

SECTION 075500 – PROTECTED MEMBRANE ROOFING

PART 1 - GENERAL

1.1 M.S.U. ISSUES

- A. The preferred roofing system on all new construction at M.S.U. is the Protected Membrane Roof (PMR), also known as Inverted Roof Membrane Assembly (IRMA, a registered trademark of the Dow Chemical Company). On new construction or remodeling projects, if a PMR cannot be installed or is inappropriate to the building, the M.S.U. standard is a built-up coal-tar roof (see 075116 – BUILT-UP COAL TAR ROOFING).
- B. M.S.U. requires the roofing system utilize products by Commercial Innovations Inc. or Durapax LLC. The roof must be installed in strict accordance with the manufacturer's printed instructions.
- C. Any wood used in construction or flashing of a roof must be pressure-preservative-treated material in accordance with the standards of AWWPA.
- D. M.S.U. requires that the installer be licensed by the roofing system manufacturer and provide references documenting successful installation of roofs of a similar nature. The contractor shall have a minimum of 5 years applicable experience. The installation contractor should be prepared to provide names and telephone numbers of key individuals in the firm that can be reached 24 hours a day. Telephone numbers to an answering service or telephone answering machine will not be considered acceptable.
- E. It the intent of MSU that all roof construction used on its projects will comply with LEED™ NC 3 Credit Requirements EA Prerequisite 2: Minimum Energy Performance and Credit Requirement EA Credit 1: Optimize Energy Performance.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protected membrane, built-up coal-tar roofing system.
- B. Related Sections include the following:
 - 1. Division 07 Section THERMAL INSULATION for insulation beneath the roof deck.
 - 2. Division 07 Section SHEET METAL FLASHING AND TRIM for metal roof penetration flashings, flashings, and counterflashings.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

- B. Bitumen: A generic term for either asphalt or coal tar pitch.
- C. Hot Coal-Tar Pitch: Coal-tar pitch heated to its equiviscous temperature, the temperature at which its viscosity is 25 centipoise for either mopping or mechanical application, within a range of plus or minus 25 deg F, measured at the mop cart or mechanical spreader immediately before application.
- D. Hot Roofing Asphalt: Roofing asphalt heated to its equiviscous temperature, the temperature at which its viscosity is 125 centipoise for mopping application and 75 centipoise for mechanical application, within a range of plus or minus 25 deg F, measured at the mop cart or mechanical spreader immediately before application.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.

1.5 SUBMITTALS

- A. Provide a complete list of all proposed materials being used to install the roofing system, including manufacturers names and product data for each type of product indicated.
- B. Shop Drawings: For roofing system. Include details for the following:
 - 1. All sheet metal flashing.
 - 2. Base flashings, cants, and membrane terminations.
 - 3. Tapered insulation, including slopes.
 - 4. Crickets, saddles, and tapered edge strips, including slopes.
 - 5. Insulation fastening patterns.
- C. Samples for Verification: For the following products:
 - 1. Aggregate ballast in color and gradation indicated.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements.
- F. Maintenance Data: For roofing system to include in maintenance manuals.
- G. Warranties: Special warranties specified in this Section.
- H. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

- A. 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 warranty.
- B. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.
- C. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. 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, and directions for storage.
- B. Roofing materials must be stored and handled in a manner that will prevent moisture intrusion. Store in a dry, well ventilated, weather tight place. Do not leave unused felts on the roof overnight or when roofing work is not in progress unless protected from weather or other moisture sources. Store rolls of felt and other sheet materials on end on pallets or other raised surface and completely cover with tarps. Handle and store materials and equipment in a manner to avoid damage to and/or significant or permanent deflection of the deck. Any felts or other materials that have been subjected to dampness or rain will be marked for permanent removal from the premises.
- C. In the event a roof has to be used as a storage, work, and/or walkway area, the following protective measure must be employed:
 1. The Owner's Project Representative will determine exact location of storage, work area, and/or walkway.

