Preparing Activity: USACE Superseding
UFGS-07 54 19 (February 2013)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 54 19

POLYVINYL-CHLORIDE ROOFING

08/23

PART 1 GENERAL

1.1 REFERENCES
1.2 SUMMARY
1.3 ASSEMBLY REQUIREMENTS
1.3.1 Fire Resistance
1.3.2 Wind Uplift Resistance
1.3.3 Solar Reflectance Index (SRI)
1.4 SUBMITTALS
1.5 QUALITY ASSURANCE
1.5.1 Qualification of Manufacturer
1.5.2 Qualifications of Applicator
1.5.3 Conformance and Compatibility
1.5.4 Preroofing Conference
1.6 DETAIL DRAWINGS
1.7 DELIVERY, STORAGE, AND HANDLING
1.7.1 Delivery
1.7.2 Storage
1.7.3 Handling
1.8 ENVIRONMENTAL REQUIREMENTS
1.9 SEQUENCING
1.10 WARRANTY
1.10.1 Roof Membrane Manufacturer Warranty
1.10.2 Roofing System Installer Warranty
1.10.3 Continuance of Warranty

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 PVC Roof Membrane
2.1.2 Energy [and Cool Roof] Performance
2.1.3 Bonding Adhesive
2.1.4 Water Cutoff Mastic/Water Block

2.1.5 Membrane Flashing
2.1.6 Membrane Fasteners and Plates
2.1.6.1 Stress Plates, Bar or Rail for Fasteners
2.1.6.2 Auxiliary Fasteners
2.1.7 Protection Mat
2.1.8 Pre-manufactured Accessories
2.1.9 PVC Walk Tread
2.1.10 Elevated Metal [Walkways] [and] [Platforms]
2.1.11 Roof Insulation
2.1.12 Wood Products
2.2 REINFORCED, PVC MEMBRANE
2.3 PHOTOVOLTAIC (PV) SYSTEMS - RACK MOUNTED SYSTEMS

PART 3 EXECUTION

3.1 CONCRETE SURFACE DRYNESS
3.2 EXAMINATION
3.3 APPLICATION METHOD
3.3.1 Special Precautions
3.3.2 PVC Roofing Membrane
3.3.2.1 Nailing
3.3.2.2 Flashing
3.3.2.3 Expansion Joints
3.3.2.4 Cutoffs
3.3.2.5 Walkways
3.3.3 Adhered Membrane Application
3.3.4 Mechanically Fastened Membrane Application
3.3.5 Perimeter and High Wind Attachment
3.3.6 Securement at Base Tie-In Conditions
3.3.7 Pre-fabricated Curbs
3.3.7.1 Set-On Accessories
3.3.8 Roof Walkways
3.3.9 Elevated Metal [Walkways] [and] [Platforms]
3.3.10 Isolated Paver Blocks
3.4 FLASHINGS
3.4.1 General
3.4.2 Membrane Flashing
3.4.2.1 Installation
3.4.2.2 Sealing
3.4.3 Flashing at Roof Drain
3.5 ROOF WALKPADS
3.5.1 Elevated Metal [Walkways][and][Platforms]
3.6 CORRECTION OF DEFICIENCES
3.7 PROTECTION OF APPLIED ROOFING
3.7.1 Water Cutoffs
3.7.2 Temporary Flashing for Permanent Roofing
3.7.3 Temporary Walkways, Runways, and Platforms
3.8 FIELD QUALITY CONTROL
3.8.1 Construction Monitoring
3.8.2 Manufacturer's Inspection
3.9 CLEAN UP
3.10 INSTRUCTIONS TO GOVERNMENT PERSONNEL
3.11 ROOF DRAIN TEST

-- End of Section Table of Contents --

****

USACE / NAVFAC / AFCEC / NASA	**UFGS-07 54 19 (August 2023)**

Preparing Activity: USACE	**Superseding** **UFGS-07 54 19 (February 2013)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

****

SECTION 07 54 19

POLYVINYL-CHLORIDE ROOFING
08/23

****

NOTE: This guide specification covers the requirements for reinforced polyvinyl chloride roofing membrane on both existing and new roof systems with slopes from 6 mm to 76 mm 1/4 inch to 3 inches per foot.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

****

NOTE: This guide specification is intended for both new construction and reroofing installations. This guide specification is also applicable for use with a supplemental, chemical/grease-resistant PVC membrane for roof areas in need of additional roof protection such as adjacent to kitchen or food service exhaust system discharge ducts; consult PVC membrane roof system manufacturer for this application. Supplemental grease, chemical and oil-resistant PVC roofing membranes are available.

Coordinate this section with other roof system components specifications such as rough carpentry, insulation and sheet metal flashing. Also coordinate this section with the criteria contained in UFC 3-110-03 Roofing, as it relates to the specific project and Service Exceptions indicated therein.

PVC membrane roofing should not be adhered directly to polystyrene, perlite or standard wood fiber insulation. The compatibility of the system must be verified by the membrane manufacturer. Glass mat and moisture resistant gypsum roof board can be used as an overlayment above and in conjunction with the roof system insulation to impart improved wind, impact, and hail resistance.

