

SECTION 07 5216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in bold.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the Uniform General Conditions for Construction Contracts, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's Supplemental General Conditions and Special Conditions for Construction.

1.2 SUMMARY

- A. Section Includes:
 - 1. Surface preparation, supply, and installation of granule surfaced, styrene-butadiene-styrene (SBS) modified-bitumen 2-ply membrane roofing system with [**self-adhered**] [**cold applied**] [**heat welded**] base sheets and [**cold applied**] [**heat welded**] cap sheets over Non-Nailable Substrate, including:
 - a. Roof deck boards
 - b. Temporary roof/ vapor retarder
 - c. Roof insulation
 - d. Cover boards

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.
- B. Roofing Systems Manufacturer: Any of the manufacturers whose systems are specified under "Acceptable Roofing System Manufacturers", and herein called "manufacturer."

1.4 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)/Single Ply Roofing Industry (SPRI):

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1. ANSI/SPRI FX-1: Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.
- B. American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI):
 1. ASCE/SEI 7: Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
 1. C36/C36M: Standard Specification for Gypsum Wallboard (withdrawn).
 2. C67: Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 3. C140: Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 4. C208: Standard Specification for Cellulosic Fiber Insulating Board.
 5. C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 6. C726: Standard Specification for Mineral Wood Roof Insulation Board.
 7. C728: Standard Specification for Perlite Thermal Insulation Board.
 8. C1177/C1177M: Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 9. C1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 10. D41/D41M: Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 11. D312: Standard Specification for Asphalt Used in Roofing.
 12. D1668: Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.
 13. D2178: Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
 14. D3617: Standard Practice for Sampling and Analysis of Built-up Roof Systems during Application.
 15. D4263: Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 16. D4586: Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 17. D4601: Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
 18. D4897/D4897M: Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing.
 19. E108: Standard Test Methods for Fire Tests of Roof Coverings.
- D. FM Global:
 1. Class Number 4450: Approval Standard for Class 1 Insulated Steel Deck Roofs.
 2. Class Number 4470: Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.
 3. [Approval Guide](#) (online resource).
- E. National Roofing Contractors Association (NRCA)/ Asphalt Roofing Manufacturers Association (ARMA):

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1. Quality Control Guidelines for Application of Polymer Modified Bitumen Roofing (Quality Control Guidelines).

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. FM Approvals Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system. Roofing system must meet the design intent and wind uplift capabilities associated with the uplift rating requirements listed in this specification and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
 1. Fire/Windstorm Classification: ASTM E108, Class 1A-[60] [75] [90] [105] [120] for application and roof slopes indicated, based on testing by Underwriters Laboratory.
 2. Hail Resistance Rating: SH.
 3. Roofing-system Design: Provide roofing system that is identical to systems that have been successfully tested by qualified testing agency to resist uplift pressure calculated according to SEI/ASCE 7.
 - a. Field-of-Roof Uplift Pressure: <Insert number> pounds per square foot.
 - b. Perimeter Uplift Pressure: <Insert number> pounds per square foot.
 - c. Corner Uplift Pressure: <Insert number> pounds per square foot.
- D. Energy Performance: Provide a minimum Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 Btu/h·ft² ·°F, based on three-year-aged solar reflectance and three-year-aged thermal emittance tested in accordance with CRRC-1 Standard. Provide roofing membrane to meet applicable local Building Department requirements and minimum three-year aged solar reflectance not less than 0.55 and three-year-aged thermal emittance not less than 0.75 when tested in accordance with CRRC-1 Standard.
- E. Insulation R-Value: Minimum R-25 Long Term Thermal Resistance (LTTR) as determined in accordance with CAN/ULC-S770.
- F. Roof Assembly must meet the current version of ASHRAE 90.1.
- G. Roof assembly shall be designed in accordance with the 2015 Houston Commercial Energy Conservation Code with local Amendments, including the City of Houston Roof Repair and Cool Roof Guidelines.

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1.6 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate Work to ensure that new insulation and roofing materials and building interior are kept continuously dry; that continuous, watertight, new roofing system is provided; and that adjacent areas are not adversely affected. Coordinate:
1. With Owner's Representative.
 2. With other trades:
 - a. To ensure that work done by other trades is complete and ready for roofing Work.
 - b. To avoid or minimize work on, or in immediate vicinity of, roofing Work in progress and completed new roofing.
 - c. To ensure that subsequent work will not adversely affect completed roofing.
- B. Pre-installation Roofing Conference: Conduct conference at Project site. Contractor's site foreman, roofing-system manufacturer's technical representative, Roofing Installer, Owner's Representative, Architect/Engineer shall attend.
1. Site use, access, staging, and set-up location limitations.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions. Including, but not limited to, the following: forecast weather conditions, storage and protection of materials prior to installation, surface preparation and pretreatment, environmental conditions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system and surrounding work during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
 10. Reporting procedures.
 11. Related project details and interfaces with adjacent work.
 12. Testing and inspection requirements.
 13. Notification procedures for inspections.
 14. Documentation of modifications and repairs for project record.
 15. Documentation required for manufacturer's warranty.
 16. Governing regulations and requirements for insurance and certificates if applicable.
 17. Quality control and quality assurance plans.
- C. Contractor's Site superintendent, roofing-system manufacturer's technical representative, roofing Installer's foreman, Owner's Representative, Architect/Engineer, and testing agency representative shall attend

1.7 ACTION SUBMITTALS

- A. Product Data: Roofing-system manufacturer's literature, including written instructions for evaluating, preparing, and treating substrate; technical data including tested physical and performance properties; and application instructions
 - 1. For membrane and base flashing materials, and roofing cement, asphalt, primer, mastic sealant, and fasteners.
 - 2. Include temperature ranges for storage and application of materials, and special cold weather application requirements or limitations.
 - 3. Include Safety Data Sheets (SDS) for information only; safety restrictions are sole responsibility of Contractor.
- B. LEED Action Submittals (Projects authorized for LEED certification only):
 - 1. Building Product Disclosure and Optimization - Sourcing of Raw Materials:
 - a. Leadership Extraction Practices
 - 1) Extended Producer Responsibility (EPR): Submit documentation indicating that manufacturers have a take back or recycling program for the product purchased.
 - 2) Recycled Content: For products having recycled content, indicate percentages by weight of post-consumer and pre-consumer recycled content.
 - a) Include statement indicating costs for each product having recycled content.
 - b. Sourcing of Raw Materials: For products that are required to comply with requirements for regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 1) Include statement indicating distance to Project, cost for each regional material and the fraction by weight that is considered regional.
 - 2) Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
 - 2. Laboratory Test Reports: For installation adhesives indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work. Include manufacturer's reviewed and approved details that are project specific. Manufacturer's generic details or replication of Architectural drawings will not be accepted.
 - 1. Base flashings and membrane terminations. Draw to scale.
 - 2. Tapered insulation layout including, crickets, saddles, and tapered edge strips, including amount, direction of slopes, and dimensions.
 - 3. Dimensions and locations of all field, perimeter, and corners roof areas.

