SECTION 075113 - BUILT-UP ASPHALT 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:

Built-up asphalt roofing.

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,[ Construction Manager,] Director’s Representative, 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.

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,] 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.

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.
				5. Submittals Package: Submit the shop drawings, product data, samples, and quality control submittals specified below at the same time as a package.
				6. Product Data: For each type of product.

Revise the membrane manufacturer’s product data as necessary to suit the requirements of the Contract Documents. Manufacturer’s details are not to be used for the Work of this contract.

Manufacturer’s Warranty: Sample copy of the membrane manufacturer’s 10 year warranty covering workmanship and materials.

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

* + - * 1. Sustainable Design Submittals:
				2. Shop Drawings:

When there is a proposed deviation from the Contract Documents, submit the revised detail labeled as such for approval. The revised detail shall show existing conditions and shall be referenced directly to the related details on the Contract Drawings.

Include plans, sections, details, and attachments to other work, including the following:

Layout and thickness of insulation.

Base flashings and roofing terminations.

Flashing details at penetrations.

Retain one or more subparagraphs below.

Tapered insulation, including slopes.

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

Submit an accurate layout of the wood nailers showing their required locations and required spacing between nailers. Show the direction of the felt run in relation to the slope of the deck and the wood nailers.

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:

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:

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

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

Acceptable Certification: Letter from Factory Mutual, or a copy of the Factory Mutual Approval Report for the roofing system.

Material Certification:

Written certification from the roofing membrane manufacturer certifying that the insulation, insulation fasteners (if any), flashings and accessory products provided by the membrane manufacturer are approved for use with the roofing system and are included in the “10 year full system warranty”.

Coordinate "Qualification Data" paragraph below with qualification requirements and as may be supplemented in "Quality Assurance" Article.

Qualification Data: For Installer and Manufacturer.

Manufacturer Certificates:

Retain "Performance Requirement Certificates" subparagraph below if retaining "FM Approvals' RoofNav Listing," or "Energy Performance" paragraph in "Performance Requirements" Article.

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

Submit evidence of compliance with performance requirements.

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

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

Evaluation Reports: For components of 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.

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

Concrete internal relative humidity test reports.

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

* + - * 1. Closeout Submittals:

Maintenance Data: For roofing system to include in maintenance manuals.

Sample Warranties: For manufacturer's special warranties.

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

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

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

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

The manufacturer must 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.

Workers: The crew chief and at least one other member of the roofing crew shall have installed at least 3 built-up roof systems and shall be thoroughly familiar with all aspects of the installation

* + - * 1. Fire Department Regulations: Equipment and fuel shall meet the requirements of the New York State Building Code, and the local Fire Department.
				2. Fire Hazard Classification: The built-up roof system shall have an Underwriters Laboratories Class External Fire Resistance rating; as determined by tests conducted in conformity with UL-790 (ASTM E 108).

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

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

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:

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.

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.

Secure the services of the Company Field Advisor for a minimum of **<insert quantity>** days at a minimum of **<insert quantity>** hours per day to inspect the workmanship of the roofing system installer.

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 all aspects of the system including inspection techniques.

Answering questions that might arise.

Edit remaining subparagraphs below to suit project complexity and need. Discuss appropriateness of subparagraphs with Design Project Manager and the Division of Construction.

Attend each bi-weekly meeting.

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

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

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

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

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

Date of report and inspection.

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

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

Discussions with Contractor regarding work anomalies and resolution.

Conditions that are not in compliance with the Contract documents.

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

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

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

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
				2. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing 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. Do not execute the Work of this Section unless the Director’s Representative is present, or unless he directs that the Work be performed during his absence.
				2. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be installed according to manufacturer's written instructions and warranty requirements.
				3. Do not execute the Work of this Section unless the substrate is dry, and free from debris and dust.
				4. Moisture Protection:

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

Use subparagraph below on rehabilitation work only.

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

* + - * 1. During the progress of the work every effort must be made to keep odors generated by the work from entering the building.

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

Shut off and wrap all air intakes in the vicinity of the work.

