SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.

Do not select ballasted EPDM roofing system for combustible systems.

Loosely laid and ballasted, ethylene-propylene-diene-terpolymer (EPDM) roofing system.

Substrate board.

Vapor retarder.

Roof insulation.

Cover board.

Walkways.

Retain first paragraph below if acoustical roof deck is required and if installation of insulation strips is included in this Section.

* + - * 1. Section includes installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."
			1. DEFINITIONS
				1. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

The definition below supersedes the definition in Section 014216 for Company Field Advisor.

* + - * 1. Company Field Advisor; An individual meeting the requirements of either subparagraph below:

An employee of the company producing or manufacturing the system (or the company which lists and markets the primary components of the system under their name) who is certified in writing by the company to be technically qualified in design, installation, and servicing of the required products, and has experience in the installation of the required products. Personnel involved solely in sales do not qualify.

An individual employed by an organization (other than the company producing or manufacturing the system), certified in writing by the company producing or manufacturing the system, that the individual is technically qualified in design, installation and servicing of the required products and is capable to act as company field advisor in their behalf, and has experience in the installation of the required products. Personnel involved solely in sales do not qualify.

* + - 1. PREINSTALLATION MEETINGS

Retain "Preinstallation Roofing Conference" paragraph below if Work of this Section is extensive or complex enough to justify a conference.

* + - * 1. Preinstallation Roofing Conference: Conduct conference at Project site.

Retain subparagraphs below if required. If retaining, revise to include Project-specific requirements. Insert additional requirements to suit Project.

Meet with Director’s Representative, [ Construction Manager,] Director’s Representative's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing manufacturer’s Company Field Advisor, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

Review methods and procedures related to roofing installation, including manufacturer's written instructions.

Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

Examine deck substrate conditions and finishes, including flatness and fastening.

Review structural loading limitations of roof deck during and after roofing.

Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

Review governing regulations and requirements for insurance and certificates if applicable.

Review temporary protection requirements for roofing system during and after installation.

Review roof observation and repair procedures after roofing installation.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Waiver Of Submittals:

“Named Brand” Roofing Systems: The “Waiver Of Certain Submittal Requirements” in Section 013300 applies to this Section only if a “Named Brand” roofing system is furnished.

“Or Equal” Roofing Systems: The “Waiver Of Certain Submittal Requirements” in Section 013300 does not apply to this Section if an “or equal” is submitted.

Retain the above two paragraphs for Adhered EPDM roofing system. Retain below for Ballasted EPDM roofing system.

The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.

* + - * 1. Submittals Package: Submit the shop drawings, product data, samples, and quality control submittals specified below at the same time as a package.

Retain the next four paragraphs for Adhered EPDM roofing system.

* + - * 1. “Named Brand” Submittals: Submit for approval, one of the “named brand” roofing systems and any proposed deviations from the Contract Documents. Submit Product Data, Samples, Applicator’s Certification, and Material’s Certification, to the Director’s Representative at the site for information purposes only.
				2. “Or Equal” Submittals: Submit for approval, product data, samples, quality control submittals, and any proposed deviations from the Contract Documents.
				3. Approvals: Approval of a “named brand” or “or equal” roofing system is with the understanding that the requirements of the Contract Documents will be met. Approval of a roofing system does not constitute blanket approval of the manufacturer’s installation specifications or details.

If the requirements of the Contract Documents differ from or are more stringent than the requirements of the approved roof system manufacturer, the Contract Documents have precedence over the requirements of the approved manufacturer.

* + - * 1. Proposed Deviations from the Contract Documents: Submit for approval proposed deviations when the roofing system is submitted. Proposed deviations submitted after the roofing system has been approved will not be considered for approval and may be cause for rejection of the previously approved roofing system.

Manufacturer’s Details: Do not use or submit manufacturer’s standard details unless there is an omission or a proposed deviation from the Contract Documents. In such instances, submit the revised detail for approval. Label each revised detail with the words “PROPOSED DEVIATION”.

Manufacturer’s Specifications and Installation Instructions: When there is a proposed deviation from the Contract Documents, submit the proposed deviation for approval. Label each specification and instruction revision with the words “PROPOSED DEVIATION”.

* + - * 1. Product Data: For each type of product.

For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

* + - * 1. Sustainable Design Submittals:
				2. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

Layout and thickness if insulation.

Base flashings and membrane terminations.

Before the Work commences, turn over to the Director’s Representative at the site one set of sheet membrane layout drawings prepared or approved by the membrane manufacturer.

Flashing details at penetrations.

Retain one or more subparagraphs below.

Tapered insulation, thickness, and slopes.

Submit an accurate layout of the tapered insulation showing the slopes to the drains. Show cross section drawings illustrating the location and thickness of tapered insulation pieces and filler pieces. Show the thickness of the insulation system at high and low points.

Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.

Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

Tie-in with air barrier.

* + - * 1. Samples:

Retain one or more subparagraphs below.

Roof membrane and flashings of color required.

Aggregate surfacing material in gradation[ and color] required.

Walkway pads or rolls, of color required.

Ballast: Five lbs.

Ballast Substrate board: one 6-inch square.

* + - * 1. Quality Control Submittals:

Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

Fire Hazard Certification: Written certification that the roof system, including the specific insulation, has been tested in conjunction with the type of structural roof deck and roof slope applicable to the project and has achieved an Underwriters Laboratories Class A or B external fire resistance rating.

Acceptable Certification: Letter from Underwriters Laboratories, or a copy of the Underwriters Laboratories classification listing for the roofing system.

Qualification Data: For Installer and manufacturer.

Installer Certification:

Letter from the membrane manufacturer certifying that the installer is licensed or approved to install the roof system.

Names, address, and telephone numbers of 3 buildings where the applicator has installed EPDM sheet membrane roof systems that have had the manufacturer’s warranty issued. Include the types of EPDM systems installed, the manufacturer’s name, and the warranty numbers.

Letter certifying that the job foreman or crew chief and at least one other member of the roofing crew have installed at least 3 EPDM sheet membrane roof systems and are thoroughly familiar with all aspects of the installation.

Membrane Manufacturer Certificates:

Submit a letter certifying that the manufacturer has been actively marketing the submitted system for a minimum of 5 years.

Submit the names and addresses of 10 previous roofing projects. Include the type and size of each project, and name and telephone number of a contact person at the project location.

Material Certificates:

Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

Submit evidence of complying with performance requirements.

Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

Evaluation Reports: For components of roofing system, from UNIFORM CODE-ES.

Design Consultant to review code references and verify that the referenced sections/tables are current. Note that code references shall be based on the current version of the Uniform Code.

Retain "Field Test Reports" paragraph below when applicable.

Field Test Reports:

First subparagraph below is for concrete roof decks. Second subparagraph is for roof decks requiring fastener-pullout test.

Concrete internal relative humidity test reports.

Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

Field quality-control reports.

* + - * 1. Contract Closeout Submittals:

Sample Warranties: For manufacturer's special warranties.

* + - 1. CLOSEOUT SUBMITTALS
				1. Maintenance Data: For roofing system to include in maintenance manuals.

Retain paragraph below for projects that include existing buildings with warranted roof systems interfacing with the Work of this Section.

Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

Retain paragraph below for ballasted roofing.

Operations and Maintenance Manual: Submit grease guard manufacturers printed maintenance requirements, per O&M manual requirements.

* + - * 1. Maintenance Materials Submittals:

Furnish to the Facility 25 sq ft of EPDM sheet membrane, one gallon of splicing cement, and 4 tubes of lap sealant. These materials will be used by the Facility for emergency repairs of the membrane. Include one set of the manufacturer’s printed instructions for installing the above items.

* + - 1. QUALITY ASSURANCE
				1. Manufacturer Qualifications: A qualified manufacturer that is UL listed and listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

The manufacturer shall have been actively marketing an EPDM roof system in the United States for a minimum of 5 years.