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4. Insulation fastening patterns for field, perimeter, and corners roof areas.
5. Membrane fastening (back-nailing) pattern for roof slopes in excess of 1/2 inch per foot.
6. Walkway pad plan and details.
7. Proposed temporary, watertight, tie-off details for each substrate type.
8. Interfacing details with sheet metal components, including but not limited to:
 - a. Counterflashing.
 - b. Stack flashing assemblies.
 - c. Edge and fascia sections.
 - d. Interface with coping cap assemblies.
9. Interfacing details with roofing accessories including but not limited to:
 - a. Equipment curbs.
 - b. Roof hatches.
 - c. Expansion joints assemblies.
 - d. Penetrations.
 - e. Crickets, saddles, and tapered edge strips, including slopes.

D. Samples for Verification for the Following Products:

1. Sheet roofing materials, including base sheet and membrane cap sheet, of color specified.
2. Flashing base sheet and cap sheet.
3. Roof insulation.
4. Insulation cover board.
5. Walkway pads or rolls.
6. Six insulation fasteners of each type, length, and finish.

E. Installer Certificate and Qualifications:

1. Signed by roofing-system manufacturer, certifying that Roofing Installer complies with manufacturer's requirements to install specified, warranted, roofing system.
2. Submit evidence that Installer's existing company has minimum of five years continuous experience in application of specified materials. Submit list of at least five representative, successfully-completed projects of similar scope and size, including:
 - a. Project name.
 - b. Owner's name.
 - c. Owner's Representative name, address, and telephone number.
 - d. Description of work.
 - e. SBS-modified-bitumen materials used.
 - f. Project supervisor.
 - g. Total cost of roofing work and total cost of project.
 - h. Completion date.

F. Manufacturer Certificate: Signed by roofing-system manufacturer, certifying that roofing system complies with specified requirements.

1. Roof assembly letter.

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2. Written approval by membrane manufacturer for use and performance of membrane over specified board insulation, including that materials supplied for project comply with requirements of cited ASTM standards. Approval should also indicate materials are suitable for ASTM E108, Class 1A roof and meet specified wind uplift classification.
3. Evidence of roofing system meeting performance requirements including applicable FMG assembly number.
4. Include all methods of attachment and attachment spacing for insulation and membrane system.
5. Certification that materials are free of asbestos.

1.8 INFORMATIONAL SUBMITTALS

A. LEED Informational Submittals:

1. Building Product Disclosure and Optimization - Sourcing of Raw Materials:
 - a. Raw Material Sources and Extraction Reporting: Submit Raw materials supplier corporate Sustainability Reports (CSRs); documenting responsible extraction; including extraction locations, long term ecologically responsible land use, commitment to reducing environmental harms from extraction and manufacturing processes, and a commitment to meeting applicable standards or programs that address responsible sourcing criteria.
 - 1) Submit manufacturers' self-declared reports.
 - 2) Submit third party verified corporate sustainability reports (CSR) using one of the following frameworks:
 - a) Global Reporting Initiative (GRI) Sustainability Report.
 - b) Organization for Economic Co-operation and Development (OECD).
 - c) Guidelines for Multinational Enterprises.
 - d) UN Global Compact.
 - e) ISO 26000.
 - f) USGBC approved program.
2. Building Product Disclosure and Optimization - Material Ingredients
 - a. Material Ingredient Optimization: Submit manufacturer's Environmental Product Declaration (EPD) OR at least one of the following:
 - 1) GreenScreen V1.2 Benchmark: Third party report prepared by a licensed GreenScreen List Translator, or a full GreenScreen Assessment.
 - 2) Cradle to Cradle: Manufacturer's published literature for the product bearing the Cradle to Cradle logo.
 - 3) International Alternative Compliance Path - REACH Optimization.
 - 4) Declare: Manufacturer's completed Product Declaration Form.
 - 5) Other programs approved by USGBC.
 - b. Product Manufacturer Supply Chain Optimization: Submit documentation from manufacturers for products that go beyond material ingredient optimization as follows:

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- 1) Are sourced from product manufacturers who engage in validated and robust safety, health, hazard, and risk programs which at a minimum document at least 99 percent (by weight) of the ingredients used to make the building product or building material, and
 - 2) Are sourced from product manufacturers with independent third party verification of their supply chain that at a minimum verifies:
 - a) Processes are in place to communicate and transparently prioritize chemical ingredients along the supply chain according to available hazard, exposure and use information to identify those that require more detailed evaluation.
 - b) Processes are in place to identify, document, and communicate information on health, safety and environmental characteristics of chemical ingredients.
 - c) Processes are in place to implement measures to manage the health, safety and environmental hazard and risk of chemical ingredients.
 - d) Processes are in place to optimize health, safety and environmental impacts when designing and improving chemical ingredients.
 - e) Processes are in place to communicate, receive and evaluate chemical ingredient safety and stewardship information along the supply chain.
 - f) Safety and stewardship information about the chemical ingredients is publicly available from all points along the supply chain
- B. Sample Warranty: Copy of roofing-system manufacturer's warranty, stating obligations, remedies, limitations, and exclusions. Submitted with bid.
- C. Maintenance Data: For roofing system to include in maintenance manuals.
- D. Prior to installation of the roof system, provide a written report with fastener withdrawal values (pull out tests) per ANSI SPRI FX-1 on all projects to verify the suitability of decking to accept a mechanically fastened insulation and/or membrane roofing system.
- E. Following completion of the Work:
1. Roofing-system manufacturer's inspection report of completed roofing installation.
 2. Completed warranty from roofing-system manufacturer.
 3. Completed warranty from Installer.
 4. Maintenance program recommended for roofing system.

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project with a minimum of ten years of documented experience.
- B. Installer Qualifications: Experienced firm that has successfully completed roofing work similar in material, design, and extent to that indicated for Project; that is approved, authorized, or

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licensed by roofing-system manufacturer to install roofing-system products; and that is eligible to receive roofing-system warranty. Must have successful installations of specified materials in local area in use for minimum of five years.

1. Employ foreman with minimum five years of experience as foreman on similar projects, who is fluent in English, to be on Site at all times during Work. Do not change foremen during the course of the Project except for reasons beyond the control of the Installer; inform Architect/Engineer in advance of any changes.
- C. Source Limitations: Obtain components including **[roof insulation] [fasteners] <Insert products>** for membrane roofing system **[from same manufacturer as membrane roofing] [or] [approved by membrane roofing manufacturer]**.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Testing: At Owners cost, Owner reserves the right to perform wind uplift testing of installed roof system per FM 1-52. Locations and quantities to be determined by Architect/Engineer. Independent testing agency with experience and capability to conduct testing indicated, as documented according to ASTM E548.
- G. Pre-Installation Testing: Provide fastener withdrawal testing at metal deck and lightweight insulating concrete deck areas per the latest version of ANSI/SPRI FX-1 testing procedures to verify fastener withdrawal resistance and identify fastener quantity and spacing.
- H. Environmental Considerations:
 1. The Contractor shall ensure through training and proper supervision that the fume protection device is used correctly and maintained in good working order throughout the job. Doors, vents, and exhausts shall be kept closed to prevent smoke and fume escape. Operators failing to use the devices properly shall be dismissed from the job and replaced by a worker satisfactory to the Engineer.
 2. Air Intake: The Contractor shall coordinate with the Roof Engineer and Owner to create a schedule for all rooftop air handler intake protection during the project.
 3. Rooftop Air Intakes: The Owner will close or otherwise adjust rooftop air intakes for minimum attraction of roofing material fumes from rooftop work.
 4. Vent Covers: Contractor shall furnish plastic, charcoal, or other suitable covers for air intake vents and shall install and remove such covers where requested to do so by the Owner.
- I. Open Flame or Torch Operator Certification:

