flashing and Pipe Flashing:

SPEC WRITER NOTES:

1. See NRCA manual for KEE base flashing.
2. Use with metal cap flashing.
3. Use detail E when joint is 25 mm (1 inch) or less; DO NOT USE as a building expansion joint. Put expansion joint on curb.

4. Coordinate with sheet metal work to provide metal cap flashing for base flashing on curbs and walls and penetrations.
 5. Use surface mounted type (NRCA manual) on existing walls.
 6. Use umbrella type (NRCA manual) on pipes that are not open.
 7. Do not terminate base flashing or membrane edge exposed on top of parapet walls or in reglets on horizontal or sloped wash surface. Terminate only under cap flashings or coping covers except gravel stops and for draw bands on pipe boots.
 8. Use 203 mm (8 inch) minimum height for base flashing.
 9. Do not use "pitch pocket" or "sealant pocket" in lieu of base flashings and cap flashings.
1. Install KEE flashing membranes to pipes, wall or curbs to a height not less than 203 mm (8 inches) above roof surfaces and 101 mm (4 inches) on roof membrane.
 - a. Adhere flashing to pipe, wall or curb with adhesive.
 - b. Form inside and outside corners of KEE flashing membrane in accordance with NRCA manual. Form pipe flashing with pipe boot in accordance with NRCA manual.
 - c. Lap ends not less than 101 mm (4 inches).
 - d. Heat weld flashing membranes together and flashing membranes to roof membranes. Finish exposed edges with sealant as specified.
 - e. Install flashing membranes in accordance with NRCA manual.
 2. Anchor top of flashing to walls or curbs with fasteners spaced not over 203 mm (8 inches) on centers. Use fastening strip on ducts. Use pipe clamps on pipes or other round penetrations.
 3. Apply sealant to top edge of flashing.
- D. Installing Building Expansion Joints:
- SPEC WRITER NOTES:
1. Do not put expansion joints at roof membrane level.
 2. Design joints to be installed on curbs not less than 203 mm (8 inches) high especially at walls.
 3. Detail expansion joint.
1. Install base flashing on curbs as indicated in construction documents.

2. Coordinate installation with metal expansion joint cover or roof expansion joint system.
2. Install flexible tubing 1-1/2 times width of joint over joint. Cover tubing with KEE flashing strip adhered to base flashing and lapping base flashing 101 mm (4 inches). Finish edges of laps with sealants as specified.

E. Repairs to membrane and flashings:

1. Remove sections of KEE sheet roofing or flashing that is creased wrinkled or fish mouthed.
2. Cover removed areas, cuts and damaged areas with a patch extending 101 mm (4 inches) beyond damaged, cut, or removed area. Heat weld to roof membrane or flashing. Finish edge of lap with sealant as specified.

3.7 FLEXIBLE WALKWAYS:

SPEC WRITER NOTES:

1. Use unreinforced membrane for walkways over roof areas which do not have paver walkways between equipment.
2. Use pavers around equipment requiring servicing or having discharges detrimental to KEE and at doors for roofs.
3. Clearly indicate on roof plan flexible walkways.

- A. Use reinforced sheet not less than 915 mm (3 feet) wide.
- B. Heat weld walkway sheet to roof sheet at edges. Weld area 50 mm (2 inches) wide by the entire length of the walkway sheet.
- C. Finish edges of laps with sealants as specified.

3.8 INSTALLATION OF PAVERS:

SPEC WRITER NOTES:

1. Use pavers in the following locations as a minimum:
 - a. At working and access areas of equipment requiring servicing.
 - b. At equipment having discharges detrimental to roof membrane, under gooseneck discharges from kitchens and chemical exhausts.
 - c. At landing points for hatches, ladders, and doors entering roof level.
2. Show extent of walkways and pavers on roof plan.
3. Specify pavers and anchorage for pavers when weight of pavers does not

meet the requirements for the wind velocities per FM TAB 1-29.

4. Pavers without interlocking connectors require strapping together and edge clamps when they do not provide the minimum weight per square meter (square foot) for wind uplift resistance.
5. Use mechanical strapping to create a perimeter anchor, at penetrations, cuts at valleys, over drains, and where partial or cut units occur.
6. Detail strapping, perimeter restraints, edge clamps and location of strapping. Do not anchor through base flashing or into cants.
7. Interlocking connectors:
 - a. Use 406 mm (16 inches) on center minimum spacing of connectors.
 - b. Decrease spacing to 305, 203, or 101 mm (12, 8, or 4 inches) on center for higher wind velocities.

A. Installation of pavers:

1. Saw cut or core drill pavers for cut units.
2. Install pavers with butt joints in running bond with not less than one half-length unit at ends.
 - a. Stagger end joints; generally locate joints near midpoint of adjacent rows, except where end joints occur in valleys. Miter end joints to fit in valleys.
 - b. Cut to fit within 13 mm (1/2 inch) of penetrations.
3. Install interlocking connectors in channel units for complete tie in of units, including cut units. Use corner spacings for a distance of 1219 mm (4 feet) or more around roof drains, penetrations, and other vertical surfaces in the field of the roof area.
 - a. Space connectors at // // mm (// // inches) on center at the corners for 3.05 m (10 foot) square area.
 - b. Space connectors at // // mm (// // inches) on center at the perimeter for 1829 mm (6 foot) wide strip.
 - c. Space connectors at // // mm (// // inches) on center in the field.
 - d. Install pavers under the perimeter retainer as indicated in construction documents.
4. Install strapping where shown.
 - a. Limit strap lengths to a maximum of 9.14 m (30 feet).

- b. Install straps at corner connection to the perimeter retainer at approximate 45 degree angle at approximate 3.05 to 3.66 m (10 to 12 feet) from corner.
- c. Install straps on each side of the valleys, hips, and ridges, with cross straps spaced not over 1219 mm (4 feet) on center between the end straps.
- d. Install straps at the perimeter of the penetrations more than two (2) pavers in width or length.
- e. Anchor straps to each paver with two fasteners per unit.
- f. Pre-drill holes for fasteners in pavers.

3.9 FIELD QUALITY CONTROL:

- A. Roofing Inspector: Engage a qualified roofing inspector (approved by COR) for a minimum of //5// //7// //10// full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final reports.
 - 1. Examine and probe seams in the membrane and flashing in the presence of COR and Membrane Manufacturer's Inspector.
 - 2. Probe edge of welded seams with a blunt tipped instrument. Use sufficient hand pressure to detect marginal welds, voids, skips, and fishmouths.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 - 1. Notify COR 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING:

- A. Protect membrane-roofing system from damage and wear during remainder of construction period.
- B. 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 free of damage and deterioration at time of acceptance by COR.

C. Clean overspray and spillage from adjacent construction. Clean membrane and restore surface to like-new condition meeting solar reflectance requirements.

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