Ensure that all operable windows in the vicinity of the work area are closed.

Equip each kettle with a fume recovery system. An after burner type system is not acceptable.

* + - 1. WARRANTY

Include Section 007306 “Supplementary Conditions” - Warranty Extension.

* + - * 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.

Retain "Special Warranty" paragraph below if manufacturer's labor-and-materials warranty, covering roofing system, is required. Verify extent of coverage offered by manufacturers, because roof insulation, fasteners, and other roofing components may be excluded unless part of a roof membrane manufacturer's roofing system warranty. If inserting special provisions, retitle paragraph "Special Roofing Manufacturer's Warranty." Verify warranty availability, and coordinate selection of manufacturers accordingly.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

Special warranty for the Work of this Section. The warranty shall include but not be limited to, repair of leakage caused by defects in materials or workmanship. The monetary value of the warranty shall be at least equal to the original cost of the installation.

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, bitumen, membrane flashings, and other accessory items provided by the membrane manufacturer.

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.

Verify available roofing warranties and warranty periods with manufacturers.

Warranty Period: 10 years from date of Substantial Completion.

1. PRODUCTS
	* + 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.

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): as indicated on the Drawings.

Zone 2 (Roof Area Perimeter): as indicated on the Drawings.

Zone 3 (Roof Area Corners): as indicated on the Drawings.

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. Use 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 aggregate surfacing or coating material specified complies before retaining.

* + - * 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 Global or UL, or to comply with provisions of manufacturer's special warranty. Consult manufacturer's literature, because requirements vary.

* + - * 1. Source Limitations: Obtain components for roofing system from same manufacturer as roofing membrane or manufacturer approved by roofing membrane manufacturer.
			1. ROOFING MEMBRANE SHEET MATERIALS

Retain one of four "Base Sheet" paragraphs below if required by manufacturer. Base sheets separate roofing plies from deck, support and cushion roofing plies from rough or irregular deck, and provide a strong first layer to the roofing membrane. On nailable roof decks, base sheets may also provide a base layer to adhere rigid insulation.

Retain first "Base Sheet" paragraph below for SBS-modified asphalt-coated, glass-fiber base sheet.

Type II, Low slope asphalt; use on slopes above 0 to 1/2 -inch per foot. Type III, Steep slope asphalt; use on slopes 1/2 -inch to 3-inches per foot.

* + - * 1. Base Sheet: ASTM D6163, **[Type II, ] [Type III, ]**SBS-modified asphalt-impregnated and -coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides.

Type VI ply sheet, Special Steep Slope, use on slopes 3 to 6-inches per foot.

* + - * 1. Ply Sheet: ASTM D2178, Type IV, asphalt-impregnated, glass-fiber felt.

Retain "Cap Sheet" paragraph below if using traditional granule-surfaced asphaltic cap sheet. Cap sheets add another ply to roofing membrane ply count and are used in place of roof coatings or flood coating and aggregate surfacing.

* + - * 1. Cap Sheet: ASTM D3909, asphalt-impregnated and -coated, glass-fiber cap sheet, with white coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface.
			1. BASE FLASHING SHEET MATERIALS
				1. Backer Sheet: ASTM D4601, Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

Retain "Granule-Surfaced Flashing Sheet" or "Metal-Foil-Surfaced Flashing Sheet" paragraph below for SBS-modified asphalt flashing sheet.

* + - * 1. Granule-Surfaced Flashing Sheet: ASTM D6164, Type I or II, Grade G, polyester reinforced or ASTM D6162, Type I or II, Grade G, composite polyester reinforced and glass-fiber reinforced, granule-surfaced; suitable for application method specified, and as follows:

Granule Color: **[White] [Gray] [Tan] <Insert color>**.

Metal-foil-surfaced flashing sheet is produced by several manufacturers for torch and, in some cases, hot-mopped application.

* + - * 1. Metal-Foil-Surfaced Flashing Sheet: ASTM D6298, glass-fiber-reinforced, SBS-modified, metal-foil-surfaced asphalt sheet, suitable for application method specified, and as follows:

Foil Surfacing: Aluminum.