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1. All personnel or operators of open flame torches must be certified by the local municipality fire department through an approved training course or the Midwest Roofing Contractors Association CERTA Program.
2. The Contractor must submit the torch applicator certifications with the submittals for the Project. No workers may use open flame torches without approved certifications submitted in advance.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials according to manufacturer's recommendations and in such a manner as to prevent damage to materials or structure. Limit stored materials on structures to safe loading capacity of structure at time materials are stored, and to avoid permanent deflection of deck.
- B. 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.
- C. Keep materials dry and do not allow materials to be exposed to moisture during transportation, storage, handling, or installation. Store materials in original, undamaged containers in clean, dry, protected location on raised platforms with weather-protective coverings, within temperature range required by manufacturer. Protect stored materials from direct sunlight. Use canvas tarps for protection of moisture-sensitive roofing materials. If plastic coverings are used, venting of each package is required. Roofing-system manufacturer's standard packaging and covering is not considered adequate weather protection. Reject and remove from Site new materials that exhibit evidence of moisture during application or that have been exposed to moisture. Store materials in original, undamaged containers in clean, dry, protected location on raised platforms with weather-protective coverings, within temperature range required by manufacturer.
- D. Material storage procedures will be constantly monitored and strictly enforced.
- E. Select and operate material handling equipment in a safe manner, guarding against damage to existing construction or newly applied roofing and conforming to manufacturer's recommendations of handling and storage.
- F. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- G. 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. Manufacturer's packaging is not considered adequate protection from moisture.

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- H. Handle and store materials and equipment on structures to safe loading of structure at time and to avoid permanent deflection of deck. Conspicuously mark wet or damaged materials and promptly remove from Site. Materials, having been determined by the Owner/Owner's representative to be damaged, shall be immediately removed from the construction site and replaced at no cost to the Owner.
- I. Store rolled materials on ends only, unless otherwise required by roofing-system manufacturer's written instructions. Discard rolls that have been flattened, creased, or otherwise damaged.
- J. Do not store materials at locations where new roofing materials have been installed.
- K. Remove and replace materials that cannot be applied within stated shelf life.
- L. Store flammable materials in a cool, dry area away from sparks and open flames. Follow all precautions as outlined in manufacturer's Safety Data Sheets.

1.11 PROJECT CONDITIONS

- A. Safety:
 - 1. Take all necessary precautions regarding worker health and safety when using solvents, adhesives and hot asphalt.
 - 2. Store flammable liquid and materials away from open sparks, flames and extreme heat.
 - 3. Take necessary precautions when using solvents and adhesives near fresh air intakes.
 - 4. Comply with all OSHA requirements for construction.
- B. Daily site cleanup shall be performed to minimize debris and hazardous congestion.
- C. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions e.g. extreme temperature, high winds, high humidity and moisture, permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- D. Environmental Limitations: Install roofing when existing and forecast weather conditions permit roofing system to be installed according to roofing-system manufacturer's written instructions and warranty requirements.
 - 1. Apply roofing when substrate temperature is falling, and when substrate and ambient temperatures are within range recommended by roofing-system manufacturer.
 - 2. Do not proceed with installation during inclement weather except for temporary work necessary to protect building interior and installed materials. Remove temporary work and Work that becomes moisture damaged.
- E. Verify existing dimensions and details prior to installation of materials. Notify Architect/Engineer of conditions found to be different than those indicated in Contract Documents. Architect/Engineer will review situation and inform Contractor and Installer of changes.

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- F. Protect existing roofing from damage from construction activities. Repair damage to existing roofing from construction activities that result in leakage.
- G. Ensure that drains are operational at the end of each workday or if precipitation is forecast.
- H. Comply with Owner's limitations and restrictions for site use and accessibility.
- I. Install materials in strict accordance with safety requirements required by roofing manufacturer, Safety Data Sheets, and local, state, and federal rules and regulations.
- J. Protection:
 - 1. Schedule installation sequence to limit access and utilization of the newly installed membrane for material storage, construction staging, mechanical and/or excessive foot traffic.
 - 2. Protect roofing membrane, building surfaces, paving, and landscaping from traffic and roofing equipment. Provide temporary walkways constructed of plywood and set on protective material in traffic and construction areas.
 - 3. Restore or replace all work or materials damaged by the roofing operation.
 - 4. Remove protection materials upon completion of work.
 - 5. Adverse weather could have a detrimental effect on adhesives, general production efforts or the quality of the finished installation. Contact manufacturer for recommendations and acceptable tolerances.
- K. Daily seal: Ensure that moisture does not penetrate beneath any completed sections of the roof by sealing temporary roof terminations at the end of each work day and prior to the arrival of inclement weather. Inspect existing components for moisture intrusion along the temporary terminations at temporary cut-offs, tie-ins, and night seals after opening the seal on the next workday. Remove any wet, damp or moisture-damaged materials.
- L. All construction debris shall be removed from the construction site and legally disposed of offsite.
- M. Handle and install materials in strict accordance with safety requirements required by roofing-system manufacturer; Safety Data Sheets (SDS); and local, state, and federal rules and regulations. Maintain Safety Data Sheets (SDS) with materials in storage area and available for ready reference at Site. Handle and install materials in strict accordance with safety requirements required by roofing-system manufacturer; Safety Data Sheets (SDS); and local, state, and federal rules and regulations. Maintain Safety Data Sheets (SDS) with materials in storage area and available for ready reference at Site.
- N. Maintain adequate ventilation during preparation and application of roofing materials.

1.12 CHANGES IN THE WORK

- A. During rehabilitation work, existing conditions may be encountered which are not known or are at variance with the Contract Documents. Such conditions may interfere with the Work

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and may consist of damage or deterioration of the substrate or surrounding materials that could jeopardize the integrity or performance of the Work.

1. Notify Architect of conditions that may interfere with the proper execution of the Work or jeopardize the performance of the Work prior to proceeding with the Work.

1.13 WARRANTY

- A. Special No-dollar-limit (NDL) Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 1. Special warranty includes membrane roofing, base flashings, fasteners, stacks, drains, wall flashings, metal flashings and other components of membrane roofing system. Warranty shall cover wind speeds up to 74 MPH.
 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Installer's Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Maintenance: Along with the issuance of the warranty, a set of instructions shall be included detailing preventative maintenance and noting a list of harmful substances that may damage the roofing membrane.
 1. Conspicuously mount laminated or otherwise protected roof assembly letter and warranty at roof hatch upon completion of the Project.

1.14 COORDINATION

- A. Prior to installation of materials, a pre-roofing conference shall be held with the roofing contractor and Owner/Owner's representative(s) to discuss the specified roofing system and coordinate its proper application and the expectations of all parties involved. The authorized roofing contractor and the Owner/Owner's representative shall notify all parties a minimum of fourteen days prior to the meeting.
- B. Plan and coordinate the installation of the roofing system with other trades in such a manner to avoid membrane damage, keeping the complete installation weather tight and in accordance with all approved details and warranty requirements.
 1. Install roof drains, perimeter walls, and plumbing/ mechanical equipment at proper elevations above deck prior to roofing in order to accommodate minimum insulation thickness and base flashing height requirements.