The manufacturer shall have the technical expertise and qualified technical representatives to resolve questions or problems that may arise both during and after the Work is completed.

The manufacturer shall furnish the names, addresses, and telephone numbers of at least 10 previous projects of comparable size, scope, and complexity as the work of this Section.

The manufacturer shall require that the roof system be installed by a licensed or approved installer.

* + - * 1. 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.

The installer shall have previously installed at least 3 EPDM sheet membrane systems for which the manufacturer’s warranty was issued.

Workers: The crew chief or foreman and at least one other member of the roofing crew shall have installed at least 3 EPDM sheet membrane roof systems and shall be thoroughly familiar with all aspects of the installation.

* + - * 1. Fire Hazard Classification: The EPDM sheet membrane roof system shall have an Underwriters Laboratories Class A or B External Fire Resistance rating, as determined by tests conducted in conformity with UL-790 (ASTM E 108).

The roof system, which includes a specific generic type of insulation and in some instances, a specific name brand insulation, shall have been tested in conjunction with the type of structural roof deck and roof slope applicable to the project.

* + - 1. ROOFING MANUFACTURER’S COMPANY FIELD ADVISOR
				1. The manufacturer of the roofing system, issuing the final system guarantee on this roofing project, must supply a Company Field Advisor, as a technical representative, with the following minimum qualifications:

Five years of field experience on the same type of roofing system.

Ten projects where role was a Company Field Advisor; include contact names and phone numbers for each project.

Attendance at a roof specific instructional seminar within the last two years.

It is mandatory to discuss the use of the paragraph below with the Client, the Division of Construction, and perhaps the specified manufacturers, at project inception, particularly on downstate projects. There is a fee associated with the number of hours for a field advisor to be on a project. Include this additional cost in the project estimate beginning with the program estimate.

Edit number of days and hours below depending on size and complexity of project. Six days at 4 hours per day could work as a minimum for a simpler project. Six days or more, at more than 4 hours per day could work for a larger, more complex project.

* + - * 1. Secure the services of the Company Field Advisor for a minimum of<Insert Value> days at a minimum of **<Insert Value>**hours per day to inspect the workmanship of the roofing system installer.
				2. Company Field Advisor Duties and Responsibilities:

Become familiar with the Contract Documents and approved submittals prior to the pre-roofing conference.

Attend the pre-roofing conference and the beginning of the actual membrane installation for the purpose of:

Rendering technical assistance to the Contractor regarding installation procedures of the system.

Familiarizing the Director’s Representative with aspects of the system including inspection techniques.

Answering questions that might arise.

Edit remaining subparagraphs below to suit project complexity and need. Discuss appropriateness of subparagraphs with design project manager and the division of construction.

Attend each bi-weekly meeting.

Be objective, unbiased and impartial in each inspection, recommendation, conversation, action and written report.

Inspect and approve the existing substrate, flashing, blocking, and related materials as being acceptable for the installation of the roofing system.

Ensure proper fastening patterns and fastener sizes of wood blocking, insulation, edge flashing, and related components.

Immediately report non-compliant conditions, if any, to the Director’s Representative.

Provide to the Director’s Representative a written report, submitted prior to leaving the Project Site each day the Company Field Advisor is present. Each daily written report shall contain at a minimum:

Date of report and inspection.

Weather conditions at the start, middle, and end of the workday.

Work performed including Contractor activity, contractor crew size, supervisor’s name, area of activity, and progress and quality of the work as observed.

Discussions with Contractor regarding work anomalies and resolution.

Conditions that are not in compliance with the Contract documents.

Continue documenting non-compliance issues in subsequent reports until the issue has been resolved. Document resolution of non-compliance issues when resolved.

Report to the Director’s Representative in writing failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.

Confirm, after completion of the roofing work and based on the Company Field Advisor’s inspections and tests, that the Company Field Advisor has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. 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, approval or listing agency markings, and directions for storing and mixing with other components.
				2. 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 material from direct sunlight.

Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

* + - * 1. 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.
				2. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.
			1. FIELD CONDITIONS
				1. Do not execute the Work of this Section unless the Director’s Representative is present, unless otherwise directed in writing.
				2. Do not execute the Work of this Section unless the substrate is dry and free of dirt and debris.
				3. Moisture Protection:

Cover, seal or otherwise protect the roof and flashings so that water cannot accumulate or flow under completed portions. When and where necessary to accomplish this, provide temporary water cut-offs in accordance with the membrane manufacturer’s written specifications.

Use subparagraph below on rehabilitation work only.

Limit the removal of existing materials to areas that can be completely re-roofed or temporarily protected within the same day. At the discretion of the Director’s Representative, a watertight built-up vapor barrier may be acceptable temporary protection for a maximum of 48 hours.

* + - * 1. Do not smoke or use open flames near volatile materials.
				2. 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.
			1. WARRANTY
				1. Warranty Extension: The one year period required by Paragraph 9.8 of the General Conditions is extended to 2 years for the Work of this Section. Refer to Supplementary Conditions.

Include 007306 Supplementary Conditions - Warranty Extension.

Retain paragraph below for ballasted roofing system.

* + - * 1. Manufacturer’s Warranty: In addition to the two year period specified above, furnish the membrane manufacturer’s printed 10 year warranty for the Work of this Section. The warranty shall include but not be limited to, repair of leakage caused by defects in materials or workmanship. The monetary value of the warranty shall be at least equal to the original cost of the installation.

Retain paragraph below for adhered roofing system.

Edit warranty below. Typical warranty for 60 mil membrane system is 20 years and warranty for 90 mil membrane system is 30 years. Consult with manufacturers and the client when choosing warranty periods. The 60 mil specification can also be 15 year but a 20 year warranty should be specified unless instructed otherwise. The 90 mil systems can also be 25 year, but again 30 year should be the specified period. The cost as a warranty increases is as follows:

10 year is approximately 4 cents a square foot, 15 year - 7 cents a foot, 20 year - 10 cents a foot, and 30 year - 20 cents a foot.

* + - * 1. Manufacturer’s Warranty: In addition to the 2 year period specified above, furnish the membrane manufacturer’s printed **[15][20][30]** Year Full System Warranty for **[60 mil][90 mil]** membrane, covering workmanship, materials, and wind related damage, for the Work of this Section.

The warranty shall include, but not be limited to, repair of leakage and the repair and/or replacement of the roofing system as necessary to correct defects or damage caused by; materials, workmanship, or wind speeds less than 72 MPH.

Materials shall include the membrane, insulation, fasteners, adhesives and tapes, flashing originally provided by the manufacturer, and all accessory products.

Repair and/or replacement of the roofing system shall include the replacement of wet insulation. For the purpose of this specification, insulation will be considered wet if either of the following exists:

Free water is visible when the insulation is compressed.

No free water is visible when the insulation is compressed, but the insulation is damp to the touch over a large enough area, as determined by the Director’s Representative, to jeopardize the integrity of the roof system and any of its components, or to significantly lower the specified R value of the insulation.

1. PRODUCTS
	* + 1. PERFORMANCE REQUIREMENTS
				1. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.

Requirements in "Accelerated Weathering" and "Impact Resistance" subparagraphs below are required by the BCNYS for all roof coverings installed on roofs with slopes less than 2:12.

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

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.

* + - * 1. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

Retain "Wind Uplift Resistance" paragraph below for nonballasted roofing systems. See the Evaluations and Roof Wind Designer online software program, or consult structural engineer for determination of wind uplift pressures.

If Project has wood or wood panel roof decks, verify with roofing system manufacturers that test reports are available.

* + - * 1. 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:

Indicate dimensions of perimeter and corners in subparagraphs below for simple roof shapes or indicate on Drawings.

Zone 1 (Roof Area Field): **<Insert lbf/sq. ft. >**.

Zone 2 (Roof Area Perimeter): **<Insert lbf/sq. ft. >**.

Location: From roof edge to <Insert dimension> inside roof edge.

