SECTION 07 54 19
POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Polyvinyl Chloride (PVC) sheet roofing mechanically fastened to roof deck.

1.2 RELATED WORK

A. General sustainable design documentation requirements: Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS.

B. Treated wood framing, blocking, and nailers: Section 06 10 00, ROUGH CARPENTRY

C. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.

D. Sheet metal components and wind uplift requirements for roof-edge design: Section 07 60 00, FLASHING AND SHEET METAL.

E. Roof hatches, equipment supports, dome type skylights, and gravity ventilators: Section 07 72 00, ROOF ACCESSORIES

F. Miscellaneous items: Section 07 71 00, ROOF SPECIALTIES/ Section 07 72 00, ROOF ACCESSORIES.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.

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

ANSI/SPRI ES-1-03.....Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

C. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):

ASCE/SEI-7-10.....Minimum Design Loads for Buildings and Other Structures

D. ASTM International (ASTM):

C67-09.....Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

C140-10.....Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C1371-04.....Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

C1549-09.....Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

D4263-83(2005).....Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

D4434-09.....Poly (Vinyl Chloride) Sheet Roofing

E96-10.....Water Vapor Transmission of Materials

E108-10.....Standard Test Methods for Fire Tests of Roof Coverings

E408-71(R2008).....Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

E1918-06.....Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

E1980-11.....Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

E. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)

ASHRAE 90.1-2010.....Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix f.

F. Cool Roof Rating Council:

CRRC-1-10.....Product Rating Program, www.coolroofs.org

G. FM Approvals: RoofNav Approved Roofing Assemblies and Products.

4450-89.....Approved Standard for Class 1 Insulated Steel Deck Roofs

4470-12.....Approved Standard for Class 1 Roof Coverings

1-28-09.....Loss Prevention Data Sheet: Design Wind Loads.

1-29-09.....Loss Prevention Data Sheet: Above-Deck Roof Components

1-49-09.....Loss Prevention Data Sheet: Perimeter Flashing

H. National Roofing Contractors Association: Roofing and Waterproofing Manual

I. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog, www.biopreferred.gov

J. U.S. Department of Energy (DoE): Roof Products Qualified Product List, www.energystar.gov

1.4 PERFORMANCE REQUIREMENTS

A. 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.

B. Roofing System Energy Performance Requirements: Provide a roofing system identical to components that that have been successfully tested by a qualified independent testing and inspecting agency to meet the following requirements:

1. Energy Performance, Energy Star: Provide roofing system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
2. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980 based on testing identical products by a qualified testing agency.
3. Energy Performance, CRRC-1: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.
4. Energy Performance, Aged: Provide roofing system with minimum three-year aged solar reflectance not less than 0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and in addition, a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408.
   a. Where tested aged values are not available for proposed product, submit calculations to adjust initial solar reflectance to demonstrate compliance as indicated in ASHRAE 90.1-2007 Addendum f.

b. Alternatively, provide roofing system with minimum three-year aged Solar Reflectance Index of not less than 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 BTU/h-ft2 (12 W/m2K).

1.5 QUALITY CONTROL

A. Installer Qualifications:
   1. Licensed or approved in writing by manufacturer to perform work under warranty requirements of this Section.
   2. Employ full-time supervisors knowledgeable and experienced in roofing of similar types and scopes, and able to communicate with owner and workers.

B. Inspector Qualifications: Inspection of work by third-party technical inspector or technical representative of manufacturer experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer’s compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
   1. An authorized full-time technical employee of the manufacturer, not engaged in the sale of products.
   2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute (RCI), retained by the Contractor or the Manufacturer and approved by the Manufacturer.

C. Product/Material Requirements:
   1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.

D. Roofing system design standard requirements:
   1. Recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to modified bituminous sheet roofing for storage, handling and application.
   2. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
   3. Recommendations of ANSI/SPRI ES-1 for roof edge design.

4. Roofing System Design: Provide 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/SEI 7.
5. FM Approvals Listing: Provide roofing membrane, base flashing, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a roofing system and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
   a. Windstorm Classification: Class 1A120.
6. High Wind Zone Design Requirement: Contractor Option: In lieu of FM Approval Listing windstorm classification, provide roofing membrane, base flashing, and component materials that comply with Miami-Dade County requirements.