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- C. Manufacturer shall be available to make recommendations necessary to ensure compliance with project specifications and specification alternatives due to unforeseen job conditions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All products and components for the roofing system shall be supplied by the roofing system manufacturer.
 - 1. Roofing-system manufacturer shall have at least ten years documented experience and FM Global approval for roofing system identical to that specified for Project.
- B. Components other than those manufactured or supplied by the roofing system manufacturer shall be submitted for review, prior to ordering. Any product(s) not specifically authorized in writing for the project by the roofing system manufacturer, shall be considered unacceptable and their performance excluded from the warranty.
- C. Roofing membranes may be installed over or adhered directly to pre-approved insulation, cover board, decking or composites thereof. Contact manufacturer for additional information regarding compatible substrates.

2.2 SBS-MODIFIED ASPHALT-SHEET MATERIALS

- A. SBS-Modified Bituminous Membrane Roofing: Manufacturers: Subject to compliance with requirements, provide products by one of the following with composite reinforcing. No substitutions.
 - 1. Johns Manville:
 - a. Bottom Ply: DynaLastic 180 S.
 - b. Cap Sheet: DynaLastic 250 FR CR G; hot applied (HA), Bright White. Initial solar reflectance index (SRI) not less than 85 per E 1980.
 - 2. Siplast:
 - a. Bottom Ply: Paradiene 20 EG.
 - b. Cap Sheet: Paradiene 40 FR TG BW.
 - 3. Soprema:
 - a. Bottom Ply: Elastophene 180 Sanded.
 - b. Cap Sheet: Sopralene 250 FR GR SG.
 - 4. Granule color: White, to achieve initial solar reflectance index (SRI) not less than 85.
- B. Base Flashing Systems: Subject to compliance with requirements, provide products by one of the following, no substitutions:
 - 1. Johns Manville:

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- a. Backer Sheet: DynaLastic 180.
 - b. Flashing Sheet: DynaClad (aluminum-foil-surfaced), heat-welded
2. Siplast:
 - a. Backer Sheet: Paradiene 20 TG.
 - b. Flashing Sheet: Veral **[Aluminum]** **[Stainless Steel]**, heat-welded.
3. Soprema:
 - a. Backer Sheet: Elastophene 180 PS.
 - b. Flashing Sheet: Sopralast **[50 TV ALU]** **[TV Copper]**, heat-welded.
4. Flashing sheet to be coated with granules. Granule color to match color of roofing membrane granules.
5. Glass-Fiber Fabric: ASTM D1668, Type I, woven glass-fiber cloth treated with asphalt

2.3 TEMPORARY ROOF/VAPOR RETARDER

- A. ASTM D 6163 Type I, Grade S, and CSA A123.23-15 Type A, Grade 2 for SBS-modified bituminous sheet materials using glass fiber reinforcements.

2.4 PENETRATION FLASHING SYSTEMS

- A. Use same membranes as installed in field of roof.
- B. Liquid-applied Flashing Systems:
 1. PMMA-based, fully reinforced flashing system by the roofing manufacturer.

2.5 AUXILIARY ROOFING MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesive: 80 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. Non membrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.

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- B. Asphalt Primer: ASTM D41.
- C. Roofing Asphalt: ASTM D312, Type IV.
- D. Mastic Sealant: Polyisobutylene, plain or modified bitumen; non hardening, non-migrating, non-skinning, and non-drying.
- E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing-system manufacturer for application. Do not use unless specifically approved by roofing-system manufacturer. Do not use for sealing laps in membrane or base flashing, surface or stripping flashing at equipment penetrations and drains, or repairs to membrane or flashing.
- F. Low-rise Urethane Adhesive: Used to adhere insulation and cover board within the roof assembly, as acceptable to roofing system manufacturer.
- G. Fasteners: Factory-coated steel fasteners and metal plates complying with corrosion-resistance provisions in FM Global Class Number 4470, and acceptable to roofing system manufacturer.
 - 1. Designed for fastening roofing membrane components to substrate and tested by manufacturer for required pullout strength.
- H. Metal Flashing Sheet: As specified in Division 07 Section "Sheet Metal Flashing and Trim."
- I. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing membrane.
- J. Metal Powder: Provided by roofing-system manufacturer, to match foil-faced flashings.
- K. Termination Bar: Roofing-system manufacturer's standard; Type-304 stainless steel or aluminum bars, approximately 1-inch wide by 1/8-inch thick; with predrilled holes 8 inches on center.
- L. Lead flashing for Roof Drains: Not allowed. Use liquid-applied flashings at roof drains with manufacturer liquid-flashing drain details.
- M. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.6 ROOF INSULATION

- A. Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
- B. For insulation that will be placed using adhesive, board sizes shall not exceed 4 ft. by 4 ft. maximum. Largest appropriate sized insulation boards, but not exceeding 4 ft. by 4 ft. as

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appropriate, shall be installed where possible. Using multiple smaller sized sections of insulation where larger sections would be more appropriate shall not be allowed.

- C. Polyisocyanurate Flat Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces; 25-pounds-per-square-inch-minimum compressive strength in accordance with ASTM D1621; and meet flame spread requirements of ASTM E84.
- D. Polyisocyanurate Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated. Drainage crickets and saddles will have a minimum thickness of 1/2" and a minimum slope of 1/2" per foot. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Edges of material that are 1/2 inch or taller will require the use of tapered edge strips to taper edge to zero inches.
- E. Cover Boards: ASTM C1177; water-resistant, gypsum substrate, 4 feet by 4 feet in size. Edges of material that are 1/2 inch or taller will require the use of tapered edge strips to taper edge to zero inches.
 - 1. Acceptable Products:
 - a. 1/2 inch Securock as manufactured by United States Gypsum.
 - b. 1/2 inch DensDeck Prime as manufactured by GPC.
- F. Fire Resistance:
 - 1. Flame spread 0, smoke developed 0, when tested in accordance with ASTM E84. Noncombustible when tested in accordance with ASTM E136.

2.7 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
 - 1. For steel deck and as allowed by design uplift pressures, only the first layer of insulation shall be fastened into steel deck and all other successive layers shall be fully adhered. Insulation over concrete decks shall be adhered.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Adhesive: Manufacturer's standard adhesive formulated to adhere roof insulation to concrete substrate and subsequent layers of insulation and cover board to each other.
- D. Tapered Edge and Cant Strips: ASTM C728, perlite insulation board.

2.8 WALKWAY PADS

- A. Walkway Pads: Same granulated cap sheet product as used in the field area of the roof and as follows:
 - 1. Granule Color: Gray.
 - 2. Size: As standard with manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. The roofing contractor is responsible for ensuring appropriate system specific addendums from manufacturer.
- B. The roofing contractor is responsible for determining that the substrate surface is suitable for the proper installation of the Roofing System, roof insulation, and specified components.
- C. Application of the roofing system constitutes an agreement that the roofing contractor has inspected and found the substrate suitable for the installation of the Roofing System.
- D. The roofing contractor is responsible for coordinating the installation to ensure that the system remains watertight at the end of each working day.

