SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.

Hybrid roofing system that combines built-up ply sheets with styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.

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 the 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 "Preliminary Roofing Conference" paragraph below if Work of this Section is extensive or complex enough to justify a conference. A preliminary roofing conference precedes a preinstallation conference and focuses on roof deck construction and planning activities of roofing Installer.

* + - * 1. Preliminary Roofing Conference: Before starting roof deck construction, 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, Company Field Advisor, [ Construction Manager,] Director’s Representative's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, 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.

Review deck substrate requirements for 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.

Retain "Preinstallation Roofing Conference" paragraph below if Work of this Section is extensive or complex enough to justify a conference. paragraph is recommended with or without "Preliminary Roofing Conference" paragraph above.

* + - * 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,] Company Field Advisor, Director’s Representative's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, 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 for compliance with requirements, 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:

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

* + - * 1. Submittals Package: Submit items specified below, except contract closeout submittals and MSDS, at the same time as a complete package. Partial submittals will not be considered.
				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 the 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.

Manufacturer’s installation instructions.

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

Layout and thickness of insulation.

Base flashings and membrane terminations.

Flashing details at penetrations.

Retain one or more subparagraphs below.

Tapered insulation, including 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 thickness of the insulation at high and low points.

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

Crickets, saddles, and tapered edge strips, including slopes.

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

Tie-in with adjoining air barrier.

* + - * 1. Samples:

Retain one or more subparagraphs below.

Cap Sheet: Samples of [manufacturer's standard colors for selection by Director’s Representative] [specified color].

Flashing Sheet: Samples of [manufacturer's standard colors for selection by Director’s Representative] [specified color].

Aggregate surfacing material in gradation[ and color] required.

Walkway Pads or Rolls: Samples of [manufacturer's standard colors for selection by Director’s Representative] [specified color].

* + - * 1. Quality Control Submittals:

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

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

Qualification Data: For Installer, manufacturer [and] [testing agency].

Manufacturer 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.

Installer’s Qualifications Data:

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

Names, addresses, and telephone numbers of 5 buildings where the installer has installed the submitted roof system with a manufacturer’s full system warranty. Include the manufacturers’ names and the warranty numbers.

Written certification that the project supervisor or crew chief and at least one other member of the roofing crew have installed at least 5 of the submitted roof systems and are thoroughly familiar with all aspects of the installation.

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

Evaluation Reports: For components of membrane roofing system, from ICC-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 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" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

Field quality-control reports.

Sample Warranties: For manufacturer's special warranties.

* + - * 1. Contract Closeout Submittals

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.

* + - * 1. Material Safety Data Sheets (MSDS): Do not include the MSDS in the Submittals Package. Submit the MSDS to the Director’s Representative at the Pre-Installation Conference.
				2. Roofing Manufacturer’s Company Field Advisor:

Documentation of 5 years of field experience on the same type of roofing system.

Documentation of 10 projects where role was a Company Field Advisor; include contact names and phone numbers for each project.

Documentation of attendance at a roof specific instructional seminar within the last two years.

Questions regarding the use of the article below should be directed to the Business Unit’s Roofing QIT Representative.

* + - 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.

Delete below for granular surfaced roofing.

Inspect the completed roof membrane before aggregate surfacing is applied.

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. QUALITY ASSURANCE
				1. Fire Hazard Certification: The modified bitumen 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 “Tests for Fire Resistance of Roof Covering Materials”.

The roof system, which includes a specific generic type of insulation and in some instances, 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. Material Classification Identification: Materials delivered to the site that are a component of the roofing system shall bear the UL Classification mark.
				2. Manufacturer Qualifications: A qualified manufacturer that is UL listed or listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

The manufacturer shall have been actively marketing a modified bitumen 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 have installed at least 5 previous projects of comparable size, scope, and complexity as the Work of this Section within the past 5 years.

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

* + - * 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 5 cold process modified bitumen roofing systems for which the manufacturer’s warranty was issued.

Workers: The supervisor or crew chief and at least one other member of the roofing crew shall have installed at least 5 cold process modified bitumen roof systems and shall be thoroughly familiar with all aspects of the installation.

* + - 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.