* + - * 1. 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.
			1. ASPHALT MATERIALS

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

* + - * 1. Asphalt Primer: ASTM D41.

Retain one of three options in first "Roofing Asphalt" paragraph below for traditional roofing asphalt. See roofing manufacturer's written instructions for requirements. "Steep" asphalt (Type III) and "extra steep" asphalt (Type IV) predominate.

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

Retain "Roofing Asphalt" paragraph below for SEBS-modified roofing asphalt.

* + - * 1. Roofing Asphalt: ASTM D6152, SEBS modified.
			1. AUXILIARY ROOFING MATERIALS
				1. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with other roofing components.

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

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

* + - * 1. 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.

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 roof decks or if not required by manufacturer's specifications.

* + - * 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 one of two "Cold-Applied Asphalt Adhesive" paragraphs below if adhering substrate board, roof insulation, cover board, base sheets, ply sheets, or base flashings in 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 D4479, Type I or Type II, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.

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 manufacturer.

* + - * 1. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required by roofing 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 built-up roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing manufacturer.

Retain "Aggregate Surfacing" paragraph below if required.

* + - * 1. Aggregate Surfacing: ASTM D1863, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges.
				2. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.
			1. SUBSTRATE BOARDS

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 fire-resistance-rated roofing 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.

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

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

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

Georgia-Pacific Gypsum LLC; Dens Deck.

USG Corporation; Securock Glass Mat Roof Board.

Approved equivalent.

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

Retain paragraph for use over existing gypsum deck, Wood Deck, or Structural Wood Fiber Deck.

* + - * 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 paragraph below if rubberized asphalt adhesive is required. Use over concrete deck, or existing vapor retarder.

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

Retain "Glass-Fiber Felts" paragraph below if a built-up vapor retarder composed of felts and hot asphalt is required. Use on all new and existing decking types.

* + - * 1. Glass-Fiber Felts: 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 roof 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: 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 compatible 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 board]** to substrate and acceptable to roofing 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.

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

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

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

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 built-up roofing on sloping roof decks. Revise 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. Gypsum-based cover boards are not recommended when cover board temperatures are expected to reach 130 deg F (59.4 deg C) and above.

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

[Products:](http://www.specagent.com/Lookup?ulid=5003) Subject to compliance with requirements, provide one of the following:

[Georgia-Pacific Gypsum LLC](http://www.specagent.com/Lookup?uid=123457146316); Dens Deck Prime.

[USG Corporation](http://www.specagent.com/Lookup?uid=123457146320); Securock Glass Mat Roof Board.

Approved equivalent.

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

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

* + - * 1. Joint Tape: 6- or 8-inch-wide, coated, glass fiber.
			1. COATING MATERIALS

Retain this article if roof coatings are required over built-up roofing or base flashing. Coatings protect against ultraviolet exposure and degradation and may be required to achieve fire rating or "cool-roof" rating. Recoating may be required at five- to seven-year intervals, depending on severity of exposure.

Asphalt-emulsion coatings in first two "Roof Coating" paragraphs below may be finish coatings or may be a base coat for an aluminum-pigmented finish coating. ASTM D1227 applies to asphalt emulsions for use as protective coatings over roofing with minimum roof slope of 1/2 inch per 12 inches (1:24). Revise description to SBS- or SEBS-modified asphalt emulsions if required.

* + - * 1. Roof Coating: ASTM D1227, Type II, **[Class 1, mineral-colloid-emulsified, fibered] [Class 2, chemically emulsified, filled or fibered]** asphalt emulsion, asbestos free.

Retain first option in "Color" subparagraph below if "cool roof" is required.

Color: **[White] [Gray] [Buff]**.

* + - 1. WALKWAYS
				1. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition, slip-resisting pads, manufactured as a traffic pad for foot traffic and acceptable to roofing manufacturer, 3/4 inch thick, minimum.

Pad Size: Approximately 36 by 60 inches.

Color: Contrasting with cap sheet.