2. The storage, work area, or walkway areas will be covered by a 1-inch layer of water resistant insulation such as EPS and a layer of ½ inch plywood. Stagger the seams of the insulation and plywood, using plywood chips to prevent cupping.
 3. Make storage, work areas, and walkways large enough, and line perimeter with barricades and warning tape to ensure that all traffic will stay on the protected areas.
- D. 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.
- E. 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.
- F. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements. Do not install materials when rain, cold moisture, frost, snow or other climatic conditions prevent the adhesion of bitumen or other formation of a homogeneous membrane. During cold weather, use "wind chill factor" as a relative guide as to whether or not the weather is suitable for construction a built-up roofing system

1.9 WARRANTY

- A. Special Warranty: Provided by Commercial Innovations Inc. or Durapax LLC, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, vapor retarder, roof pavers, walkway products and other components of roofing system.
 2. Warranty Period: Minimum of 20 years from date of Substantial Completion.
- B. Special Project Warranty: Provided by installer, without monetary limitation, in which the installer agrees to repair or replace components of roofing system that fail in workmanship within specified warranty period. Failure includes roof leaks.
1. Special workmanship warranty includes installation of roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, vapor retarder, roof pavers, walkway products and other components of roofing system.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Protected Membrane Built-up Coal-Tar Roofing:
 - a. Commercial Innovations Inc.
 - b. Durapax LLC

2.2 BASE-SHEET MATERIALS

- A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft.
- B. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- C. Base Sheet: ASTM D 2626, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

2.3 ROOFING MEMBRANE PLIES

- A. Ply Sheet: ASTM D 227, coal-tar-saturated organic felt.
- B. Composite Membrane Plies – Envelope Felts: ASTM D 226-89 Type I asphalt saturated organic felts (non-perforated).

2.4 FLASHING MATERIALS

- A. Backer Sheet: Roofing system manufacturer's standard spun-bonded, nonwoven, polyester-reinforced fabric, of standard color and weight, suitable for application method specified.
- B. Flashing Sheet: ASTM D 6164, Type I or II, polyester-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified and as follows:
 - 1. Granule Color: White.

2.5 BITUMEN MATERIALS

- A. Asphalt Primer: ASTM D 41.
- B. Coal-Tar Primer: ASTM D 43.
- C. Coal-Tar Pitch: ASTM D 450, Type I.
- D. Roofing Asphalt: ASTM D 312, Type III.

2.6 AUXILIARY ROOFING MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.
- B. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- C. Coal-Tar Roofing Cement: ASTM D 5643, coal-tar-based roofing cement, asbestos free.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM 4470; designed for fastening roofing membrane components to substrate; tested by manufacturer for required pullout strength; and acceptable to roofing system manufacturer.
- E. Metal Flashing Sheet: Metal flashing sheet is specified in Division 7 Section "Sheet Metal Flashing and Trim."
- F. Separator Sheet: Polyethylene sheet, black, 6 mils thick minimum.
- G. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.7 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 36, Type X gypsum wallboard, 5/8 inch thick.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening substrate panel to roof deck.

2.8 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type VI, square edged, 2" thick. This is to be installed in two layers to make a total of 4".
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.9 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- D. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- E. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric mat, water permeable and resistant to ultraviolet degradation, type and weight as recommended by roofing system manufacturer for application.

2.10 PROTECTED MEMBRANE ROOFING AGGREGATE BALLAST

- A. Aggregate Ballast: Provide aggregate ballast that will withstand weather exposure without significant deterioration and not contribute to membrane degradation, of the following type and size:
 - 1. Aggregate Type: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone.
 - 2. Size: ASTM D 448, Size 57.