* + - * 1. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.
			1. FIELD CONDITIONS
				1. 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.
				2. Unless otherwise directed, do not execute the Work of this Section if the Director’s Representative is not present.
				3. Do not execute the Work of this Section unless the substrate is dry and free of dirt and debris.
				4. 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 retarder may be acceptable temporary protection for a maximum of 48 hours.

* + - * 1. Do not smoke or use open flames near volatile materials.
				2. During the progress of the Work make every effort to keep odors generated by the Work from entering the building.

Coordinate the use of materials that could cause noise, dust and odors to permeate the building with the Director’s Representative.

Shut off and wrap air intakes in the vicinity of the Work. Coordinate air system shut down with the Director’s Representative.

Insure that operable windows in the vicinity of the Work area are closed.

* + - * 1. Do not begin work when inclement weather is forecast to occur prior to the anticipated completion time of work planned for the day unless approved by the Director’s Representative.
			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. A 20 year warranty is typical but may be changed to 15, 20 or 30 years

* + - * 1. Manufacturer’s Warranty: In addition to the 2 year period specified above, furnish the membrane manufacturer’s printed 20 Year, No dollar Limit, Full System Warranty, covering workmanship and materials for the Work of this Section.

Wind speed: Up to 73 mph.

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 caused by the materials or workmanship.

Materials shall include membrane, insulation, fasteners, adhesives, membrane flashings, and other accessory items provided as part of the complete roof system.

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. SYSTEM DESCRIPTION

Delete “an intermediate ply sheet” from the paragraphs below for minor roofs, canopies or when weight is an issue. Select one or more of the desired roofing systems below and delete the remaining.

* + - * 1. Modified Bitumen Roofing System: Granular surfaced SBS modified bitumen membrane system consisting of a smooth modified bitumen base sheet, an intermediate ply sheet, and cap ply sheet, applied cold adhesive over gypsum coverboard, insulation and vapor retarder.

On metal decks and decks requiring a fire rating, provide underlayment board directly on the deck and below the vapor retarder as part of the modified bitumen roofing system.

* + - * 1. Modified Bitumen Roofing System: Smooth surfaced SBS modified bitumen membrane system consisting of a smooth modified bitumen base sheet, an intermediate ply sheet, and cap ply sheet, applied cold adhesive over gypsum coverboard, insulation and vapor retarder.

On metal decks and decks requiring a fire rating, provide underlayment board directly on the deck and below the vapor retarder as part of the modified bitumen roofing system.

* + - 1. PERFORMANCE REQUIREMENTS
				1. General Performance: Installed roofing system and 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. Roof system 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 of 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.

Always retain "Wind Uplift Resistance" paragraph below.

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 each 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. 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.

Retain one option in "Fire/Windstorm Classification" subparagraph below based on windstorm classification of Project. Verify availability of roofing systems that comply with these classifications. "Class 1A" signifies compliance with ASTM E108 Class A fire performance for FM Approvals Class 1 roof covers.

Retain Class 1A-120 for projects in Downstate New York.

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 1-34 **[MH] [SH] [VSH]**.

Retain "ENERGY STAR Listing" or "Energy Performance" paragraph below if "cool-roof" performance is required. Verify that cap sheet 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.
			1. MANUFACTURERS

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

* + - * 1. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.
				2. Manufacturers: Subject to compliance with requirements, provide products by the following:

Tremco, Inc.

Siplast, Inc.

The Garland Inc.

Soprema USA.

Approved equivalent.

* + - 1. BASE SHEET MATERIALS

Select from the three paragraphs below (A, B, or C).

* + - * 1. Select from the following three options:

SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

SBS-Modified Bitumen Polyester and Fiberglass Mat Base Sheet: ASTM D6162, Type II, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

Retain "Asphalt-Coated Fiberglass Mat Base Sheet" paragraph below for coated glass-fiber base sheet. Product is classified by UL as Class G-2 coated base sheets.

* + - * 1. Asphalt-Coated Fiberglass Mat Base Sheet: ASTM D4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

Retain "Vented Base Sheet" paragraph below for coated glass-fiber venting base sheet. Venting base sheets may be required over insulating concrete roof decks or over existing roofing before reroofing. Revise description if a proprietary, SBS-modified, asphalt-coated venting base sheet is required. Review other options with roofing system manufacturer, and revise description to suit Project.