Zone 3 (Roof Area Corners): <**Insert lbf/sq. ft.** >.

Location: **<Insert dimension>** in each direction from building corner.

Retain "FM Approvals' RoofNav Listing" paragraph below if Project is FM Global insured or if FM Global requirements set a minimum quality standard. Delete paragraph if roof assembly includes a cementitious wood fiber, wood, or wood panel roof deck because FM Approvals' RoofNav does not include listings for such roof decks. Coordinate requirements in FM Approvals classification with other requirements in this Section. Loosely laid and ballasted roofing systems cannot be approved by FM Approvals but may be accepted on a project-by-project basis. For further clarification, consult FM Approvals.

* + - * 1. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

"Class 1A" signifies complying with ASTM E108, Class A fire performance for FM Approvals Class 1 roof covers. Select Class 1A-120 when required by code.

Fire/Windstorm Classification: Class 1A-90 **[Class 1A-120]**.

Retain one option in "Hail-Resistance Rating" subparagraph below based on geographical location of Project or desired rating. Verify availability of roofing systems, including specified components, that comply with these ratings using FM Approvals' RoofNav.

Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 **[MH] [SH] [VSH]**.

Retain applicable "Solar Reflectance Index," "ENERGY STAR Listing," or "Energy Performance" paragraph below if "cool-roof" performance is required. Verify that EPDM roof membrane specified complies before retaining.

Retain "ENERGY STAR Listing" paragraph below for roofs that must comply with ENERGY STAR requirements. The DOE's ENERGY STAR "Roof Products Qualified Product List" is available in PDF at www.energystar.gov.

* + - * 1. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for **[low] [steep]**-slope roof products.

Usually retain "Energy Performance" paragraph below for roofs that must comply with "California Code of Regulations, Title 24." Options are values required for low-slope roofs by prescriptive approach; revise if other values are required for building-envelope trade-off approach or whole-building performance approach. A list of products tested according to CRRC-1, with their test values, is available in PDF at www.coolroofs.org.

* + - * 1. Energy Performance: Roofing system shall have an initial solar reflectance of not less than **[0.70] <Insert value>** and an emissivity of not less than **[0.75] <Insert value>** when tested according to CRRC-1.

Retain "Exterior Fire-Test Exposure" paragraph below based on fire classification of roof assembly and roof covering for ballasted roofing.

* + - * 1. 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.

Retain "Fire-Resistance Ratings" paragraph below only if products specified are part of a fire-resistance-rated assembly. Indicate rating, testing agency, and testing agency's design designation on Drawings.

* + - * 1. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.
			1. SYSTEM DESCRIPTION

Retain one of the three paragraphs below or retain ballasted roof system, match roof system type indicated on drawings.

Use Type A on cast in place concrete decks, precast concrete plank decks or precast concrete tee’s on roofs up to 100 feet+ in height, and on slopes not exceeding 2 inches to the foot. Do not use over existing gravel surfaced built up roofing. Delete substrate board below if not specified in Part 2.

* + - * 1. Type A:

Adhered EPDM System: EPDM fully adhered to coverboard with bonding adhesive, and the insulation and/or substrate board bonded together and to the substrate with hot steep asphalt.

Use Type B on cast in place concrete decks, precast concrete plank decks or precast concrete tee’s on roofs of any height and slope. Do not use over existing gravel surfaced built up roofing. Delete substrate board below if not specified in Part 2.

* + - * 1. Type B:

Adhered EPDM System: EPDM fully adhered to bonding adhesive, and the insulation and/or substrate board bonded together and to the substrate with adhesive.

Use Type C on steel decks, wood decks, cementitious wood fiber decks (2” thick minimum), light weight concrete decks or gypsum decks (2-1/2” thick minimum) on any roof slope, height, or size. Cast in place concrete decks on any slope or height when access to roof with hot asphalt is difficult or prohibitive. Any type of deck, slope or height when reroofing over existing gravel surfaced built up roofing. .

* + - * 1. Type C:

Adhered EPDM System: EPDM fully adhered coverboard with bonding adhesive, and the insulation and/or substrate board mechanically attached to the structural deck.

Retain paragraph below for ballasted EPDM roofing.

* + - * 1. Ballasted System: Loose-laid rigid insulation, EPDM sheet membrane, ballast substrate, and ballast.
			1. ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING
				1. EPDM Sheet: ASTM D4637, Type I, nonreinforced, EPDM sheet with factory-applied seam tape.

Products: Subject to compliance with requirements, provide one of the following:

Retain second option for white 90 mil membrane systems only, first option is for 60 mil and 90 mil membrane thicknesses.

Carlisle SynTec Incorporated; **[Sure-Seal EPDM.][**Sure-White EPDM**]**

Retain, for the next subparagraph, first option for 60 mil membrane system, second option for 90 mil membrane system, or third option for white 90 mil membrane system.

Firestone Building Products; **[RubberGard EPDM.][RubberGard EPDM Platinum.][ RubberGard EcoWhite EPDM]**

Retain subparagraph for 60 mil membrane system only.

**[GenFlex Roofing Systems; GenFlex Fully Adhered Roofing System. ]**

Delete next two subparagraphs if using white 90 mil membrane system.

Johns Manville; a Berkshire Hathaway Company; JM EPDM NR.

Versico Roofing Systems; VersiGard Fully Adhered Roofing System.

Approved equivalent.

Retain one of four options in "Thickness" subparagraph below or revise to suit Project. Coordinate thickness with warranty period. Select 45 mil thickness for ballasted roof system. 60 mil or 90 mil is typical, however 75 mil thicknesses may be available, confirm with manufacturers.

Thickness: **[45 mils] [60 mils] [75 mils] [90 mils]**, nominal.

Retain one option in "Exposed Face Color" subparagraph below.

Exposed Face Color: **[Black] [White on black] <Insert color>**.

Retain "Source Limitations" subparagraph below if required to comply with FM Approvals, UL, or provisions of manufacturer's special warranty. Consult roof membrane manufacturer because requirements vary.

Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

* + - 1. AUXILIARY ROOFING MATERIALS
				1. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

Retain "Adhesive and Sealants" subparagraph below for projects located in jurisdictions where VOC limits are established by statute.

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

* + - * 1. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.

Retain "Protection Sheet" paragraph below if applicable. Carlisle and Versico offer epichlorohydrin, and Firestone offers neoprene as a protection sheet over EPDM to resist hydrocarbons, non-aromatic solvents, grease, and oil.

* + - * 1. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

Retain one of two "Slip Sheet" paragraphs below if slip sheets are required. See roofing system manufacturer's specifications for requirements. Retain first paragraph over cementitious wood-fiber roof decks if required by roof membrane manufacturer.

* + - * 1. Slip Sheet: ASTM D2178, Type IV; glass fiber; asphalt-impregnated felt.
				2. Slip Sheet: Manufacturer's standard, of thickness required for application.

Retain "Vented Base Sheet" paragraph below for lightweight insulating concrete roof decks.

* + - * 1. Vented Base Sheet: ASTM D4897, Type II; nonperforated, asphalt-impregnated fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.
				2. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

Retain “Compression Clamp” flashing round penetrations. Use for factory fabricated flashings only.

Compression Clamp: Stainless steel or cadmium plated steel worm drive clamp.

* + - * 1. Expansion Joint Tube: Compressible neoprene or polyethylene tube, twice the diameter of the width of the expansion joint
				2. Roof Vents: As recommended by roof membrane manufacturer.

Size: Not less than 4-inch diameter.

* + - * 1. Bonding Adhesive: Manufacturer's standard.
				2. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 6-inch- wide minimum, butyl splice tape with release film.
				3. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

Retain “Sealant” paragraph below only for termination bar when no cap flashing is used.

* + - * 1. Sealant: One-part, low modulus, silicone sealant:

Products: Subject to compliance with requirements, provide one of the following:

Dowsil; 790 Silicone Building Sealant.

GE Silicones; SCS2000 Silpruf Sealant.