E. Pre-Roofing Meeting:
1. Upon completion of roof deck installation and prior to any roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers Technical Representative, Roofing Applicator, Contractor, and Resident Engineer.
2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
3. Inspect roof deck at this time to:
   a. Verify that work of other trades which penetrates roof deck is completed.
   b. Determine adequacy of deck anchorage, presence of foreign material, moisture and unlevel surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
   c. Examine samples and installation instructions of manufacturer.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, SAMPLES.

B. Product Data:
   1. Adhesive materials.
   2. Membrane sheet roofing and flashing membrane.
   3. Roofing cement.
   4. Roof walkway.
   5. Fastening requirements.
   6. Application instructions.
C. Samples:
   1. Nails and fasteners, each type.
D. Shop Drawings: Include plans, sections, details, and attachments.
   1. Base flashings and terminations.
E. Certificates:
   1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.
   3. Indicating compliance with energy performance requirement.
F. Warranty: As specified.
G. Documentation of supervisors' and inspectors' qualifications.
H. Field reports of roofing inspector.
I. Temporary protection plan. Include list of proposed temporary materials.
J. Contract Close-out Submittals:
   1. Maintenance Manuals.
   2. Warranty signed by installer and manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with the recommendations of the NRCA “Roofing and Waterproofing Manual” applicable to single ply membrane roofing for storage, handling and installation.

1.8 ENVIRONMENTAL REQUIREMENTS

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.
B. Environmental Controls: Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

C. Protection of interior spaces: Refer to Section 01 00 00, GENERAL REQUIREMENTS.

1.9 WARRANTY

Roofing work subject to the terms of the Article "Warranty of Construction," FAR clause 52.246-21, except extend the warranty period to 20 years.

PART 2 - PRODUCTS

2.1 PVC SHEET ROOFING

A. Energy Star rated PVC Sheet: ASTM D4434, Type III, fabric reinforced, 1.5 mm (60 mils) thick, with no backing.
   1. Color: White.
B. Additional Properties:
   1. Water Vapor Permeance, ASTM E96: Minimum 0.14 perms (Water Method).
   2. Fire Resistance, ASTM E108: Class A; no combustion beyond flame/heat source.
   C. Manufacturer: Sarnafil or approved equal

2.2 ACCESSORIES:

A. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.
B. Bonding Adhesive: Manufacturer's standard, water based.
C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 25 by 3 mm (1 by 1/8 inch) thick; with anchors.
D. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 25 mm wide by 1.3 mm (1 inch wide by 0.05 inch) thick, prepunched.
E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening membrane to substrate.
F. Miscellaneous Accessories: Provide sealers, preformed flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories acceptable to manufacturer.

2.3 ADHESIVE AND SEALANT MATERIALS:

A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, 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. Single-Ply Roof Membrane Adhesives: 250 g/L.
   f. Other Adhesives: 250 g/L.
   g. PVC Welding Compounds: 510 g/L.
   h. Adhesive Primer for Plastic: 650 g/L
   i. Single-Ply Roof Membrane Sealants: 450 g/L.
   j. Nonmembrane Roof Sealants: 300 g/L.
   k. Sealant Primers for Nonporous Substrates: 250 g/L.
   l. Sealant Primers for Porous Substrates: 775 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.

B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

3.2 PREPARATION

A. Complete roof deck construction prior to commencing roofing work:

1. Install curbs, blocking, edge strips, nailers, cants, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.

2. Complete deck and insulation to provide designed drainage to working roof drains.
3. Document installation of related materials to be concealed prior to installing roofing work.

B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates.

C. Sweep decks to broom clean condition. Remove all dust, dirt or debris.

D. Remove projections that might damage materials.

E. Concrete Decks, except Insulating Concrete:
1. Test concrete decks for moisture prior to application of roofing materials. Test for capillary moisture by plastic sheet method according to ASTM D4263.
2. Prime concrete decks, including precast units, with primer as specified. Keep primer back four inches from joints in precast units.
3. Allow primer to dry before application of bitumen.

F. Insulating Concrete Decks:
1. Allow to dry out for at least five days after installation before the placement of materials.
2. If rain occurs during or at end of drying period or during installation of roofing, allow additional drying time before the placement of the roofing materials.

G. Poured Gypsum Decks: Dry out poured gypsum in accordance with manufacturer's printed instructions prior to application of roofing materials.