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

W.R. Meadows; Whitewalk.

Humane Manufacturing Co.; Roof-Gard Pads.

Approved equivalent.

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

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

Verify that wood 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 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. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. VERIFICATIONS OF CONDITIONS
				1. Testing Existing Roof Drains and Conductor Pipes: Before commencing with the Work, water test existing drains and conductor pipes, 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. PREPARATION
				1. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing 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.

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

* + - * 1. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

Submit test result within 24 hours of performing tests.

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 installed in this Section.

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

Use next two paragraphs below on rehabilitation projects.

* + - * 1. Ensure roof drain strainers are in place and secured during removal of insulation and other debris. Provide cast iron strainers where existing strainers are missing.
				2. Cleaning: Before the roofing installation commences, sweep and/or vacuum all surfaces as required to remove all dirt, dust, loose aggregate, foreign matter, and debris left from removals of existing roofing.
				3. Repair of Existing Vapor Retarder:

Remove all deteriorated (loose, wet, blistered, torn) portions of the existing vapor retarder so that only sound, firmly bonded felts remain.

Repair defective areas with 2 plies of asphalt fiberglass felt embedded in and coated with hot steep asphalt or interply adhesive. Lap the felts a minimum of 6 inches beyond the defect.

* + - 1. INSTALLATION OF ROOFING, GENERAL
				1. Install roofing system according to 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 in to existing roofing to maintain weathertightness of transition**[ and to not void warranty for existing roofing system]**.

Retain 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 under **[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, ply 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 manufacturers.

* + - * 1. Asphalt Heating:

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

Circulate asphalt during heating.

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

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.

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

Retain one of first two subparagraphs below if mechanical fastening of substrate board to steel roof deck is required. Substrate board is usually attached when base layer of roof insulation, which overlays substrate board, is attached. See third subparagraph below.

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 manufacturer's 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 article "Air Barrier Installation" 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.

Retain first paragraph below if mechanically fastening base sheet to substrate before adhering first layer of insulation.

* + - * 1. Install one lapped base sheet course and mechanically fasten to substrate according to roofing membrane manufacturer's written instructions.

Roofing 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 greater 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 manufacturer's written instructions.

* + - * 1. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane with vertical surfaces or angle changes greater than 45 deg.
				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 the flow of water is not restricted.

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.

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

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

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

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

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

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

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

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

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

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

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

At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.

Trim insulation so that water flow of water 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.

Coordinate with "Performance Requirements" Article. Fastener numbers will increase at corners and perimeter over number required for field of roof.

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; 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 the flow of water is not restricted.

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 the flow of water is not restricted.

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 SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

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; 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 the flow of water is not restricted.

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 the flow of water is not restricted.

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 the cementitious wood-fiber roof deck of not less than 2 inches in thickness with either mechanical fasteners or cold adhesives. 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.

Coordinate with "Performance Requirements" Article. Fastener numbers will increase at corners and perimeter over number required for field of roof.

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; 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 polyisocyanurate board insulation.

Where installing insulation in two or more layers, install board insulation for bottom layer and intermediate layers, if applicable, and install 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 the flow of water is not restricted.

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 the flow of water is not restricted.

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 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.

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

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

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

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; 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 the flow of water is not restricted.

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 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 the flow of water is not restricted.

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 the flow of water is not restricted.

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

First option in subparagraph below applies only to concrete, lightweight insulating concrete, and steel roof decks. Section option applies to concrete, lightweight insulating concrete, cementitious wood fiber, steel, and wood roof decks. See the Evaluations.

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

Retain first subparagraph below for hot-asphalt application. Usually delete for sustainable projects. Verify with applicable 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 BUILT-UP ROOFING MEMBRANE
				1. Install roofing according to roofing manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing" and as follows:

Retain "Base Sheet" subparagraph below if required. NRCA recommends a base sheet, except for those assemblies over cover board or over a second layer of insulation.

Base Sheet: **[One] [One, installed over sheathing paper]**.

Number of Ply Sheets: Four.