Pecora Corp.; 864NST Silicone Sealant.

Tremco;

Approved equivalent.

* + - * 1. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
				2. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
				3. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.

Fasteners: 1-1/2-inch stainless steel fasteners with neoprene washers.

* + - * 1. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

Edit for type of deck.

Wood Decks: hardened, self-tapping, anti-backout, Phillips pan head screws with round, square or hexagonal steel stress plates. Plate size as recommended by the manufacturer.

Minimum penetration 1-inch, minimum pull out resistance from deck 360 pounds unless specified otherwise by the membrane manufacturer.

Steel Decks: hardened, self-tapping, anti-backout, Phillips pan head screws with round, square or hexagonal steel stress plates. Plate size as recommended by the membrane manufacturer.

Minimum penetration 1-inch, minimum pull out resistance from deck 400 pounds unless specified otherwise by the membrane manufacturer.

Concrete Decks: hardened, anti-backout, Phillips pan head screws with round, square or hexagonal steel stress plates; or hammer driven spikes with deformed shanks and round, square, or hexagonal steel stress plates. Plate size as recommended by the membrane manufacturer.

Minimum penetration 1-inch, minimum pull out resistance from deck 400 pounds unless specified otherwise by the membrane manufacturer.

Edit subparagraph below for the type of deck.

Structural Wood Fiber Decks/Gypsum Decks/Lightweight Concrete Decks: non-metallic, anti-backout, reinforced polymer auger fastener with round, square or hexagonal steel stress plates or a metal fastener specifically designed for light weight decks.

Penetration Into Deck: Minimum 1-1/2 inches.

Select subparagraphs below for type of deck.

Structural Wood Fiber Decks: Minimum pullout resistance 300 pounds.

Gypsum Decks: Minimum pullout resistance 350 pounds.

Lightweight Concrete Decks: Minimum pullout resistance 350 pounds.

* + - * 1. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

Provide white flashing accessories for white EPDM membrane roofing.

Retain "Liquid Coating" paragraph below if a color coating of membrane roofing or base flashing is required for aesthetic reasons or improved reflectance.

* + - * 1. Liquid Coating: Product specifically formulated for coating EPDM membrane roofing, as follows:

Type: Acrylic emulsion complying with ASTM D6083.

Color: White.

Retain “Retro-Fit Roof Drains” paragraph below on reroofing projects if there is a need for retrofits. Do not use on new work.

* + - * 1. Retro-Fit Roof Drains: Metal roof drains designed specifically for installation into an existing roof drain and conductor pipe. The drain shall be formed with an expandable drop tube or with an expandable rubber boot to form a watertight seal between the drop tube and the existing conductor pipe. The drain shall also have a large flashing flange, clamping ring and an aluminum strainer.

Products: Subject to compliance with requirements, provide one of the following:

Marathon Roofing Products, Inc.; Coppertight Roof Drain.

OMG Inc.; RAC Insert Drain System.

Portals Plus, Inc.; Portals Plus Reroof Drain.

Membrane manufacturer’s standard insert drain.

Approved equivalent.

* + - * 1. Roof Drain Membrane Clamping Collar: Universal cast iron membrane clamping collar and mounting hardware.

Products: Subject to compliance with requirements, provide one of the following:

Jay R. Smith Mfg. Co.; Universal Membrane Clamping Collar Model No. 1002.

Marathon Roofing Products Inc.; Universal clamping ring.

Approved equivalent.

* + - * 1. Pitch Pocket Filler Material:

Mortar: ASTM C 270, Type S.

Elastomeric Cement: Non-sag, cold applied, trowel grade, single component rubber elastomer with minimum elongation of 400 percent, supplied by the membrane manufacturer to satisfy warranty requirements.

* + - 1. SUBSTRATE BOARDS

Retain one of three "Substrate Board" paragraphs below if required, or delete this article. Substrate boards may serve as building-code-required thermal barriers, separating foam insulation from steel, wood, or wood panel roof decks. They may also be used over steel decks as part of a fire-resistance-rated roofing system or to provide a smooth substrate for a vapor retarder. For fire-rated assemblies, coordinate actual product retained with UL Design Number used. Verify suitability for application. Roofing manufacturers do not recognize substrate boards to be part of roofing system.

Use article below on all combustible decks, when using a vapor retarder on combustible decks. ½ inch should be specified for wide fluted metal decks.

* + - * 1. Substrate Board: ASTM C1177, glass-mat, water-resistant gypsum board or ASTM C1278, fiber-reinforced gypsum board.

[Products:](http://www.specagent.com/Lookup?ulid=5110) Subject to compliance with requirements, provide one of the following:

[Georgia-Pacific Gypsum LLC](http://www.specagent.com/Lookup?uid=123457146858); Dens Deck.

[USG Corporation](http://www.specagent.com/Lookup?uid=123457146862); Securock Glass-Fiber Roof Board.

Approved equivalent.

Thickness: **[**1/2 inch**] [Type X,** 5/8 inch**]**.

Surface Finish: **[Factory primed] [Unprimed]**.

* + - * 1. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.
			1. VAPOR RETARDER
				1. Vapor retarder to have a minimum perm rating of 0.05 per ASTM E96. Vapor retarder must be acceptable as a temporary roof and have a minimum 90 day exposure rating.

Use below to repair existing vapor retarder.

* + - * 1. Materials For Repair Of Existing Vapor Retarder:

Primer: Quick drying asphalt primer; ASTM D 41.

Asphalt Fiberglass Base Sheet: Nonporous asphalt coated glass fiber base sheet: ASTM 4601, Type IV.

Plastic Roof Cement: Non-asbestos bearing, fibrous, flashing grade; ASTM D 4586.

Bitumen: Steep asphalt; ASTM D 312, Type III.

Interply Adhesive: Membrane manufacturer’s cold process solvent based modified adhesive.

Asphalt content: 42 percent ASTM D 4479.

Density: 8 lbs./gal ASTM D 1475.

Asbestos content: None.

Retain “Laminated Sheet” for use on new steel decks.

* + - * 1. Laminated Sheet: Two-layer, fire-retardan polyethylene laminate, reinforced with cord grid.

Products: Subject to compliance with requirements, provide one of the following:

Owens Corning; Permstop Vapor Retarder and Permstop Adhesive.

St. Regis, Sisalkraft Division; Vaporstop 398 and Pyro-Kure Adhesive.

Approved equivalent.

Flame-Spread Index: Not more than 5 when tested in accordance with ASTM E84.

Smoke-Developed Index: Not more than 35 when tested in accordance with ASTM E84.

Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

Retain "Self-Adhering-Sheet Vapor Retarder" paragraph below if rubberized asphalt adhesive is required.

* + - * 1. Self-Adhering-Sheet Vapor Retarder: ASTM D1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil-total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

Retain "Glass-Fiber Felts" paragraph below if a built-up vapor retarder composed of felts and hot asphalt is required. Use for new vapor retarder on gypsum decks and lightweight concrete fill decks.

* + - * 1. Glass-Fiber Felts: ASTM D2178, Type IV, asphalt impregnated.
				2. Asphalt Fiberglass Base Sheet: Nonporous asphalt coated glass fiber base sheet: ASTM 4601, Type IV.
			1. ROOF INSULATION
				1. General: Preformed roof insulation boards manufactured or approved by EPDM roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.

Retain paragraph below for Ballasted roofing. Do not use on Steel Decks.

* + - * 1. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. minimum density, 25-psi minimum compressive strength square/butt edged.

Products: Subject to compliance with requirements, provide one of the following:

DuPont; Styrofoam Brand Deckmate Plus.

Owens Corning; Foamular 400.

Approved equivalent.

Thermal Resistance: R-value of 5.0 per inch.

Adhered insulation usually requires first option in "Size" subparagraph below.

Size: **[48 by 48 inches] [48 by 96 inches]**.

Thickness: as required to achieve R-value of roof/ceiling assembly.