H. Existing Membrane Roofs and Repair Areas:
1. Comply with requirements in Section 07 01 50.19 PREPARATION FOR REROOFING.
2. At areas to be altered or repaired, remove loose, damaged, or cut sheet that is not firmly adhered only where new penetrations occur or repairs are required.
3. Cut and remove existing roof membrane for new work to be installed. Clean cut edges and install a temporary seal to cut surfaces. Use roof cement and one layer of 7 Kg (15 pound) felt strip cut to extend 150 mm (6 inches) on each side of cut surface. Bed strip in

roof cement and cover strip with roof cement to completely embed the felt.

4. At modified bituminous base flashing to be repaired, either bend up cap flashing or temporarily remove cap flashing. Brush and scrape away all deteriorated sheets or surface material of base flashing.

3.3 TEMPORARY PROTECTION

A. Install temporary protection at the end of day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent. Comply with approved temporary protection plan.

B. Install temporary cap flashing over the top of base flashings where permanent flashings are not in place to provide protection against moisture entering the roof system through or behind the base flashing. Securely anchor in place to prevent blow off and damage by construction activities.

C. Provide for removal of water or drainage of water away from the work.

D. Provide temporary protection over installed roofing by means of duckboard walkways, plywood platforms, or other materials, as approved by Resident Engineer, for roof areas that are to remain intact, and that are subject to foot traffic and damage. Provide notches in sleepers to permit free drainage.

3.4 INSTALLATION, GENERAL

A. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FM 4450 and FM 4470 as part of a membrane roofing system as listed in FM Approval's "RoofNav" for fire/windstorm classification indicated. Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.

B. NRCA Installation Standard: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations.

C. Manufacturer Recommendations: Comply with roofing system manufacturer's written installation recommendations.

D. Coordination with related work: Coordinate roof operations with roof insulation and sheet metal work so that insulation and flashings are installed concurrently to permit continuous roofing operations.

E. Installation Conditions:
   1. Apply dry roofing materials. Apply roofing work over dry substrates and materials.
   2. Apply materials within temperature range and surface and ambient conditions recommended by manufacturer.
   3. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:
      a. Do not apply materials when the temperature is below 4 deg. C (40 deg. F).
      b. Do not apply materials to substrate having temperature of 4 deg. C (40 deg. F) or less.

3.5 INSTALLATION OF PVC ROOFING

A. Do not allow the membrane to come in contact with surfaces contaminated with asphalt, coal tar, oil, grease, or other substances which are not compatible with PVC.
B. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.
C. Commence installation at the low point of the roof and work towards the high point. Lap the sheets so the flow of water is not against the edges of the sheet.
D. Position the membrane so it is free of buckles and wrinkles.
E. Roll sheet out on deck; inspect for defects as being rolled out and remove defective areas. Allow for relaxing before proceeding.
   1. Lap edges and ends of sheets 50 mm (two inches) or more as recommended by the manufacturer.
   2. Heat weld or solvent weld laps. Apply pressure as required. Seam strength of laps as required by ASTM D4434.
   3. Check seams to ensure continuous adhesion and correct defects.
   4. Finish edges of laps with a continuous beveled bead of sealant to sheet edges to provide smooth transition.
   5. Finish seams as the membrane is being installed (same day).
   6. Anchor perimeter to deck or wall as specified.
F. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.

G. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 100 mm (four-inches) beyond cut.

H. Membrane Perimeter Anchorage:

1. Install metal fastening strip at the perimeter of each roof level, curb flashing, expansion joints and similar penetrations as indicated and in accordance with membrane manufacturer's instructions on top of roof membrane to deck or wall.
2. Mechanically Fastened Metal Fastening Strip:
   a. Set top of mechanical fastener set flush with top surface of the metal fastening strip. Space mechanical fasteners a maximum 300 mm (12 inches) on center starting 25 mm (one inch) from the end of the nailing strip.
   b. When strips are cut round corners and eliminate sharp corners.
   c. After mechanically fastening strip cover and seal strip with a six-inch wide roof membrane strip; heat or solvent weld to roof membrane and seal edges.
   d. At roof edge metal, turn the membrane down over the front edge of the blocking or the nailer to below blocking. Secure the membrane to the vertical portion of the nailer; or, if required by the membrane manufacturer with fasteners spaced not over 300 mm (12 inches) on centers.
   e. At parapet walls, intersecting building walls and curbs, secure the membrane to the structural deck with fasteners 300 mm (12 inches) on centers or as shown on NRCA manual.