* + - * 1. Vented Base Sheet: ASTM D4897, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.
			1. INTERPLY SHEETS

Retain "Glass-Fiber Interply Sheet" paragraph below for hybrid roofing systems that combine built-up roofing ply sheets with a polymer-modified bituminous membrane cap sheet.

* + - * 1. Glass-Fiber Interply Sheet: ASTM D2178, Type IV, asphalt-impregnated, glass-fiber felt.
			1. STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

Retain "Smooth-Surfaced Roofing Cap Sheet" paragraphs below, if applicable.

* + - * 1. Select from the following three options:

Smooth-Surfaced Roofing Cap Sheet: ASTM D6164, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

Smooth-Surfaced Roofing Cap Sheet: ASTM D6162, Type II, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

Smooth-Surfaced Roofing Cap Sheet: ASTM D6163, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

"Granule-Surfaced Roofing Cap Sheet" paragraphs below if applicable.

* + - * 1. Select from the following three options:

Granule-Surfaced Roofing Cap Sheet: ASTM D6164, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

Granule Color: White.

Granule-Surfaced Roofing Cap Sheet: ASTM D6163, Type II, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

Granule Color: White.

Granule-Surfaced Roofing Cap Sheet: ASTM D6162, Type III, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

Granule Color: White.

* + - 1. BASE FLASHING SHEET MATERIALS

Retain one of three "Backer Sheet" paragraphs below if backer sheet is required behind exposed flashing sheet. Coordinate selection with warranty duration.

Retain one of first two "Backer Sheet" paragraphs below if flashing is installed over wood-sheathed parapet walls. Although coated glass-fiber backer sheet is typical, coated organic backer sheet in second paragraph is also offered by some manufacturers.

* + - * 1. Backer Sheet: ASTM D4601, [Type I] [Type II], asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
				2. Backer Sheet: ASTM D2626, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

SBS backer sheet in "Back Sheet" paragraph below can be applied directly over masonry, concrete, and ASTM C1177 and ASTM C1278 cover board material applied to vertical face of parapet walls without the use of a mechanically attached baker sheet. Retain option that matches cap sheet. Granule-surfaced membranes are not used as backer sheets.

* + - * 1. Backer Sheet: ASTM D6164, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, ASTM D6163, Type I, Grade S, SBS-modified asphalt sheet, reinforced with glass fibers, or ASTM D6162, Type II, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers, smooth surfaced, suitable for application method specified.

Retain "Granule-Surfaced Flashing Sheet" paragraph below for flashing sheet. Usually retain option that matches cap sheet.

* + - * 1. Granule-Surfaced Flashing Sheet: ASTM D6164, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, ASTM D6163, Type  II, Grade G, SBS-modified asphalt sheet, reinforced with glass fibers, or ASTM D6162, Type II, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers, granule surfaced, suitable for application method specified, and as follows:

Granule Color: White.

Retain "Glass-Fiber Fabric" paragraph below if glass-fiber fabric is required at upper flashing terminations.

* + - * 1. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668, Type I.
				2. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

Edit out paragraphs below if not required on your project.

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

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

New York State Ozone Transport Commission guidelines limits for shipment of products containing VOCs.

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

Products: Subject to compliance with requirements, provide products by the following:

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

Marathon Roofing Products Inc.; Universal clamping ring.

Approved equivalent.

Use retro-fit drain when existing drain body is deteriorated and cannot easily be replaced.

* + - * 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 products by the following:

Marathon Roofing Products; Coppertight Roof Drain.

OMG Inc.; RAC Insert Drain System.

Portals Plus, Inc.; Portals Plus Reroof Drain.

Approved equivalent.

* + - * 1. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
				2. Roof Vents: As recommended by roof membrane manufacturer.

Size: Not less than 4-inch diameter.

* + - * 1. Materials for Pitch Pockets:

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.

The product below may be used as an alternative to pitch pockets. This product is currently only available from two manufacturers.