Retain "Molded (Expanded) Polystyrene Board Insulation" paragraph below for noncomposite unfaced, molded-polystyrene insulation. EPS insulation requires a cover board for ballasted roof systems on concrete decks.

* + - * 1. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. minimum density, 15-psi minimum compressive strength, square edge.

Thermal Resistance: R-value of 4.25 per inch.

Adhered insulation usually requires first option in "Size" subparagraph below.

Size: **[48 by 48 inches] [48 by 96 inches]**.

Thickness: as required to achieve R-value of roof/ceiling assembly.

Retain "Composite Molded (Expanded) Polystyrene Board Insulation" paragraph below for composite molded polystyrene insulation on Steel Decks with ballasted roofing systems.

* + - * 1. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. minimum density, with factory-applied facings, as follows:

Thermal Resistance: R-value of 4.25 per inch.

Retain one of two "Facer" subparagraphs below, or revise to include another board facer if required. Verify availability with manufacturers.

Facer: ASTM C728, Perlite mineral board insulation. 3/4-inch thick, thermal value R-2.08/inch.

Adhered insulation usually requires first option in "Size" subparagraph below.

Size: **[48 by 48 inches] [48 by 96 inches]**.

Thickness: as required to achieve R-value of roof/ceiling assembly.

Retain "Polyisocyanurate Board Insulation" paragraph below for polyisocyanurate board insulation with felt or glass-fiber mat facers.. Verify availability of options with insulation manufacturers.

* + - * 1. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

Coordinate compressive strength with grade of insulation retained in "Polyisocyanurate Board Insulation" paragraph above. First option is for Grade 2; second option is for Grade 3.

Compressive Strength: 20 psi.

Adhered insulation usually requires first option in "Size" subparagraph below.

Size: **[48 by 48 inches] [48 by 96 inches]**.

Thickness: as required to achieve R-value for roof/ceiling assembly.

* + - * 1. Tapered Insulation: Provide factory-tapered insulation boards.

Material: Match roof insulation.

Minimum Thickness: 1/4 inch.

Slope:

Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.

Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

* + - 1. INSULATION ACCESSORIES
				1. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

Retain "Fasteners" paragraph below if insulation requires mechanical fastening. Retain option if separate cover boards require fastening.

* + - * 1. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation**[ and cover boards]** to substrate, and acceptable to roofing system manufacturer.

Retain “Insulation Adhesive” for Type B roofing.

* + - * 1. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

Modified asphaltic, asbestos-free, cold-applied adhesive.

Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

Full-spread, spray-applied, low-rise, two-component urethane adhesive.

Retain "Cover Board" paragraph below if required. For reroofing applications where a portion of the exiting roofing system remains (recovering), retitle these paragraphs "Recovery Board." Cover boards are usually needed over noncomposite foam insulation.

Cover boards are not recommended with a ballasted system.

Use paragraph below on all types of roofing systems. Coverboard insulation is also available in 1/4 inch thickness.

* + - * 1. Cover Board: ASTM C1177, glass-mat, water-resistant gypsum substrate, or ASTM C1278, fiber-reinforced gypsum board.

Products: Subject to compliance with requirements, provide one of the following:

Georgia-Pacific Gypsum LLC; Dens Deck.

USG Corporation; Securock Glass Mat Roof Board.

Approved equivalent.

Thickness: **[1/4 inch] [1/2 inch]**.

Surface Finish: **[Factory primed] [Unprimed]**.

Protection mats in "Protection Mat" paragraph below may be placed on roofing as protection from roof pavers or crushed-aggregate ballast.

* + - * 1. 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.

Products: Subject to compliance with requirements, provide one of the following:

Carlisle SynTec Incorporated.

Sure-Seal HP Protective Mat.

Approved equivalent.

* + - 1. ASPHALT MATERIALS
				1. Roofing Asphalt: ASTM D312, Type III.

Retain "Asphalt Primer" paragraph below if priming concrete roof deck (not for lightweight concrete fill deck).

* + - * 1. Asphalt Primer: ASTM D41.
			1. BALLAST

Retain this article for ballasted installations.

* + - * 1. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size, to ASTM C 136:

50% must be retained by 3/4-inch screen.

95% must be retained by 1/2-inch screen.

98% must be retained by 1/4-inch screen.

* + - 1. WALKWAYS

Retain below for Adhered Roofing.

* + - * 1. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

Size: Approximately 30 by 30 inch with factory rounded corners.

Color: Contrasting with roof membrane.

Retain below for Ballasted Roofing.

* + - * 1. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged, factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

Coordinate size selection in "Size" subparagraph below with minimum paver coverage required, especially at corners, perimeter, penetrations, and above large wall openings. Consider handling of pavers as weight increases. Paver sizes vary among manufacturers and include 12 by 12 and 18 by 18 inches.

Size: 24 by 24 inches by 2-inches thick. Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch in length, height, and thickness.

Compressive Strength: 3500psi minimum.

Textures: non-slip, broomed finish.

* + - 1. MISCELLANEOUS MATERIAL

On EPDM Roofs, grease guards are required around ventilators exhausting kitchen exhaust hoods.

* + - * 1. Grease Guards: Grease containment system consisting of an extruded anodized aluminum frame and 3-inch thick, 3 layer absorbent filter, deflection cap flanges, and miscellaneous accessories, sized 48 inches larger than the exhaust curb;

Product: Subject to compliance with requirements, provide one of the following:

Facilitec USA.

Grease Guard.

Approved equivalent.

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.

Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

Retain first subparagraph below for steel roof deck.

Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

Retain or revise subparagraphs below for concrete roof decks.

Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than [75] <Insert number> percent, or as recommended by roofing system manufacturer when tested according to ASTM F2170.

Test Frequency: One test probe per each [1000 sq. ft.] <Insert area>, or portion thereof, of roof deck, with not less than three test probes.

Submit test reports within 24 hours of performing tests.

Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

Retain first subparagraph below for lightweight insulating concrete roof decks.

Verify that minimum curing period recommended by roof system manufacturer for lightweight insulating concrete roof decks has passed.

Retain both subparagraphs below for cementitious wood-fiber roof decks.

Verify any damaged sections of cementitious wood-fiber decks have been repaired or replaced.

Verify adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch at top surface.

* + - * 1. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. PREPARATION
				1. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
				2. 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.

Retain first paragraph below for lightweight insulating concrete roof decks, wood and wood panel roof decks, poured gypsum roof decks, cementitious wood-fiber plank roof decks, and steel roof decks less than 0.0295 inch thick.

* + - * 1. Perform fastener-pullout tests according to roof system manufacturer's written instructions and as identified in Part 2.

Submit test result within 24 hours of performing tests.

Retain paragraph below for Type C Roof Systems.

* + - * 1. Testing Pull Out Resistance of Fasteners: Before commencing with the roofing work, in the presence of the Director’s Representative, conduct fastener pull out tests to determine if the pull out values meet the requirements of the Contract Documents and the membrane manufacturer.

Conduct the tests at representative locations and/or where selected by the Director’s Representative as follows:

Up to 5,000 square feet: 3 tests.

5,000 to 10,000 square feet: 6 tests.

10,000 to 50,000 square feet: 10 tests.

50,000 to 100,000 square feet: 20 tests.

Patch holes at the test locations.

Do not proceed with the roofing work if the pull out resistance of the fasteners is less than specified in this Section.

Retain paragraph below if acoustical roof deck rib insulation, shaped to fit into topside ribs of acoustical roof deck, is installed in this Section.

* + - * 1. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

Use below with existing roof removal to repair existing vapor retarder. All decks except steel.

* + - * 1. Patching Existing Vapor Retarder: Remove loose and/or deteriorated portions of the existing vapor retarder. Patch defective areas with fiberglass felt embedded in and coated with plastic roof cement. Extend the patch a min of 6 inches beyond the defect on all sides.

Use below when existing roof membrane is to remain. Edit for type of roofs.