3.2 SUBSTRATE EXAMINATION

- A. The roofing contractor is responsible for verifying that the deck condition and/or existing roof construction is suitable for the specified installation of the Roofing System..
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 - 2. 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.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 3123 "Steel Decking."
 - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 - 7. The application of adhesives directly to structural concrete; existing smooth and/or granular BUR materials may require sealing or priming with an accepted asphalt primer prior to application.

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8. 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.
 9. Examine surfaces for low areas that will not drain properly, foreign material, ice, wet insulation, unevenness or any other defect that would prevent the proper execution and quality application of the Roofing System as specified.
- C. Prepared substrate shall be smooth, dry, and free of debris and/or any other irregularities which would interfere with the proper installation of the Roofing System. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Installer and roofing-system manufacturer's representative shall examine substrate to ensure that it is properly prepared and ready to receive roofing system. Roofing-system manufacturer's representative shall report in writing to Installer and Architect/Engineer conditions which will adversely affect roofing-system installation or performance. Do not proceed with roofing-system installation until these conditions have been corrected and reviewed by Architect.
- E. Provide fastener withdrawal values (pull out tests) per ANSI SPRI FX-1 on all projects to verify the suitability of decking to accept a mechanically fastened insulation or membrane roofing system.
- F. Notify Architect in writing of conditions which may adversely affect installation or performance of roofing Work and recommend corrections.
- G. Do not proceed with roofing Work until adverse conditions have been corrected and reviewed by Architect.
- H. Commencing roofing Work constitutes acceptance of Work surfaces and conditions.

3.3 PROTECTION

- A. Take precautions to ensure safety of people, including building users, passers-by, and workmen, and animals, and protection of property, including adjacent building elements, landscaping, and motor vehicles.
- B. Prevent construction debris and other materials from coming into contact with pedestrians, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
- C. Protect paving and sidewalks, and adjacent building areas from mechanical damage due to scaffolding and other equipment.
- D. Limit access to Work areas only to authorized personnel.
- E. Erect temporary protective canopies, as necessary, over walkways and at points of pedestrian and vehicular access that must remain in service during Work.

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- F. Comply with roofing-system manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products.
- G. Cover adjacent surfaces with materials that are proven to resist roofing materials.
- H. Assume responsibility for injury to persons or damage to property due to Work and remedy at no cost to Owner.

3.4 COORDINATION

- A. Coordinate Work to ensure that new insulation and roofing materials and building interior are kept continuously dry and that continuous, watertight, new roofing system is provided. Coordinate:
 - 1. With Owner's Representative.
 - 2. With other trades to avoid or minimize work on, or in immediate vicinity of, installation in progress and completed new roofing.
 - 3. To avoid or minimize adverse effects on completed new roofing.
 - 4. Ensure that drains are operational at end of each workday or if precipitation is forecast.

3.5 SUBSTRATE PREPARATION FOR NEW ROOFING

- A. Steel Deck:
 - 1. Steel decking shall conform to Factory Mutual (FM) guidelines for Class-1 insulated steel deck construction.
 - 2. Steel decking shall be constructed of a minimum 22 gauge cold rolled steel sheets with factory G-90 galvanized coating.
 - 3. Panel profiles (ribs) shall be formed to minimize deflection and provide suitable strength and integrity to support anticipated structural live and dead loads.
 - 4. Steel decking shall be installed in compliance with specified design criteria and local building code requirements.
- B. Concrete (Poured and/or Pre-cast):
 - 1. Decking shall be installed in strict conformance with industry standards, practices and/or pre-cast panel manufacturer's installation requirements.
 - 2. Decking shall be installed to provide positive slope and subsequent positive drainage of the new Roofing System.
 - 3. Finished decking shall be properly cured and dry, prior to the installation of approved insulation
 - 4. Finished surface(s) to receive new roof system shall be smooth and level without significant surface depressions or irregularities. Camber differentials greater than 3/16 inch must be leveled using a cementitious grout.
 - 5. Finished surfaces shall be free of moisture, dust, loose debris and any other irregularity that may hinder the proper performance of the new Roofing System.
 - 6. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

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3.6 SUBSTRATE PREPARATION FOR RE-ROOFING

A. General:

1. Roofing Contractor shall be responsible for informing the Owner of any issues in regard to the condition and structural integrity of the existing decking.
2. The Owner/Owner representative shall make and be responsible for the determination as to the proper method of treatment and/or replacement.
3. Re-roofing applications shall require fastener withdrawal tests to substantiate proposed attachment patterns for the new mechanically fastened insulation systems and/or membranes.
4. Re-roofing applications that require modification to the deck and/or insulation system shall be installed to provide positive slope and subsequent positive drainage of the new Roofing System.
5. All terminations of the Roofing System shall be constructed to prevent water from penetrating behind or beneath the new Roofing System. This includes water from above, beside, below and beneath the new system.

B. Removal of Existing Roof System(s):

1. Remove all existing roofing material(s), insulation, flashing, metal and deteriorated wood blocking and legally dispose off-site.
2. Remove only enough roofing to accommodate the day's work and ensure the exposed area can be made 100 percent watertight at the end of the day or first sign of inclement weather.
3. Provide temporary protection as needed if water-tightness is compromised.
4. Do not begin removal of existing roofing system when weather conditions are not conducive to maintaining water-tightness or for application of new construction.
5. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation, according to roofing-system manufacturer's written instructions. Remove sharp projections.
6. Mask adjoining surfaces not receiving roofing system to prevent spillage or migration affecting other construction.
7. Close off roof drains and other penetrations to prevent materials from entering and clogging drains and conductors, and from spilling or migrating onto adjacent surfaces. Remove roof-drain plugs when no work is taking place or when rain is forecast.
8. Installer and roofing-system manufacturer's representative shall examine substrate to ensure that it is properly prepared and ready to receive roofing system. Roofing-system manufacturer's representative shall report in writing to Installer and Architect/Engineer conditions that will adversely affect roofing-system installation or performance. Do not proceed with roofing-system installation until these conditions have been corrected and reviewed by Architect/Engineer.
9. Proceed with installation only after unsatisfactory conditions have been corrected. Commencing installation constitutes acceptance of Work surfaces and conditions

C. Steel Decks:

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1. All rotted and/or deteriorated decking shall be removed and replaced with like kind. Deck is to be screwed or welded into place with side and end laps matching Steel Deck Institute (SDI) specifications for such installation or the Drawings in these Specifications, whichever is the most stringent.
2. Areas of structurally acceptable steel decking exhibiting slight surface rust shall be properly cleaned with a wire brush, primed and painted prior to installing the approved insulation.
3. All decking shall be inspected for proper attachment and excessive deflection that would compromise the uplift performance of the new Roofing System.
4. Attachment and deflection deficiencies shall be repaired and brought into compliance with current, local building code requirements.