* + - * 1. PMMA (Polymethyl-Methacrylate) Flashing: Supplied by the membrane manufacturer to satisfy warranty requirements.

Sheathing paper may be required as a slip sheet over wood roof decks, usually under the base sheet. Delete "Sheathing Paper" paragraph below if not using wood decks or if sheathing paper is not required by roof membrane manufacturer.

* + - * 1. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft..
				2. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

Retain "Cold-Applied Asphalt Adhesive" paragraph below if adhering roof insulation, base sheets, roofing membrane, or base flashing using cold-applied adhesives. Cold-applied adhesives are typically solvent based. For sustainable projects, verify with applicable sustainability program before using cold-applied adhesives containing solvents. Some roof membrane manufacturers have low-VOC-content (200 -g/L or less) cold-applied adhesives.

* + - * 1. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with **[roofing membrane] [and] [base flashings]**.
				2. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with **[interply sheets] [and] [aggregate surfacing adhesive]**.

Retain "Asphalt Roofing Cement" paragraph below if asphalt roofing cement is used to adhere flashings or integral metal sheet flashings and is acceptable to roofing system manufacturer.

* + - * 1. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required by roofing system manufacturer for application.

Retain "Mastic Sealant" paragraph below if sealant is needed for moving joints in sheet metal accessories or for certain locations where asphalt roofing cement may be inadequate or undesirable.

* + - * 1. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
				2. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
				3. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve; color to match roof membrane.
				4. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.
			1. SUBSTRATE BOARDS

Retain "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 deck 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 utilized. Verify suitability for application. Roof membrane manufacturers do not recognize substrate boards to be part of roofing system.

* + - * 1. Substrate 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.

½ Inch should be specified for wide fluted metal decks.

Thickness: **[1/4 inch] [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 board to roof deck.
			1. VAPOR RETARDER

Retain this article if a vapor retarder is required. Review compatibility of vapor retarder with other roofing system materials. Coordinate vapor retarder type and installation method with wind uplift requirements. Select material and installation method to minimize penetrations through vapor retarder. A substrate board or layer of insulation is needed, because vapor retarders cannot be placed directly over a steel deck. If necessary, retitle article "Air Retarder" or "Vapor/Air Retarder," depending on function of retarder.

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

Permeance Rating: Not more than 0.062 perm.

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. Usually delete for sustainable projects. Verify with applicable sustainability program.

* + - * 1. Glass-Fiber Felt: ASTM D2178, Type IV, asphalt impregnated.
			1. ROOF INSULATION

If retaining more than one insulation material in this article, indicate location of each on Drawings, or indicate where each layer is used in roofing system. Coordinate insulation selection and thicknesses with adjoining construction as well as HVAC design and energy program.

Roofing system manufacturers may require use of their own insulations or limit approvals to specific insulation manufacturers. Retain second option in "General" paragraph below if FM Approvals' approval is required.

* + - * 1. General: Preformed roof insulation boards, manufactured or approved by roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roofing assemblies.
				2. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

Coordinate "Compressive Strength" subparagraph 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: **[provide thickness required to achieve R-<Insert Value>] [Insert Thickness][per drawings]**.

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

Retain one of first three subparagraphs below.

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

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

Retain "Insulation Cant Strips" paragraphs below; delete if using wood cants specified in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry."

* + - * 1. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

Retain "Wood Nailer Strips" paragraph below if wood nailer strips are required. Wood nailer strips are used to prevent insulation slippage and to backnail roofing membrane on sloping roof decks. Revise paragraph to add material requirements for wood nailer strips if preferred.

* + - * 1. Wood Nailer Strips: Comply with requirements in **[Section 061000 "Rough Carpentry."] [Section 061053 "Miscellaneous Rough Carpentry."]**

Use at roof perimeter if no parapet or vertical wall exists.

* + - * 1. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

For reroofing applications where a portion of the exiting roofing system remains (re-covering), retitle these paragraphs "Recovery Board." Cover boards are usually needed over noncomposite foam insulation. When base sheets or cap sheets are torch-applied, a noncombustible cover board, such as glass-mat, water-resistant gypsum board or fiber-reinforced gypsum board, is required. Gypsum-based cover boards are not recommended when cover board temperatures are expected to reach 130 deg F (59.4 deg C) and above.