Surfacing: **[Aggregate] [Asphalt surfacing or coating] [Mineral-granule-surfaced cap sheet]**.

Retain subparagraph below if required.

Mineral-granule-surfaced cap sheet is in addition to number of ply sheets specified.

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

* + - * 1. Coordinate installation of roofing, so insulation and other components of 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 membrane 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.

Retain first paragraph below if sheathing paper is required over wood decks by roofing system manufacturer. 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.
				2. Install lapped base sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:

Retain appropriate installation method in subparagraphs below. Usually retain first for nailable substrate and third for nonnailable or insulated substrates. Mechanically fasten or spot or strip mop vented base sheets, because they vent laterally.

Mechanically fasten to substrate.

Spot or strip mop to substrate with hot roofing asphalt.

Adhere to substrate **[in a solid mopping of hot roofing asphalt] [using cold-applied asphalt adhesive] [using cold-applied polymer-modified asphalt adhesive]**.

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

* + - * 1. Install fourply sheets, starting at low point of roof.

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.

Retain one of three subparagraphs below.

Embed each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

Embed each ply sheet in cold-applied asphalt adhesive applied at a rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

Embed each ply in cold-applied polymer-modified asphalt adhesive applied at a rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

Install ply sheets without wrinkles, tears, and free from air pockets.

Retain "Cap Sheet" paragraph below if surfacing roofing membrane with mineral-granule-surfaced cap sheet. Cap sheet usually counts as an additional ply in built-up roofing membrane ply count.

* + - * 1. Cap Sheet: Install lapped granulated cap sheet, starting at low point of roofing.

Offset laps from laps of preceding ply sheets, and align cap sheet without stretching.

Lap in direction to shed water.

Extend cap sheet over and terminate above cants.

Retain one of three subparagraphs below.

Embed cap sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing system manufacturer.

Embed each ply sheet in cold-applied asphalt adhesive applied at a rate required by roofing system manufacturer.

Embed each ply in cold-applied polymer-modified asphalt adhesive applied at a rate required by roofing system manufacturer.

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

Retain one of two "Aggregate Surfacing" paragraphs below if surfacing roofing with aggregate.

* + - * 1. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with 60 lb/100 sq. ft. of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

Aggregate weight in first option in "Aggregate Weight" subparagraph below is for gravel or crushed stone; second is for slag. Coordinate with aggregate selected.

Aggregate Weight: **[400 lb/100 sq. ft.] [300 lb/100 sq. ft.]**.

An interim glaze coat may be permitted if flood coating for aggregate surfacing is delayed.

If aggregate surfacing is delayed, promptly apply glaze coat of hot roofing asphalt at a rate of 10 lb/100 sq. ft..

* + - * 1. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with cold-applied polymer-modified asphalt adhesive at a rate recommended by roof system manufacturer. Cast the following average weight of aggregate in a uniform course:

Aggregate weight in first option in "Aggregate Weight" subparagraph below is for gravel or crushed stone; second is for slag. Coordinate with aggregate selected.

Aggregate Weight: **[400 lb/100 sq. ft.] [300 lb/100 sq. ft.]**.

An interim glaze coat may be permitted if flood coating for aggregate surfacing is delayed.

* + - * 1. If aggregate surfacing is delayed, promptly apply glaze coat of cold-applied polymer-modified asphalt adhesive at a rate recommended by roof system manufacturer.

Retain paragraph below if surfacing smooth roofing with a roof coating.

* + - * 1. Glaze coat roofing surface with hot roofing asphalt applied at a rate of 10 to 15 lb/100 sq. ft..
			1. INSTALLATION OF FLASHING AND STRIPPING
				1. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; 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; retain 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] [cold-applied polymer-modified asphalt adhesive]**.

Backer Sheet Application: Adhere backer sheet to substrate in **[a solid mopping of hot roofing asphalt] [cold-applied adhesive] [cold-applied polymer-modified asphalt adhesive]**.

Retain one of five "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 not less than 425 deg F. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing manufacturer.

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

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

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

Flashing Sheet Application: Torch apply flashing sheet to substrate.