2.11 PROTECTED MEMBRANE ROOFING PAVER BALLAST

- A. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed, concrete units, square edged factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
 - 1. Available Manufacturers:
 - a. Hanover Architectural Products.
 - b. Wausau Tile, Inc.; Terra-Paving Div.
 - c. Or approved equal.
 - 2. Size: 24 by 24 inches, minimum thickness 2 inches, non-slip surface with grooved backs with 4-way drainage capability. Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch in length, width, and thickness.
 - 3. Weight: 22-lb/sq. ft.
 - 4. Compressive Strength: 6500 psi, minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements, as applicable to the deck surface, and other conditions affecting performance of roofing system:
1. Verify that roof openings and penetrations are in place and set and braced and that roof drains 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 comply with requirements in Division 5 Section "Steel Deck."
 4. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 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.
 - a. Test for moisture by pouring 1 pint of hot roofing asphalt or hot coal-tar pitch on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if test sample foams or can be easily and cleanly stripped after cooling.
 6. 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.
 7. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. 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.
- C. Concrete Decks:
1. Prime surface with asphalt primer at a rate of 3/4 gal. /100 sq. ft. and allow primer to dry.
 2. Install one ply of 43 lb. Coated organic base sheet set in full mopping of hot steep asphalt.
- D. Metal Decks:
1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 2. Mechanically fasten substrate board to top flanges of steel deck according to roofing system manufacturer's written instructions.

E. Gypsum Decks:

1. Mechanically fasten one ply of 43 lb. Coated organic base sheet.

F. Wood Decks:

1. Mechanically fasten one layer of red rosin paper and one ply of 43 lb. Coated organic base sheet

3.3 INSULATION INSTALLATION

- A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

3.4 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install built-up roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
- B. Cooperate with testing and inspecting agencies engaged or required to perform services for installing built-up roofing system.
- C. Coordinate installing roofing system components so insulation and roofing membrane sheets are not exposed to precipitation or left exposed at the end of the workday or when rain is forecast.
- D. Bitumen Heating: Heat bitumen and apply within plus or minus 25 deg F of equiviscous temperature unless otherwise required by roofing system manufacturer. Do not raise bitumen temperature above equiviscous temperature range more than one hour before time of application. Do not exceed bitumen manufacturer's recommended temperature limits during bitumen heating. Do not heat bitumen within 25 deg F of flash point. Discard bitumen maintained for more than 4 hours at a temperature exceeding 325 deg F for coal-tar pitch or finished blowing temperature for roofing asphalt.
1. Bitumen Mopping Weights: For interply and other moppings, unless otherwise indicated, apply solid moppings of hot coal-tar pitch between ply sheets at a minimum rate of 20-lb/100 sq. ft.
- E. Install two organic felt envelopes, set in roofing asphalt, at perimeters where bitumen dripping can occur. One envelope shall be turned down over face of nailers and shall be secured with large head cap nails. Fold second felt a minimum of six inches back over plies.
- F. Substrate-Joint Penetrations: Prevent coal-tar pitch or roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.
- G. Flood-coat roofing membrane surface of protected membrane roofing with hot coal tar pitch applied at a rate of 70-lb/100 sq. ft.

3.5 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
 - 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
- B. Extend base flashing up walls or parapets a minimum of 12 inches above roofing membrane and 4 inches onto field of roofing membrane.

3.6 PROTECTED MEMBRANE ROOFING INSULATION AND BALLAST INSTALLATION

- A. Loosely lay separator sheet over cooled roofing membrane, with minimum 2-inch side laps and 4-inch end laps.
- B. Insulation: Loosely lay board insulation units over roofing membrane, with long joints of insulation in a continuous straight line and with end joints staggered between rows. Abut edges and ends between units. Install to achieve required insulation thickness over roofing membrane. Cut and fit to within 3/4 inch of projections and penetrations.
 - 1. Where multiple layers of insulation are required, install required thickness with joints of each succeeding layer staggered over joints of previous layer a minimum of 12 inches in each direction.
 - 2. Install protection mat over insulation, overlapping edges and ends at least 12 inches. Do not lap ends of fabric sheets within 72 inches of roof perimeter. Extend fabric 2 to 3 inches above ballast at perimeter and penetrations. Apply additional protection mat layer around penetrations to prevent aggregate from getting between penetrations and insulation. Do not cover drains or restrict water flow to drains.
- C. Roof-Pavers and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions, on roof corners and perimeter as defined by ANSI/SPRI RP-4. Install Size 57 aggregate ballast elsewhere on roofing uniformly over protection mat at a minimum rate of 10-lb/sq. ft.
- D. Roof-Paver Walkways: Install heavyweight roof pavers according to manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
- B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. 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.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075500