Delete paragraph below if not fastening underlayment board to deck and insulation is being adhered.

Use article below on all projects.

* + - * 1. Cover Board: ASTM C1177, glass-mat, water-resistant gypsum board 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.

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

Thickness: 1/2 inch.

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

* + - 1. ASPHALT MATERIALS

Retain "Asphalt Primer" paragraph below if priming concrete roof deck.

* + - * 1. Asphalt Primer: ASTM D41.

Retain one of two "Roofing Asphalt" paragraphs below for roofing asphalt used with base sheets or glass-fiber base-ply sheets, and possibly with roofing membrane and base flashing. See roofing manufacturer's written instructions for requirements. Although "steep" asphalt (Type III) is used, "extra steep" asphalt (Type IV) predominates. SEBS-modified roofing asphalt is offered by some roofing system manufacturers. SEBS-modified roofing asphalt has a higher softening temperature and better low-temperature flexibility than standard roofing asphalt but also costs more.

* + - * 1. Roofing Asphalt: ASTM D312, **[Type III] [Type IV] [Type III or IV as recommended by roofing system manufacturer for application]**.
				2. Roofing Asphalt: ASTM D6152, SEBS modified.
			1. WALKWAYS

Retain "Walkway Cap-Sheet Strips" paragraph below for roofing cap-sheet strips used as walkways.

* + - * 1. Walkway Cap-Sheet Strips: same material as cap sheet material, granule surfaced; suitable for application method specified, and as follows:

Size: 36 by 60 inches.

Granule Color: contrasting color to field cap sheet.

Retain article below to achieve highest reflective surface.

* + - 1. COATING MATERIALS
				1. White Reflective Roof Coating: Water-based, Energy Star Certified, CRRC certified, elastomeric roof coating formulated for use on bituminous roof surfaces, with the following physical properties:

Asbestos Content, EPA/600/R-93/116: None.

Non-Volatile Content (by weight), minimum, ASTM D 1644: 59 percent.

Percent Solids (by volume), minimum, ASTM D 5201: 65 percent.

Solar Reflectance Index: Minimum .78.

Volatile Organic Compounds (VOC), ASTM D 3960: None.

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 cants, 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."

Delete first subparagraph below if not using wood or plywood decks.

Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.

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 value> 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 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 roofing system manufacturer for lightweight insulating concrete roof decks has passed.

Retain subparagraphs below for cementitious wood-fiber roof decks.

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

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

* + - * 1. Testing Existing Roof Drains and Conductor Pipes: Before commencing with the Work of this Section, water test existing roof drains and conductor pipes and submit a written report to the Director’s Representative indicating which drains or conductors, if any, are not functioning properly. Repair of existing drains and conductors is not included in the Work. Repair work (if any) may, at the Director’s option, be accomplished by an Order on Contract.
				2. 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 installation according to roofing system manufacturer's written instructions.

Remove sharp projections.

* + - * 1. 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 if priming concrete deck before installing overlying roofing system components in hot roofing asphalt.

* + - * 1. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft., and allow primer to dry.

Use paragraph below when installing vapor retarder underlayment board.

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.

Submit test result within 24 hours of performing tests.

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 400 pounds.

Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

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

* + - * 1. Install sound absorbing insulation strips in ribs of acoustical roof decks according to acoustical roof deck manufacturer's written instructions.
			1. INSTALLATION OF ROOFING, GENERAL
				1. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof 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 the end of the 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 first paragraph below if using air barriers for 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 in **[Section 072713 "Modified Bituminous Sheet Air Barriers."] [Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers."] [Section 072726 "Fluid-Applied Membrane Air Barriers."]**

Retain one of two "Asphalt Heating" paragraphs below if insulation, base sheet, interply sheets, or cap sheet are installed using hot asphalt. Usually delete both paragraphs for sustainable projects. Verify with applicable sustainability program. Retain first paragraph for traditional roofing asphalt complying with ASTM D312; retain second for SEBS-modified roofing asphalt complying with ASTM D6152. Heating and application requirements may differ among roofing system manufacturers.