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) and a maximum of 24 inches.

* + - * 1. Extend base flashing up walls or parapets a minimum of 8 inches above built-up roofing 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 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.

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

Retain one of three subparagraphs below.

Flashing Sheet Stripping: Install flashing sheet stripping in a continuous coating of asphalt roofing cement, in a solid mopping of hot roofing asphalt applied at not less than 425 deg F, and extend onto roofing membrane, in cold-applied adhesive, or in cold-applied polymer-modified adhesive.

Flashing Sheet Stripping: Install flashing sheet stripping by heat welding and extend onto roofing membrane.

Built-Up Stripping: Install stripping of not fewer than two roofing ply sheets, setting each ply in a continuous coating of asphalt roofing cement, in a solid mopping of hot roofing asphalt, in cold-applied adhesive, or in cold-applied polymer-modified adhesive, and extend onto roofing membrane 4 inches and 6 inches, respectively.

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 metal 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 manufacturer's written instructions.

* + - 1. INSTALLATION OF COATINGS

Retain this article if roof coating is required. Retain last option in paragraph below if coating is required to comply with CCR Title 24.

* + - * 1. Apply coating to **[roofing membrane] [and] [base flashings]** according to manufacturer's written instructions, by spray, roller, or other suitable application method**[, to provide a dry film thickness of not less than 20 mils].**
			1. INSTALLATION OF WALKWAYS

Retain "Walkway Pads," "Walkway Cap Sheet Strips," or "Roof-Paver Walkways" paragraph below if walkways are required.

* + - * 1. Walkway Pads: Install walkway pads, using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

Install walkways at following locations:

Retain one or more of 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-inchclearance between adjoining pads.

Retain subparagraph below if applicable.

Set walkway pads **[in additional pour coat of hot roofing asphalt] [in cold-applied adhesive] [in cold-applied polymer-modified adhesive]** after sweeping away loose aggregate surfacing.

Retain "Walkway Cap Sheet Strips" paragraph below for walkway cap sheet strips; install strips before flood coating and aggregate surfacing the roofing membrane if required.

* + - * 1. Walkway Cap Sheet Strips: Install walkway cap sheet strips, approximately 36 inches wide and in lengths not exceeding 10 feet, 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 following locations:

Retain one or more of following subparagraphs. Edit 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 this article if field inspecting and testing are required. Revise to suit local practices and requirements of authorities having jurisdiction if applicable. Quality-control inspections by roofing Contractor are already mandated in "General Installation Requirements" Article in ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."

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:

Retain one or more of "Flood Testing," "Infrared Thermography," "Electrical Capacitance/Impedance Testing," "Nuclear Hydrogen Detection Testing," Low-Voltage Electrical Conductance Testing," and "High-Voltage Spark Testing" subparagraphs below.

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

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

Perform tests before overlying construction is placed.

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

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

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

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

Cost of retesting is the responsibility of the Contractor.

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

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

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

Perform tests before overlying construction is placed.

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

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

Cost of retesting is Contractor's responsibility.

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

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

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

Perform tests before overlying construction is placed.

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

Cost of retesting is Contractor's responsibility.

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

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

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

Perform tests before overlying construction is placed.

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

Cost of retesting is Contractor's responsibility.

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

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

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

Perform tests before overlying construction is placed.

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

Cost of retesting is Contractor's responsibility.

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

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

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

Perform tests before overlying construction is placed.

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

Cost of retesting is Contractor's responsibility.

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

"Test Cuts" paragraph below is based on Appendixes 2 and 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing." ARMA/NRCA recommends continuous visual examination of roofing installation. Test cuts are intended to evaluate problems observed during quality-assurance inspections.

* + - * 1. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing system as follows:

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

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

Repair areas where test cuts were made according to roofing 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 and 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 compliance of replaced or additional work 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 and Director’s Representative.

* + - * 1. Correct deficiencies in or remove roofing components that do not comply with requirements, repair substrates, and repair or reinstall roofing to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

Retain paragraph below if coating roofing 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 075113