D. Concrete:

1. Repair or replace deteriorated decking with appropriate materials according to standard industry regulations and practices.
2. Repair depressions or areas where reinforcing has become exposed. Properly patch substrate defects (such as voids, form tie holes, honeycombing, and cracks) with latex-modified concrete or another material acceptable to roofing-system manufacturer and Architect.
3. When new insulation system is to be installed using hot asphalt or an approved adhesive:
 - a. Cracks and or camber differentials greater than 3/16 inch shall be repaired using an appropriate cementitious grout or fill, and feathered to promote a smooth transition.
 - b. Joints between pre-stressed panel units and over bulb-tees shall be taped, stripped or grouted with an appropriate cementitious fill.
 - c. All surface irregularities shall be leveled to ensure complete contact with the decking for insulation bonded in hot asphalt or approved adhesives.
4. Where insulation is to be mechanically attached or ballasted, camber differentials and/or surface irregularities of up to 1/2 inch shall be acceptable.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete curbs, expansion joints, and transitions from one surface plane to another (inside and outside corners) are cleanly formed and free of broken edges and excess concrete.
7. Remove grease, oil, asphalt solids, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete. Thoroughly sweep substrate and clean with oil-free compressed air.

E. Lightweight "Insulating" Concrete:

1. All wet lightweight shall be removed and replaced with appropriate and/or compatible material.
2. Surface to receive new Roofing System shall be smooth and free of ridges, depressions and other irregularities.
3. Repair depressions, irregularities and/or excessive deflection with compatible material.

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F. Plywood Substrates:

1. Clean and prepare plywood substrate according to roofing-system manufacturer's written instructions. Provide clean, dust-free, and dry substrate for roofing application.
2. Remove and replace plywood that is damaged, that cannot easily be cleaned, or that does not meet the requirements of roofing-system manufacturer. Use exterior-grade plywood that conforms to APA standards.
3. Verify that plywood is fastened with non-projecting screws. If not, supplement existing fastening with new corrosion-resistant screws.

3.7 ROOFING SYSTEM INSTALLATION

- A. Install roofing membrane and base flashings according to roofing-system manufacturer's written instructions and applicable recommendations of NRCA/ARMA Quality Control Guidelines for Application of Polymer Modified Bitumen Roofing.
- B. Install materials in strict accordance with safety requirements required by roofing-system manufacturer, Material Safety Data Sheets, and local, state, and federal rules and regulations
1. Follow safety procedures of OSHA and other applicable governing agencies. Assume responsibility for Work area safety at all times.
 2. Provide fully-charged fire extinguishers, appropriately sized and rated, and water within 50 feet of open flame.
 3. Torch Safety for areas where torches are approved for use by Owner' Representative and Architect/Engineer.
 - a. Do not use wood-fiber cant strips or insulation.
 - b. Install continuous, glass-fiber, base sheet over combustible substrates.
 - c. Install metal flashings at penetrations, or protect with tight-fitting felt collar before torching.
 - d. Torches to have safety lever (pilot only or self-igniting). Do not use full-time torches.
 - e. Maintain fully-charged fire extinguishers, appropriately sized and rated, within 50 feet of torch work locations.
 - f. Walk job every day at least one hour after torches are out for fire watch.
- C. Maintain adequate ventilation during installation of roofing materials. Notify Owner's Representative at least one week in advance of Work with materials with noxious vapors. Review application schedule and venting precautions with Owner's Representative prior to beginning application.
- D. Coordinate installation of roofing-system components so insulation and roofing membrane sheets are not exposed to precipitation or left exposed at end of workday or when rain is forecast.
1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- E. Prohibit foot traffic and equipment movement over roofing system until adhesive has cured. Minimize foot traffic and equipment movement over base ply prior to installation of membrane top ply/cap sheet.
- F. Cooperate with Architect/Engineer in performing inspections and testing of roofing system.

3.8 TEMPORARY ROOF/ VAPOR RETARDER INSTALLATION

- A. Install temporary roof/ vapor retarder over properly prepared deck substrate in accordance with the roof assembly letter to achieve design wind pressure throughout the system and in accordance with the manufacturer's installation instructions.
1. Completely seal at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.9 ROOF INSULATION AND COVER BOARD INSTALLATION

- A. General:
1. Damaged corners shall be cut out and replaced with an insulation piece a minimum of 12 inch x 12 inch. Pieces that are cut from larger panels and are smaller than one square foot are not acceptable.
 2. Install no more material than what can be covered during the same working day.
 3. When a cover board and/or multiple layers are installed each layer shall be offset from the previous layer a minimum of 12 inch on center.
 4. At the end of each working day, provide a watertight cover on all unused insulation as to avoid moisture penetration.
- B. Insulation Installation:
1. Comply with roofing system manufacturer's written instructions for installing roof insulation.
 2. Roof insulation shall be installed whereby the long dimension of the board(s) run in parallel alignment and the short dimensions are staggered.
 3. Insulation shall be installed with minimum joint dimensions and shall be tightly butted where possible.
 - a. Cut and fit insulation within 1/4 inch of nailers, projections and penetrations.
 - b. Fill gaps exceeding 1/4 inch with insulation.
 4. Install one or more layers of insulation to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer at least 6 inches in each direction.

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5. Trim surface of insulation where necessary at roof drains so finished surface is flush with top of drain-bowl flange and does not restrict flow of water.

C. Insulation Cant Strips:

1. Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes more than 45 degrees.
2. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

D. Mechanically Fastened Insulation:

1. For metal roof decks, install the base layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type. Subsequent layers of insulation shall be set in adhesive as roof assembly allows to achieve design wind pressures.
2. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification
 - a. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

E. Adhered Insulation:

1. Board sizes shall not exceed 4 ft. by 4 ft. maximum. Largest appropriately-sized boards approaching, but not exceeding 4 ft. by 4 ft. as appropriate, shall be installed where possible. The use of multiple, smaller sized sections of insulation where larger sections would be more appropriate shall not be allowed.
2. For insulation that will be installed using adhesive (not mechanically attached), provide adequate temporary ballast on insulation boards that is sufficient to fully compress each board into the adhesive until adhesive has set.
3. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

F. Tapered Edge Strip:

1. Install tapered edge strip at the leading edge of the tapered insulation panels to provide a solid substrate for the cover board.

G. Cover Board Installation:

1. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows.
2. Offset joints a minimum of 6 inches in each direction from joints of insulation below.
3. Loosely butt cover boards together.
4. Tape joints if required by roofing system manufacturer.
5. Adhere cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
6. Adhere cover boards to resist uplift pressure at corners, perimeter, and field of roof.

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7. Apply low-rise foam adhesive to underside, and bond cover board to substrate. Fill all voids greater than 1/4-inch with insulation to avoid thermal energy loss.
8. Provide adequate temporary ballast on cover boards that is sufficient to fully compress each board into the adhesive until adhesive has set.