* + - * 1. Preparing Existing Roof Membrane:

Gravel Surfaced Roofs: Remove loose aggregate surfacing, dirt, debris and surface moisture by power sweeping and vacuuming. Only firmly bonded gravel may be left in place. Remove high spots of the gravel to produce a reasonably level and smooth surface.

Smooth Surface Roofs: Remove dirt, debris, and surface moisture.

Cut open blisters so they lay flat. Where blisters will not lay flat, cut off raised or loose portions.

Use below only when there are known wet areas of existing insulation. Coordinate with drawings.

Where shown and directed cut open the existing roofing membrane and remove wet insulation. Fill the void left by the removals, with insulation to match the existing thickness.

If roofing system is not installed the same day, patch all defective areas with 2 plies of fiberglass felt embedded in and coated with plastic roof cement. Extend the patch a minimum of 6 inches beyond the defect on all sides.

* + - 1. INSTALLATION OF ROOFING, GENERAL
				1. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
				2. 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.

Retain first paragraph below if tie-ins to existing roofing are required.

* + - * 1. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition**[ and to not void warranty for existing roofing system]**.

Retain paragraph below when air barriers are part of Project. Drawing details should specifically illustrate transition between different air barrier components.

* + - * 1. 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."]**
			1. INSTALLATION OF SUBSTRATE BOARD

Retain substrate board for installation on combustible decks.

* + - * 1. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

Retain first subparagraph below for steel roof decks.

At steel roof decks, install substrate board at right angle to flutes of deck.

Locate end joints over crests of steel roof deck.

Tightly butt substrate boards together.

Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.

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 and FM Global Property Loss Prevention Data Sheet 1-29 and as follows:

Use paragraph below with Type A Roofing System.

Installing Hot Mopped Substrate Board:

Install the substrate board over the deck with the long joints running in a continuous straight line with end joints staggered. Butt edges snugly so there are no gaps between the boards.

Set each board in a full hot mopping of Type III asphalt applied at the rate of 30 pounds per square. Press each board into the hot bitumen to a firm and uniform bearing.

Use paragraph below with Type B Roofing System.

Installing Substrate Board With Adhesive:

Clean dust and debris off of existing metal deck to ensure proper adhesive attachment. Install the substrate board over the deck with the long joints running in a continuous straight line with end joints staggered. Butt edges and ends snugly so there are no gaps between the boards.

Set each board in serpentine ribbons of the adhesive applied at the manufacturer’s recommended rate, but no less than 6 inches on center. Apply boards in accordance with manufacturer’s recommendations.

Use paragraph below with Type C Roofing System.

Installing Mechanically Fastened Substrate Board:

Install the substrate board over the deck with the long joints running in a continuous straight line with end joints staggered. Butt edges and ends snugly so there are no gaps between the boards.

Check each fastener to insure that it is securely anchored to the deck, penetrating the top flute only. Do not allow the fastener to damage the substrate board. Remove loose or defective fasteners.

Retain subparagraph below for ballasted roofing systems, and for roofing systems not including a vapor retarder but incorporating the first layer of insulation over the substrate board to be mechanically attached to the roof deck.

Loosely lay substrate board over roof deck.

* + - 1. INSTALLATION OF VAPOR RETARDER

Coordinate vapor retarder material and installation method with wind uplift requirements. Retain material and installation method to minimize penetrations through vapor retarder. Retitle article "Air Barrier Installation" if that is primary function; revise installation requirements if necessary.

Retain “Laminate Sheet” for ballasted roof system on steel decks.

* + - * 1. Laminate Sheet: Loosely lay laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 and 6 inches, respectively.

Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.

Continuously seal side and end laps with tape.

Retain “Self-Adhering-Sheet Vapor Retarder” for installation on substrate board, concrete, or gypsum deck.

* + - * 1. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.

Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.

Seal laps by rolling.

Retain “Built-Up Vapor Retarder” for Type A, B and C decks and Ballasted roof deck.

* + - * 1. Built-Up Vapor Retarder: Install two glass-fiber felt plies lapping each felt 19 inches over preceding felt.

Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.

Embed each felt in a solid mopping of hot roofing asphalt.

Glaze coat completed surface with hot roofing asphalt.

Apply hot roofing asphalt within plus or minus 25 deg F of equiviscous temperature.

Always retain paragraph below. To function effectively, vapor retarders or air barriers must prevent air movement into roofing system.

* + - * 1. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.
			1. INSTALLATION OF INSULATION
				1. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
				2. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
				3. Installation Over Metal Decking:

In first subparagraph below, retain first option for 48-by-48-inch insulation boards. Retain second option for 48-by-96-inch insulation boards. Retain third option with second option when insulation is installed directly over metal roof decks.

Install base layer of insulation with **[joints staggered not less than 24 inches in adjacent rows] [end joints staggered not less than 12 inches in adjacent rows] [ and with long joints continuous at right angle to flutes of decking]**.

Retain first subparagraph below when insulation is installed directly over metal decking.

Locate end joints over crests of decking.

Retain first subparagraph below when a composite top layer is required over one or more layers of noncomposite molded (expanded) polystyrene or polyisocyanurate board insulation.

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.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Retain first subparagraph below for ballasted roofing system.

Loosely lay base layer of insulation units over substrate.

Retain first subparagraph below if base layer is mechanically attached, or if corner and perimeter insulation is attached beneath aggregate-ballasted roofing systems.

Mechanically attach base layer of insulation[ and substrate board] using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

Retain first subparagraph below if Project is FM Global insured or if FM Global requirements are proposed as a performance standard. Coordinate with "Performance Requirements" Article. Fastener numbers will increase at corners and perimeter over number required for field of roof.

Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

Retain option in first subparagraph below if tapered insulation is applicable.

Install upper layers of insulation**[ and tapered insulation]** with joints of each layer offset not less than 12 inches from previous layer of insulation.

Retain first subparagraph below for 48-by-48-inch insulation boards.

Staggered end joints within each layer not less than 24 inches in adjacent rows.

Retain first subparagraph below and delete last subparagraph above for 48-by-96-inch insulation boards.

Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Usually retain first subparagraph below for ballasted roofing system.

Loosely lay each layer of insulation units over substrate.

Retain first subparagraph below with mechanically attached base layer insulation.

Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

* + - * 1. Installation Over **[Wood] [Wood Panel]** Decking:

A mechanically fastened slip sheet is required when an adhesive or hot asphalt is used as a means of attaching roof insulation. Verify with manufacturer for other conditions requiring use of a slip sheet over weed or wood panel decking.

Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to **[wood] [wood panel]** decks.

Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

In first subparagraph below, retain first option for 48-by-48-inch insulation boards; second option for 48-by-96-inch insulation boards.

Install base layer of insulation with **[joints staggered not less than 24 inches in adjacent rows] [end joints staggered not less than 12 inches in adjacent rows]**.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Retain first subparagraph below for ballasted roofing system.

Loosely lay base layer of insulation units over substrate.

Retain first subparagraph below if base layer is mechanically attached, or if corner and perimeter insulation is attached beneath aggregate-ballasted roofing system.

Mechanically attach base layer of insulation[ and substrate board] using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to [wood] [wood panel] decks.

Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

Retain option in first subparagraph below if tapered insulation is applicable.

Install upper layers of insulation**[ and tapered insulation]** with joints of each layer offset not less than 12 inches from previous layer of insulation.

Retain first subparagraph below for 48-by-48-inch insulation boards.

Staggered end joints within each layer not less than 24 inches in adjacent rows.

Retain first subparagraph below and delete last subparagraph above for 48-by-96-inch insulation boards.

Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Retain first subparagraph below for loosely laid and ballasted roofing systems.

Loosely lay each layer of insulation units over substrate.

Retain first subparagraph below with mechanically attached base layer insulation.

Adhere each layer of insulation to substrate using adhesive according to FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

* + - * 1. Installation Over Concrete Decks:

In first subparagraph below, retain first option for 48-by-48-inch insulation boards; second option for 48-by-96-inch insulation boards.