* + - * 1. Asphalt Heating:

Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.

Circulate asphalt during heating.

Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.

For cap sheets, comply with cap sheet manufacturer's recommendations.

Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.

Do not heat asphalt within 25 deg F of flash point.

Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.

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

For cap sheets, comply with cap sheet manufacturer's recommendations.

* + - * 1. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.
				2. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.
			1. INSTALLATION OF SUBSTRATE BOARD
				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.

Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

Retain subparagraph below 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

Retain applicable vapor retarder material in this article. Verify, with roof membrane manufacturer, if a vapor retarder is required over lightweight structural concrete roof decks, normal weight concrete roof decks, or under any other circumstances. Coordinate vapor retarder material and installation method with wind uplift requirements. Select material and installation method to minimize penetrations through vapor retarder. Retitle "Air Barrier Installation" Article if that is primary function; revise installation requirements if necessary.

* + - * 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 the insulation and cover board.

Continuously seal side and end laps with tape.

* + - * 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 the insulation and cover board.

Seal laps by rolling.

Usually delete "Built-Up Vapor Retarder" paragraph below for sustainable projects. Verify with applicable sustainability program.

* + - * 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 the insulation and cover board.

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

Glaze coat completed surface with hot roofing asphalt.

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 the end of the workday.
				2. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

Roofing system manufacturers require nailer strips for insulation-covered roof decks with slopes greater than 1 inch per 12 inches (1:12). Verify roofing system manufacturer's backnailing requirements for reducing nailer-strip spacing as roof slope increases. Unless manufacturer's written instructions contain more stringent requirements, NRCA recommends spacing nailers approximately 16 feet apart for slopes up to 3 inches per 12 inches (3:12) and 48 inches apart for steeper slopes. Delete nailer strips on lightweight insulating concrete decks or other noninsulated nailable decks.

* + - * 1. Nailer Strips: Mechanically fasten 4-inch nominal-width, wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:

16 feet apart for roof slopes greater than 1 inch per 12 inches but less than 3 inches per 12 inches.

48 inches apart for roof slopes greater than 3 inches per 12 inches.

Insulation cant strips may be mechanically fastened or set in hot asphalt, depending on substrate and roofing system manufacturer's written instructions.

* + - * 1. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F.
				2. 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-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.

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.

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.

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 sustainability 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 sheathing paper or base 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 wood or wood panel decking.

Mechanically fasten **[sheathing paper] [asphalt-coated fiberglass-mat base sheet]** to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to [wood] [wood panel] decks.

Lap edges a minimum of 2 inches, or as recommended by roof membrane manufacturer.

Lap ends a minimum of 6 inches, or as recommended by roof membrane manufacturer.

Fasten **[sheathing paper] [asphalt-coated fiberglass-mat base 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; retain 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 if base layer is mechanically attached.

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 first subparagraph below if base layer is adhered.

Adhere base layer of insulation to substrate using adhesive as follows:

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

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

Set base layer of 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.

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 sustainability 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; retain 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]**.

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 subparagraph below if base layer of insulation is adhered to roof deck or to vapor retarder.

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. Usually delete for sustainable projects. Verify with applicable sustainability program.

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 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.

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 sustainability 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 a 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 sheathing paper of a base sheet over cementitious wood-fiber roof decks.

Mechanically fasten **[sheathing paper] [asphalt-coated fiberglass-mat base sheet]** to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to cementitious wood fiber decks.

Fasten [sheathing paper] [asphalt-coated fiberglass-mat base 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; retain 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.

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. Usually delete for sustainable projects. Verify with applicable sustainability 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 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.

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 sustainability 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 hot-asphalt subparagraphs 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 Decks:

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

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

Retain first subparagraph below when a composite top layer is required over one or more layers of noncomposite molded-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.

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 subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable sustainability 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 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 flow is unrestricted.

Fill gaps exceeding 1/4 inch with insulation.

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

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 sustainability 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 OF COVER BOARDS

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

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.

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 sustainability 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 sheathing paper is required over cover board.

* + - * 1. Install sheathing paper over cover board and immediately beneath roof membrane.
			1. INSTALLATION OF ROOFING MEMBRANE, GENERAL
				1. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

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].