I. Adhered System:

1. Apply adhesive in quantities required by roof membrane manufacturer.
2. Fold sheet back on itself after rolling out and coat the bottom side of the membrane and the top of the deck with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturers application instruction, roll the membrane into the adhesive in a manner that minimizes voids and wrinkles.
4. Repeat for other half of sheet. Cut voids and wrinkles to lay flat and clean for repair patch over cut area.

J. Mechanically-Attached System:

1. Secure the membrane to the structural deck with fasteners through stress plate or batten strips spaced and patterned in accordance

with the membrane manufacturer's instructions to achieve specified wind uplift performance.

2. When fasteners are installed within the laps of adjoining sheets, position the fastener so that the stress plates are a minimum 13 mm (1/2)inch) from the edge of the sheets.
3. Where fasteners are installed over the membrane after the seams have been welded, cover the fasteners with a minimum 175 mm (seven inch) wide round PVC membrane cap centered over the fasteners. If batten strips are used cover the strip with a minimum 175 mm (seven inch) wide PVC strip centered over the batten. Heat solvent weld to the roof membrane and finish edges with sealant as specified. Finish edges with sealant as specified.
4. Before installing fasteners into cast in place concrete, pre-drill the correct size hole into the deck. Drill the hole 9 mm (3/8 inch) deeper than the fastener penetration.

3.6 INSTALLATION OF FLASHING

A. Install flashings as the membrane is being installed. If the flashing can not be completely installed in one day, complete the installation until the flashing is in a watertight condition and provide temporary covers or seals.

B. Flashing Roof Drains:

1. Install roof drain flashing as recommended by the membrane manufacturer, generally as follows:
   a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
   b. Do not allow the roof cement to come in contact with the PVC roof membrane.
   c. Adhere the PVC roof membrane to the metal flashing with the membrane manufacturer's recommended adhesive.
2. Turn down the metal drain flashing and PVC roof membrane into the drain body and install clamping ring and strainer.

C. Installing PVC Base Flashing and Pipe Flashing:

1. Install PVC flashing membranes to pipes, wall or curbs to a height not less than eight-inches above roof surfaces and 100 mm (four inches) on roof membrane.
   a. Adhere flashing to pipe, wall or curb with adhesive.
   b. Form inside and outside corners of PVC flashing membrane in accordance with NRCA manual. Form pipe flashing in accordance with NRCA manual use pipe boot.
   c. Lap ends not less than 100 mm (four inches).
   d. Heat weld or solvent weld flashing membranes together and flashing membranes to roof membranes. Finish exposed edges with sealant as specified.
   e. Install flashing membranes in accordance with NRCA manual.
2. Anchor top of flashing to walls or curbs with fasteners spaced not over 200 mm (eight inches) on centers. Use fastening strip on ducts. Use pipe clamps on pipes or other round penetrations.
3. Apply sealant to top edge of flashing.

D. Installing Building Expansion Joints:
1. Install base flashing on curbs as specified.
2. Coordinate installation with metal expansion joint cover or roof expansion joint system.
3. Install flexible tubing 1-1/2 times width of joint over joint. Cover tubing with PVC flashing strip adhered to base flashing and lapping base flashing 100 mm (four inches). Finish edges of laps with sealants as specified.

E. Repairs to membrane and flashings:
1. Remove sections of PVC sheet roofing or flashing that is creased wrinkled or fishmouthed.
2. Cover removed areas, cuts and damaged areas with a patch extending 100 mm (four inches) beyond damaged, cut, or removed area. Heat weld or solvent weld to roof membrane or flashing. Finish edge of lap with sealant as specified.

3.7 FLEXIBLE WALKWAYS

A. Use reinforced sheet not less than 900 mm (three feet) wide.
B. Heat weld or solvent weld walkway sheet to roof sheet at edges. Weld area 50 mm (two inches) wide by the entire length of the walkway sheet.
C. Finish edges of laps with sealants as specified.

3.9 FIELD QUALITY CONTROL:

A. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of 5 full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final reports.

1. Examine and probe seams in the membrane and flashing in the presence of Resident Engineer and Membrane Manufacturer's Inspector.
2. Probe edge of welded seams with a blunt tipped instrument. Use sufficient hand pressure to detect marginal welds, voids, skips, and fishmouths.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of acceptance by Owner.

C. Clean overspray and spillage from adjacent construction. Clean membrane and restore surface to like-new condition meeting solar reflectance requirements.

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