3.10 ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
 1. Install roofing system according to roof assembly identification matrix and roof assembly layout illustrations in NRCA's "The NRCA Roofing and Waterproofing Manual" and to requirements in this Section.
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Where roof slope exceeds 1/2 inch per 12 inches, install roofing membrane sheets parallel with slope.
 1. Back nail roofing membrane sheets to substrate according to roofing system manufacturer's written instructions.
- D. Cooperate with testing agencies engaged or required to perform services for installing roofing system.
- E. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 1. At end of each day's work, provide tie-offs to cover exposed roofing membrane sheets and insulation. Tarp and weights are not acceptable for tie-offs. Heat weld or use self-adhering membrane with minimum 12 inch lap with existing roof.
 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- F. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.
- G. Temporary Seals:
 1. At the end of each working day or at the sign of rain, install temporary, 100% watertight seal(s) where the completed new roofing adjoins the uncovered deck or existing roof surface.
 2. The authorized roofing contractor shall create and maintain the temporary seal in such a manner to prevent water from traveling beneath the new and/or existing roof system.

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3. If water is allowed to enter beneath the newly completed roofing, the affected area(s) shall be removed and replaced at no additional expense to the Owner.
4. Prior to the commencement of work, cut out and remove all contaminated membrane, insulation, roof cement or sealant and properly dispose off-site.

3.11 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

- A. SBS-Modified-Bitumen Membrane Installation: Install roofing membrane base ply and cap sheet.
 1. Install all roofing membrane and flashing systems and all accessory components in accordance with the Drawings and Specifications; unless the manufacturers printed instructions are more stringent. Request for clarification shall be submitted in writing to the Architect/Engineer.
- B. Unroll sheets, turn upside down, and allow to relax for minimum time period required by manufacturer before installing. Cut cap sheet into lengths no longer than half the roll length and round corners. The material may be re-rolled for final application.
- C. Cut out factory splices in top ply. Alternately, cover splice with full-width section of top-ply membrane that extends at least 6 inches beyond sides of splice.
- D. Accurately align sheets without stretching and maintain uniform side and end laps of minimum dimensions required by roofing-system manufacturer for selvage and non-selvage laps.
- E. Adhere base ply according to manufacturer's recommendations with self-adhered membrane, heat welded, or cold process adhesive.
 1. Start at low point of roof deck and shingle side laps with slope of deck where possible.
 2. Stagger end laps at least 3 feet.
 3. Extend sheets over and terminate about 2 inch above top of cants.
 4. All end laps shall be lapped as specified by the manufacturer, and all membrane laps shall show a "bleed-out" of between 1/4" and 1/2". Corners of the end laps shall be rounded.
 5. "T" joints shall be notched at a 45 degree angle or as recommended by manufacturer.
 6. Broom each ply immediately to firmly embed into adhesive, free of wrinkles, creases, fish mouths, or air pockets.
 7. Cut out wrinkles and fish-mouths and repair with same number of plies removed.
 8. Prepare and prime non-selvage laps as recommended by roofing-system manufacturer.
 9. Continuously bond and seal laps, leaving no voids.
 10. Repair wrinkles and voids in lapped seams.
- F. Install modified bituminous roofing membrane cap sheet according to roofing manufacturer's written instructions.
 1. No membrane phasing allowed. The final ply may be delayed up to five days upon advance written approval of the material manufacturer warranting the roof. Prior to installation of the cap sheet, inspect the underlying plies, repair all voids, fish-mouths,

cuts, or abrasions, and completely clean the roof. Ensure that all imbedded flashings are installed and stripped in. Sweep off all loose dirt and where dirt has become imbedded, prime the area prior to commencing application of the FR cap sheet.

- G. No Foot Traffic on New Membrane: Set up points, charge points, debris chutes, asphalt filling points, drinking water containers and all other destination facilities shall be located in such a way as to preclude traffic over the newly installed membrane. No workers shall walk on the newly completed membrane for at least thirty minutes after installation to allow for cooling of the asphalt to prevent compression and displacement of asphalt due to point loading or concentration of weight due to a person's foot or equipment.
- H. Embed loose cool roof granules in bleed out or cool roof reflective coating, in accordance with the membrane manufacturer's recommendations, at side and end laps and at minor asphalt, primer, or adhesive spillage on finished membrane surfaces.
- I. At locations where asphalt, primer, or adhesive spillage on finished membrane surfaces exceeds 1 square foot, install additional top ply of membrane.
- J. Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
 - 1. Repair tears and voids in laps and lapped seams not completely sealed.
 - 2. Apply roofing granules to cover exuded bead at laps while bead is hot.
 - 3. Prepare and prime non-selvaqe laps as recommended by roofing-system manufacturer.
- K. Install roofing membrane sheets so side and end laps shed water.
- L. Ridge and Hip Cap Ply: One full-width sheet modified bitumen granulated surface sheet shall be run the full length of the ridge and hips and carefully torched in place. All run-out asphalt at the laps and sides shall be covered with granules.

3.12 BASE FLASHING AND STRIPPING INSTALLATION

- A. General: Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrate according to roofing-system manufacturer's written instructions.
- B. Prime concrete, masonry, and metal substrates with asphalt primer if required by roofing-system manufacturer. Allow primer to dry before installing base flashing.
- C. Accurately align base flashing sheets without stretching, and maintain uniform side and end laps required by roofing-system manufacturer for selvaqe and non-selvaqe laps.
- D. Embed all flashings particularly at the top and bottom of the cant to avoid bridging. Bridging of wall flashings shall be considered defective workmanship and flashings with voids or bridging shall be removed and replace.
- E. Start wall and curb base flashing at low point of roof deck and shingle with slope of deck.

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- F. Flashing plies shall not exceed 39 inches in width. Extend base flashing plies to top of curbs, to within 1 inch of counterflashing reglets, at least 8 inches above finished surface of roofing system, and 4 inches onto field of roofing membrane. At locations where height of wall exceeds height acceptable to roofing-system manufacturer, comply with recommendations of roofing-system manufacturer for flashing high walls. Recommendations include flashing in two stages: bottom half to recommended maximum height preceded by top half over remainder of wall.
- G. Bond and seal laps, leaving no voids. Repair wrinkles and voids in laps and lapped seams. Prepare and prime non-selvage laps as recommended by roofing-system manufacturer.
- H. Install at least one ply of base flashing membrane same day that roofing membrane is installed to provide temporary watertight seal
 - 1. Flashing Sheet Application: Install cold adhesive, torch apply or heat-weld the manufacturer's base flashing into place. The side laps shall extend at least 6 inches over one another and shall exhibit no bridging or voids. Lap seams so that the top finishing ply shall never coincide with the lap seams in underlying plies or layers.
 - 2. Cut sheets off end of roll and install vertically, working to selvage edge.
 - 3. For sheets without selvage edges or where selvage edge cannot be provided, limit length of sheets to 5 feet maximum. Prepare and prime non-selvage edges as recommended by roofing-system manufacturer.
 - 4. Stagger end lap seams in top ply at least 6 inches from lap seams in bottom plies.
- I. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and four inches onto field of roofing membrane.
- J. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing using termination bar. Install termination bars fastened at 8 inches on-center at the top of the flashing prior to application of metal counterflashing. Termination bars are not a substitute for saw-cut reglets or counterflashings, but shall be considered only secondary securement.
- K. At Perimeters:
 - 1. Prime both sides of metal edging, gravel stop, and gutter flanges, and allow to dry tacky to the touch.
 - 2. Set in modified mastic over membrane as recommended by roofing-system manufacturer.
 - 3. Mechanically fasten flanges inches inches on center, staggered, and strip over with additional layer of base flashing, as recommended by roofing-system manufacturer.
 - 4. Apply sealant along edge of base flashing at base of raised gravel stop dam to fill gap between base flashing and dam.
 - 5. As with all imbedded metal flashings, the strip-in shall be installed the same day the metal flashing is installed, and before the onset of inclement weather.
- L. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.