Retain first paragraph below if roof slope exceeds minimum permitted by roofing system manufacturer. Revise minimum roof slope to suit application.

* + - * 1. Where roof slope exceeds **[1/2 inch per 12 inches] [3/4 inch per 12 inches] <Insert slope>**, install roofing membrane sheets parallel with slope.

Retain first option in subparagraph below for backnailing roofing sheets to nailer strips for insulated and nonnailable decks. Retain second option for backnailing roofing sheets directly to nailable substrate.

Backnail roofing sheets to **[nailer strips] [substrate]** according to roofing system manufacturer's written instructions.

* + - * 1. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.

Remove and discard temporary seals before beginning work on adjoining roofing.

* + - 1. INSTALLATION OF BASE SHEET
				1. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

Retain first paragraph below if sheathing paper is required over wood or wood panel roof decks without above deck insulation. Base sheet placed under roof insulation is specified in "Insulation Installation" Article.

* + - * 1. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches and 6 inches, respectively.

Retain one of three paragraphs below. Coordinate with base sheet material selected above.

Base sheet in first paragraph below is for a two-ply SBS-modified bitumen roofing system.

* + - * 1. Installation of Base Sheet:

Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

Extend roofing sheets over and terminate above cants.

Install base sheet in a shingle fashion.

Retain one of the next two subparagraphs below.

Adhere to substrate in a uniform coating of cold-applied adhesive.

First subparagraph is for wood or wood panel roof decks.

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

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

Install base sheet without wrinkles, rears, and free from air pockets.

Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.

Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.

Stagger end laps not less than 18 inches.

Completely bond and seal laps, leaving no voids.

Roll laps with a 20-pound roller.

Repair tears and voids in laps and lapped seams not completely sealed.

Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

Product listed in "Installation of Asphalt-Coated Fiberglass-Mat Base Sheet" paragraph below is for minimal requirements incorporating a two-ply system.

* + - * 1. Installation of Asphalt-Coated Fiberglass-Mat Base Sheet:

Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

Extend roofing sheets over and terminate above cants.

Install base sheet in a shingle fashion.

Retain appropriate installation method in subparagraphs below. Usually retain first subparagraph for nailable substrate and second subparagraph for nonnailable or insulated substrates.

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

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

Adhere to substrate in a **[solid mopping of hot roofing asphalt] [uniform coating of cold-applied adhesive]**.

Install base sheet without wrinkles or tears, and free from air pockets.

Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.

Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.

Stagger end laps not less than 18 inches.

Completely bond and seal laps, leaving no voids.

Repair tears and voids in laps and lapped seams not completely sealed.

* + - * 1. Installation of Vented Base Sheet:

Retain first option in first subparagraph below for nailable substrates; retain second option for nonnailable substrates.

**[Mechanically fasten, using mechanical fasteners specifically designed and sized for fastening to applicable substrate] [Spot or strip mop to substrate with hot roofing asphalt]** vented base sheet with vented side down.

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

Retain article below for hybrid roofing systems that combine built-up roofing ply sheets with a polymer-modified bituminous membrane.

* + - 1. INSTALLATION OF INTERPLY SHEETS

Interply sheets may be applied directly to nonnailable deck, base sheet, insulation, or cover board. Retain number of ply sheets from options in first paragraph below.

* + - * 1. Install **[two] [three]** ply sheets, starting at low point of roofing.

Align ply sheets without stretching.

Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

Shingle in direction to shed water.

Extend ply sheets over and terminate above cants.

* + - 1. INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET
				1. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.
				2. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

Extend cap sheet over and terminate above cants.

Install cap sheet in a shingle fashion.

Install cap sheet as follows:

Retain one of first three subparagraphs below.

Adhere to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by cap sheet manufacturer.

Adhere to substrate in cold-applied adhesive.

Torch apply to substrate.

Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

Install cap sheet without wrinkles or tears, and free from air pockets.

Install cap sheet, so side and end laps shed water.

* + - * 1. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.

Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.

Stagger end laps not less than 18 inches.

Completely bond and seal laps, leaving no voids.