Install base layer of insulation with **[joints staggered not less than 24 inches in adjacent rows] [end joints staggered not less than 12 inches in adjacent rows]**.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Retain first subparagraph below for loosely laid and ballasted roofing system.

Loosely lay base layer of insulation units over substrate.

Retain first subparagraph below if base layer of insulation is adhered to roof deck, or to vapor retarder, or if corner and perimeter insulation is attached beneath loosely laid aggregate-ballasted roofing system.

Adhere base layer of insulation to **[concrete roof deck] [vapor retarder]** according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain one or both of first two subparagraphs below for hot-asphalt application. Retain both subparagraphs for application directly over concrete roof decks. Retain only second subparagraph for applications over vapor retarder.

Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft., and allow primer to dry.

Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of first two subparagraphs below and delete last subparagraphs above, for low-rise urethane adhesive application. Coordinate with product selected.

Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

Retain option in first subparagraph below if tapered insulation is applicable.

Install upper layers of insulation**[ and tapered insulation]** with joints of each layer offset not less than 12 inches from previous layer of insulation.

Retain first subparagraph below for 48-by-48-inch insulation boards.

Staggered end joints within each layer not less than 24 inches in adjacent rows.

Retain first subparagraph below and delete last subparagraph above for 48-by-96-inch insulation boards.

Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Usually retain first subparagraph below for ballasted roofing system.

Loosely lay each layer of insulation units over substrate.

Retain first subparagraph below with adhered base layer insulation.

Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of two subparagraphs below, and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

* + - * 1. Installation Over Cementitious Wood-Fiber Decks:

Retain first subparagraph below if a slip sheet is required. NRCA recommends a mechanically fastened slip sheet over cementitious wood-fiber roof decks. However, some roof membrane manufacturers allow insulation to be directly attached to the cementitious wood-fiber roof deck of not less than 2 inches in thickness with either mechanical fasteners or cold adhesive. The use of hot asphalt as a means of attaching roof insulation requires a slip sheet over cementitious wood-fiber roof decks.

Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to cementitious wood-fiber decks.

Fasten slip sheet to resist uplift pressure at corners, perimeter, and field of roof.

In first subparagraph below, retain first option for 48-by-48-inch insulation boards; second option for 48-by-96-inch insulation boards.

Install base layer of insulation with **[joints staggered not less than 24 inches in adjacent rows] [end joints staggered not less than 12 inches in adjacent rows]**.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Retain first subparagraph below for loosely laid and ballasted roofing system.

Loosely lay base layer of insulation units over substrate.

Retain first subparagraph below if base layer of insulation is adhered to slip sheet, or if corner and perimeter insulation is attached beneath loosely laid aggregate-ballasted roofing system.

Adhere base layer of insulation to slip sheet according to FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application.

Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of first two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

Retain option in first subparagraph below if tapered insulation is applicable.

Install upper layers of insulation**[ and tapered insulation]** with joints of each layer offset not less than 12 inches from previous layer of insulation.

Retain first subparagraph below for 48-by-48-inch insulation boards.

Staggered end joints within each layer not less than 24 inches in adjacent rows.

Retain first subparagraph below and delete last subparagraph above for 48-by-96-inch insulation boards.

Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Usually retain first subparagraph below for ballasted roofing system.

Loosely lay each layer of insulation units over substrate.

Retain first subparagraph below with adhered base layer insulation.

Adhere each layer of insulation to substrate using adhesive according to FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

* + - * 1. Installation Over Lightweight Insulating Concrete Roof Decks:

Mechanically fasten vented base sheet to lightweight insulating concrete, with vented side down, using mechanical fasteners specifically designed and sized for fastening to lightweight insulating concrete roof decks.

Fasten vented base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

Retain board insulation layers from subparagraphs below if additional insulation is required over lightweight insulating concrete.

In first subparagraph below, retain first option for 48-by-48-inch insulation boards; second option for 48-by-96-inch insulation boards.

Install base layer of insulation with **[joints staggered not less than 24 inches in adjacent rows] [end joints staggered not less than 12 inches in adjacent rows]**.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Retain first subparagraph below for ballasted roofing systems.

Loosely lay base layer of insulation units over substrate.

Retain first subparagraph below if base layer of insulation is adhered to vented base sheet, or if corner and perimeter insulation is attached beneath loosely laid aggregate-ballasted roofing systems.

Adhere base layer of insulation to vented base sheet according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of first two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

Retain option in first subparagraph below if tapered insulation is applicable.

Install upper layers of insulation**[ and tapered insulation]** with joints of each layer offset not less than 12 inches from previous layer of insulation.

Retain first subparagraph below for 48-by-48-inch insulation boards.

Staggered end joints within each layer not less than 24 inches in adjacent rows.

Retain first subparagraph below and delete last subparagraph above for 48-by-96-inch insulation boards.

Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.

Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

Make joints between adjacent insulation boards not more than 1/4 inch in width.

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.

Trim insulation so that water flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

Usually retain first subparagraph below for loosely laid and ballasted roofing systems.

Loosely lay each layer of insulation units over substrate.

Retain first subparagraph below with adhered base layer insulation.

Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

For reroofing applications where a portion of the exiting roofing system remains (re-covering), retitle this Article "Installation of Recovery Board" and revise "cover board" to "recovery board" in subsequent paragraphs and subparagraphs, and edit associated text accordingly.

* + - 1. INSTALLATION OF COVER BOARDS

Retain first paragraph below if cover boards will be field installed over roof insulation and immediately below roof membrane. Cover boards are not recommended with a ballasted system.

* + - * 1. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

At internal roof drains, conform to slope of drain sump.

Trim cover board so that water flow is unrestricted.

Cut and fit cover board tight to nailers, projections, and penetrations.

Retain first subparagraph below for loosely laid and ballasted roofing systems. Consult roof membrane manufacturer.

Loosely lay cover board over substrate.

Retain first subparagraph below with adhered insulation. First option below applies only to concrete, lightweight insulation concrete, and steel roof decks. Second option applies to concrete, lightweight insulating concrete, cementitious wood fiber, steel, and wood roof decks. See the Evaluations.

Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainable program.

Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.

Retain one of two subparagraphs below and delete last subparagraph above for low-rise urethane adhesive application. Coordinate with product selected.

Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

Retain paragraph below if slip sheet is required over cover board.

* + - * 1. Install slip sheet over cover board and immediately beneath roofing.
			1. INSTALLATION OF ADHERED ROOF MEMBRANE

Retain first paragraph below if applicable.

* + - * 1. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
				2. Unroll membrane roof membrane and allow to relax before installing.
				3. Start installation of roofing in presence of roofing system manufacturer's technical personnel**[ and Director’s Representative's testing and inspection agency]**.
				4. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
				5. 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.

Retain "Bonding Adhesive" paragraph below for adhesive bonding roof membrane to substrate.

Retain "Hot Roofing Asphalt" or "Fabric-Backed Roof Membrane Adhesive" paragraph below for adhering fabric-backed roof membrane to substrate. Usually delete "Hot Roofing Asphalt" paragraph for sustainable projects. Verify with applicable sustainable program.

* + - * 1. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer, and install fabric-backed roofing. Do not apply to splice area of roof membrane.
				2. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
				3. Apply roof membrane with side laps shingled with slope of roof deck where possible.

Retain "Adhesive Seam Installation" paragraph below for adhesive-splicing roofing seams.

* + - * 1. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.

Apply lap sealant and seal exposed edges of roofing terminations.

Retain subparagraph below if required.

Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

Retain "Tape Seam Installation" paragraph below for tape-splicing roofing seams.

* + - * 1. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.

Apply lap sealant and seal exposed edges of roofing terminations.

* + - * 1. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
				2. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

Retain paragraph below if protecting EPDM from hydrocarbons, non-aromatic solvents, grease, and oil.