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M. Roof Drains:

1. Sump insulation a minimum of 24 inches in each direction as measure from the center of the drain.
2. Install membrane bottom plies. Extend one inch beyond inside edge of drain bowl flange.
3. Install liquid-flashing around drains in accordance with manufacturer's details and installation instructions.
4. Install additional 40-inch-by-40-inch, base-flashing, backer sheet or bottom ply over flashing.
5. Install membrane cap sheet over base flashing. Extend 1 inch beyond inside edge of drain bowl flange.
6. Trim flashing as necessary to 1 inch from inside edge of drain bowl flange.
7. Install clamping ring and drain strainer:
 - a. Install clamping ring same day that base flashing is installed to prevent water back-up under membrane.
 - b. Remove and reinstall clamping ring when membrane top-ply is installed, if installed at later time.
 - c. Securely fasten clamping ring to provide continuous compression of drain flashings.
 - d. Install strainer dome.
8. At end of project, test drains for water-tightness and ensure that drains flow freely.

N. Through-Wall Scuppers:

1. All through-wall scupper, metal shall be primed with asphalt primer, and stripped in with two plies of modified bitumen flashing premium grade material adhered with an approved flashing mastic, or liquid-applied flashing. All corners, splices, and joints shall be soldered to provide a watertight seal.

3.13 EQUIPMENT AND EXPANSION JOINT CURBS

A. Refer to general base flashing installation requirements and the following additional procedures:

1. At wood curbs for equipment and expansion joint assemblies, extend base ply of flashing membrane up and over top of curb, and secure with nails to blocking.
2. Extend cap flashing membrane sheet up vertical surface of curb and terminate at top edge as shown on Drawings. For expansion joint locations, seal top edge of cap sheet with mastic. Securement shall be by fasteners that attach expansion joint assembly to curbs.
3. For curbs where integral sheet metal flashing is used but not attached to face of curb, install termination bar through cap sheet as shown on Drawings with fasteners at 6 inches on center.
4. Equipment Penetrations. Flash per Drawing details or per roofing-system manufacturer's recommendations.
5. Prime flange of sheet-metal flashing, allow to dry, and set in modified-bitumen mastic.

6. Apply sealant at base flashing termination on sheet metal flashing.

3.14 WALKWAY INSTALLATION

- A. 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.
 1. Fully adhere walkway pads.
- B. Use only full-size units, except partial units at corners if necessary to provide neat, finished appearance.
- C. Provide two inches minimum between adjacent units. Extend walkway six inches minimum beyond edges of equipment or supports.
- D. Sweep loose surfacing material from walkway locations.
- E. Cap Sheet Strips: Set strips, in lengths not exceeding 10 feet, in heavy application of asphalt mastic or same bitumen used to install roofing system, in accordance with recommendations of walkway and roofing-system manufacturers. Walkways shall be fully adhered to roofing cap sheet.
- F. Walkway protection material shall be installed in the following locations whether shown on the Drawings or not:
 1. Top and bottom of all roof ladders.
 2. Around all roof access hatches.
 3. Around the perimeter of all powered rooftop equipment, no matter how large.
 4. Beneath all satellite antenna supports, stands, or weights.
 5. Full perimeter of all skylights.
 6. All other heavy traffic areas, maintenance area, or rooftop access points.
 7. Any location where window washing or other roof maintenance equipment is to be stored on the roof.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage qualified, independent testing and inspection agency to perform roof inspections and tests, and to prepare reports.
- B. Architect/Engineer and Testing Agency will inspect roofing system at various stages of construction and at completion.
- C. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D3617.

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2. Test specimens will be examined for inter-ply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
 3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
- D. Infrared Survey: If roofing cap sheet is not installed immediately after the smooth surfaced base sheet is installed (Phased Construction), contractor shall provide an infrared survey of entire roof area. Survey shall be performed by organization that is approved by the Architect. Infra-red survey and subsequent report shall be performed prior to the installation of the roofing cap sheet.
- E. Manufacturer's Inspections: Arrange for the roofing systems manufacturer to provide qualified technical personnel for onsite observation and instruction full time at beginning of membrane installation to establish project standard and thereafter as the manufacturer deems necessary, but not less than one time every two weeks when roofing membrane and related work is being performed. A field observation report from each visit will be generated and submitted to the Architect within 48 hours of the visit.
- F. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion. Notify Architect and Owner 48 hours in advance of date and time of inspection. Roofing system will be considered defective if it does not pass tests and inspections.
- G. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, and describe nature and extent of deterioration and damage in written report, with copies to Architect/Engineer and Owner.
- H. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- I. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements
- 3.16 PROTECTING AND CLEANING
- A. Protect roofing system from damage and wear during remainder of construction period.
- B. At the end of each workday, clean Site and Work areas and place rubbish, empty cans, rags, and other discarded materials in appropriate containers.
- C. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements. Repair surfaces stained, marred, or otherwise damaged during roofing Work.

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- D. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction. Exercise care to avoid scratching or damage to surfaces.
- E. Accompany the manufacturer's technical inspector and assist with equipment and workmen if necessary to provide access to the roof. Correct all defects noted during the inspection
- F. Clean up debris and surplus materials and remove from Site. Follow Project waste management procedures:
 - 1. Collect surplus roofing materials that cannot be reused and deliver to recycling or disposal facility.
 - 2. Treat materials that cannot be reused as hazardous waste and dispose of in an appropriate manner

3.17 LIGHTNING PROTECTION

- A. The installation of lightning protection shall be coordinated with the authorized roofing contractor, certified lightning contractor and Owner.
- B. The lightning protection shall be installed in such a manner that base plates, air terminals and cables do not penetrate the roofing membrane without the use of pre-approved flashing details.
- C. Cables and air terminals shall be attached to the membrane by using base plates and an approved construction adhesive or by welding intermittent strips of membrane over the base plates and cables to the roofing. Contact manufacturer for specific adhesive recommendations.
- D. Recommendations regarding the selection of adhesives or alternative affixing of lightning protection systems to the membrane does not in any way imply a warranty covering their performance or ability of the adhesives to remain affixed to the membrane.

3.18 COMPLETION

- A. Remove any and all debris, excess materials and scrap of any kind from the roof and surrounding premises prior to demobilization.
- B. Inspect all field welds, detailing and terminations to ensure a 100 percent watertight installation.

3.19 WARRANTY INSPECTION

- A. Upon completion of the Project, the Contractor shall complete and submit the Project Completion Notice to manufacturer.

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- B. Upon receipt of the notice of completion, a manufacturer's representative shall schedule an inspection with the Contractor to thoroughly review the installation and verify compliance with the manufacturer's requirements.
- C. Any corrections or modifications necessary for compliance with the specifications and acceptance for warranty (punch list) shall be noted on the Final Inspection for Warranty form.
- D. Upon completion of all punch list items and final acceptance of the installation, a warranty as authorized by the manufacturer shall be issued to Owner.

END OF SECTION 07 5216