Roll laps with a 20-pound roller.

Repair tears and voids in laps and lapped seams not completely sealed.

* + - * 1. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

Usually delete paragraph in order to observe adhesive bleedout during field quality control inspections. Retain for mineral-granule-surfaced cap sheets at roof areas that are highly visible and when a uniform color is desired. Granule application to bead is considered temporary.

* + - * 1. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.
			1. INSTALLATION OF FLASHING AND STRIPPING
				1. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

Smooth surfaces of masonry and concrete walls and parapets usually require priming before applying hot asphalt or cold adhesive.

Prime substrates with asphalt primer if required by roofing system manufacturer.

Retain one of two "Backer Sheet Application" subparagraphs below if a single backer sheet is required behind flashing sheet. Retain first for backer sheets mechanically fastened to wood-surfaced walls or parapets and second for adhered backer sheets.

Backer Sheet Application:

Mechanically fasten backer sheet to walls or parapets.

Adhere backer sheet over roofing membrane at cants in **[a solid mopping of hot roofing asphalt] [cold-applied adhesive]**.

Backer Sheet Application:

Adhere backer sheet to substrate in **[a solid mopping of hot roofing asphalt] [cold-applied adhesive]**.

Retain one of three "Flashing Sheet Application" subparagraphs below, or revise to suit Project.

Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by flashing sheet manufacturer. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.

Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.

Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing system manufacturer.

Revise dimensions in first paragraph below if required. Verify minimum and maximum height limits with manufacturers if necessary. NRCA recommends a minimum base flashing height of 8 inches (200 mm).

* + - * 1. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
				2. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

Retain subparagraph below if not temporarily sealing upper termination of flashings awaiting counterflashing. Retain option if specifying termination seal.

Seal top termination of base flashing**[ with a strip of glass-fiber fabric set in asphalt roofing cement]**.

* + - * 1. Install liquid flashing system according to manufacturer's recommendations.

Extend liquid flashing not less than 3 inches in all directions from edges of item being flashed.

Embed granules, matching color of roof membrane, into wet compound.

Revise first paragraph below to describe a particular stripping arrangement if required. Manufacturers offer many variations of stripping-in metal flanges and horizontal legs of metal edgings. Some roofing manufacturers show metal items set on either base sheet or strip of modified bituminous roofing where water flow is toward, rather than away from, metal item. Cap sheet extends over metal, minimizing water flow against an exposed lap seam.

* + - * 1. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

Retain "Roof Drains" paragraph below for interior roof drains. NRCA recommends flashing size below, whereas some roofing manufacturers permit 27-inch square units.

* + - * 1. Roof Drains: Set **[30-by-30-inch-] <Insert dimensions>** 4-pound lead flashing in bed of asphaltic adhesive on completed roofing membrane.

Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of **[4 inches] [6 inches]** beyond edge of metal flashing onto field of roofing membrane.

Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.

Install stripping according to roofing system manufacturer's written instructions.

* + - 1. INSTALLATION OF WALKWAYS

Retain "Walkway Cap-Sheet Strips" paragraph below if walkways are required.

* + - * 1. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane, using same application method as used for roofing cap sheet.**[ Install walkway cap sheet strips before flood coat and aggregate surface is applied.]**

Install walkways strips at the following locations:

Retain one or more of the following subparagraphs. Revise to suit Project requirements

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-inch clearance between adjoining strips.

* + - 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, flashings, protection, and drainage components, and to furnish reports to Director’s Representative.
				2. Perform the following tests:

"Test Cuts" paragraph below is based on Appendix 2 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing." ARMA/NRCA recommends continuous visual examination of roofing installation. Test cuts are intended to evaluate problems observed during quality-assurance inspections.

Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

Determine approximate quantities of components within roofing membrane according to ASTM D3617.

Examine test specimens for interply voids according to ASTM D3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

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 inspection 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.

Retain subparagraph below if Director’s Representative wants to be present during manufacturer's final inspection.

Notify Director’s Representative 48 hours in advance of date and time of inspection.

* + - * 1. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
				2. Roofing system will be considered defective if it does not pass tests and inspections.

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, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Director’s Representative.

* + - * 1. 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 075216