* + - * 1. Adhere protection sheet over roof membrane at locations indicated.
			1. INSTALLATION OF BALLASTED ROOF MEMBRANE
				1. Loosely lay roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
				2. Unroll roof membrane and allow to relax before installing.

Retain first paragraph below if applicable.

* + - * 1. Start installation of roofing in presence of roofing system manufacturer's technical personnel**[ and Director’s Representative's testing and inspection agency]**.
				2. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
				3. Apply roof membrane with side laps shingled with slope of deck where possible.

Retain "Adhesive Seam Installation" paragraph below for adhesive-splicing roofing seams.

* + - * 1. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.

Apply lap sealant and seal exposed edges of roofing terminations.

Retain subparagraph below if required. Carlisle and Versico offer an in-seam sealant in adhesive-spliced seams.

Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

Retain "Tape Seam Installation" paragraph below for tape-splicing roof membrane seams.

* + - * 1. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.

Apply lap sealant and seal exposed edges of roofing terminations.

* + - * 1. Leave seams uncovered until inspected by **[roofing system manufacturer] [testing agency]**.
				2. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
				3. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

Retain first paragraph below if protecting EPDM from hydrocarbons, non-aromatic solvents, grease, and oil.

* + - * 1. Adhere protection sheet over roof membrane at locations indicated.

Retain first paragraph below under pavers or if crushed stone or a more angular ballast must be used. Consult roof membrane manufacturers for recommendations, because one or more layers of protection mat may be required. Revise paragraph to suit Project.

* + - * 1. Install protection mat over roof membrane, overlapping a minimum of 6 inches. Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches.

Retain "Aggregate Ballast" paragraph below if using aggregate ballast.

* + - * 1. Aggregate Ballast: Apply uniformly over roof membrane at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roof membrane is installed, leaving roof membrane ballasted at end of workday.

Insert weight of aggregate for each part of roof, based on recommendations in FM Global Property Loss Prevention Data Sheet 1-29. Indicate dimensions of corners, perimeter, and field of roof on Drawings, based on FM Global requirements.

Ballast Weight: Size 3 aggregate, **<Insert weight>**, at corners, **<Insert weight>** at perimeter, and **<Insert weight>**, elsewhere.

* + - 1. INSTALLATION OF BASE FLASHING
				1. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
				2. 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.
				3. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
				4. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
				5. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
			2. INSTALLATION OF COATINGS

Retain this article if coatings are required.

* + - * 1. Apply coatings to **[roof membrane] [and] [base flashings]** according to manufacturer's written recommendations, by spray, roller, or other suitable application method.
			1. INSTALLATION OF WALKWAYS

Retain this article if walkways are required.

* + - * 1. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

Install flexible walkways at the following locations:

Retain one or more subparagraphs below. Revise to suit Project.

Perimeter of each rooftop unit.

Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.

Top and bottom of each roof access ladder.

Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.

Locations indicated on Drawings.

As required by roof membrane manufacturer's warranty requirements.

Provide 6-inch clearance between adjoining pads.

Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

* + - * 1. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

Install roof paver walkways at the following locations:

Retain one or more subparagraphs below. Revise to suit Project.

Perimeter of each rooftop unit.

Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.

Top and bottom of each roof access ladder.

Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.

Locations indicated on Drawings.

As required by roof membrane manufacturer's warranty requirements.

Provide 3 inches of space between adjacent roof pavers.

* + - 1. FIELD QUALITY CONTROL

Retain "Testing Agency" paragraph below to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" paragraph, retain "Field quality-control reports" paragraph in "Informational Submittals" Article.

* + - * 1. Testing Agency: **[Director’s Representative will engage] [Engage]** a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Director’s Representative.

If retaining second option in first paragraph below, retain "Field quality-control reports" paragraph in "Informational Submittals" Article.

* + - * 1. **[Director’s Representative will engage a qualified testing agency to perform] [Perform]** the following tests:

Retain one or more of six tests below.

Retain "Flood Testing" subparagraph below if flood testing of roofing is required. Localize testing to flashings or penetrations if preferred. Limit water depth to not more than load capacity of deck as determined by Structural Engineer. ASTM D5957 offers guidance on flood testing waterproof membranes, rather than roofing systems, on horizontal surfaces not exceeding 1/4 inch per foot (1:48). If retaining, review procedures in ASTM D5957 for applicability. Note that NRCA does not recommend flood testing.

Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

Perform tests before overlying construction is placed.

Flood to an average depth of **[2-1/2 inches] <Insert depth>** with a minimum depth of **[1 inch] <Insert depth>** and not exceeding a depth of **[4 inches] <Insert depth>**. Maintain 2 inches of clearance from top of base flashing.

ASTM D5957 sets 24 hours as minimum and 72 hours as maximum duration for flood testing for waterproofing systems.

Flood each area for **[24] [48] [72]** hours.

After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

Cost of retesting is Contractor's responsibility.

Testing agency shall prepare survey report indicating locations initial leaks, if any, and final survey report.

Test in "Infrared Thermography" subparagraph below identifies trapped moisture within roof assembly. As such, it may not be suited for new construction. See the Evaluations. Retain "Electrical Capacitance/Impedance Testing" or "Nuclear Hydrogen Detection Testing" subparagraph with infrared thermography.

Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C1153.

Perform tests before overlying construction is placed.

After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection tests.

After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

Cost of retesting is Contractor's responsibility.

Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture, if any.

Test in "Electrical Capacitance/Impedance Testing" subparagraph below identifies trapped moisture within roof assembly. As such, it may not be suited for new construction. See the Evaluations.

Electrical Capacitance/Impedance Testing: Testing agency shall survey entire roof area for entrapped water within roof assembly according to ASTM D7954.

Perform tests before overlying construction is placed.

After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

Cost of retesting is Contractor's responsibility.

Testing agency shall prepare survey report indicating locations of entrapped moisture, if any.

Test in "Nuclear Hydrogen Detection Testing" subparagraph below identifies trapped moisture within roof assembly. As such, it may not be suited for new construction. See the Evaluations.

Nuclear Hydrogen Detection Testing: Testing agency shall survey entire roof area for entrapped water within roof assembly according to ANSI/SPRI/RCI NT-1.

Perform tests before overlying construction is placed.

After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

Cost of retesting is Contractor's responsibility.

Testing agency shall prepare survey report indicating locations of entrapped moisture, if any.

Retain "Low-Voltage Electrical Conductance Testing" subparagraph below if required. First option is for EFVM, which is the most common system. Second option is for platform-type system. Both options identify specific leak locations rather than the presence of entrapped moisture within the roof assembly. See the Evaluations for limitations.

Low-Voltage Electrical Conductance Testing: Testing agency shall survey entire roof area and flashings to locate discontinuity in the roof membrane using **[an exposed metal electrical loop to create an electrical field tested with handheld probes] [or] [a scanning platform with integral perimeter electrical loops creating a complete electrical field]**.

Perform tests before overlying construction is placed.

After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

Cost of retesting is Contractor's responsibility.

Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

Retain "High-Voltage Spark Testing" subparagraph below if required. This method does not use water, can be used on vertical surfaces, and identifies specific leak locations rather than the presence of entrapped moisture within the roof assembly. See the Evaluations for limitations.

High-Voltage Spark Testing: Testing agency shall survey entire **[roof area,] [flashings,] [and] [parapet walls]** to locate discontinuity in the roof membrane using an electrically charged metal "broom head."

Perform tests before overlying construction is placed.

After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

Cost of retesting is Contractor's responsibility.

Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

A roof inspection is required by manufacturer before warranty issue. Revise scope of inspection and source of report to a qualified roofing consultant or an independent testing and inspecting agency if preferred.

* + - * 1. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Director’s Representative, and to prepare inspection report.
				2. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
				3. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
			1. PROTECTING AND CLEANING
				1. 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 Director’s Representative and Director’s Representative.
				2. 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.

Retain paragraph below if coating membrane or if using fluid-applied bonding materials.

* + - * 1. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323