Do not use reinforced PVC membrane roofing in direct physical contact with asphalt, coal tar pitches, nor petroleum-based products. For additional guidance on PVC roofing membrane and material compatibility, consult with the PVC roofing membrane manufacturer.

NOTE: PVC roofing materials in high humidity locations are susceptible to fungal and biological growth. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). Consider other roofing materials where the avoidance of fungal and biological growth is critical.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.24	(2022) Roofing - Safety Requirements for Low-Sloped Roofs

ASTM INTERNATIONAL (ASTM)

ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4434/D4434M	(2015) Standard Specification for Poly(Vinyl Chloride) Sheet Roofing
ASTM D6754/D6754M	(2010) Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
ASTM E108	(2020a) Standard Test Methods for Fire Tests of Roof Coverings
ASTM E1980	(2011; R 2019) Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

COOL ROOF RATING COUNCIL (CRRC)

ANSI/CRRC S100	(2016) Standard Test Methods for Determining Radiative Properties of Materials

FM GLOBAL (FM)

FM 4470	(2022) 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
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2021; TIA 21-1) Life Safety Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 3621	(2017) Quality Control and Quality-assurance Guidelines for the Application of Membrane Roof Systems
NRCA 3740	(2005) The NRCA Waterproofing Manual
NRCA 3906	(2018) NRCA Guidelines for Rooftop-mounted

Photovoltaic Systems

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1	(2019) Performance Standard for Retrofit Drains
ANSI/SPRI/FM 4435/ES-1	(2017) Test Standard for Edge Systems Used with Low Slope Roofing Systems

UNDERWRITERS LABORATORIES (UL)

UL 790	(2022) UL Standard for Safety Test Methods for Fire Tests of Roof Coverings

1.2 SUMMARY

****

NOTE: Coordinate with PART 2, select the application method required and delete other options.

Where PVC membrane roofing is utilized, in either adhered, mechanically fastened, combination adhered/protected membrane and paver ballasted system configurations, the preferred norm is to attach the PVC membrane roof over a minimum, two layer assembly of rigid board roof insulation (this norm does not apply to IRMA or garden-style roofs). Additionally, adhered and mechanically fastened PVC membrane roofing systems must utilize reinforced membrane, always. Exception to use of reinforced PVC membrane is given only for specialized, pre-fabricated PVC roof system detail flashings (not deck sheet) that are supplied, warranted and recommended in the printed instructions published by the specified PVC membrane roof system manufacturer.

Do not use stone or gravel ballast on any PVC membrane roofing system.

Adhered and mechanically fastened systems are preferred along flight lines, in wind zones exceeding 160 km/h 100 mph, within 8 km 5 miles of coastline, within 457 m 1500 feet of an open body of water, and on or adjacent to critical facilities such as hospitals; but a combination adhered/protected membrane system utilizing paver ballast can be specified using interlocking pavers designed to both protect the underlying PVC membrane from airborne projectiles and to help provide the required wind load resistance established by local building code and designer preference.

Only specify combination adhered/protected roof membrane attachment for isolated geographic locations that experience extreme and extended wind conditions such as portions of Alaska, Iceland, Florida and the Gulf coast, or as otherwise required by the Government. Other mechanically fastened or

adhered PVC membrane roof system installation configurations are also accommodative to such excessive wind loading conditions.

Where an air barrier is required, apply at the deck level or within the insulation sandwich. Air barriers are specified in Section 07 22 00 ROOF AND DECK INSULATION.

Where one membrane system configuration is required for all roof areas, use the first paragraph. Where different system configurations are required, use the second paragraph successively and replace the open brackets with a description of the substrate(s) or area of the building or project where each system is to be applied.

****

[Adhered] [Mechanically fastened] [Combination adhered] polyvinyl-chloride (PVC) roof membrane system applied over [insulation] [recovery board] [concrete roof deck] [PVC membrane roofing manufacturer-accepted] substrate. [Incorporate air barrier in the roof assembly as specified in Section 07 22 00 ROOF AND DECK INSULATION.]

1.3 ASSEMBLY REQUIREMENTS

****

NOTE: For guidance on flashings and drainage details, the designer should consult the SMACNA "Architectural Sheet Metal Manual."

****

Provide roofing membrane sheet widths consistent with membrane attachment methods and wind uplift requirements, and as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Provide membrane which is free of defects and foreign material. Coordinate flashing work to permit continuous roof-surfacing operations. Install insulation and weatherproofed planned sections on the same day.

1.3.1 Fire Resistance

Complete roof system assembly:

****

NOTE: Specify Class B option only when Class A may not be attainable such as membrane system application directly to wood deck. Provide justification/rationale for Class B option with design submission

****

a. Class A [or B] rated in accordance with ASTM E108, FM 4470, or UL 790; and

b. Be listed as Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.3.2 Wind Uplift Resistance

****

NOTE: Determine the required wind uplift resistance based on ASCE 7-22 wind loading calculations or applicable building code requirements.

The specified FM rating incorporates a safety factor of 2 over the maximum calculated uplift pressure. Therefore, a FM rating of 1-90 correlates to a maximum uplift calculation of 2.2 kPa 45 psf. When a rated system is specified, ensure the specified roof system is capable of meeting the wind uplift resistance specified. Where non-rated systems may be permissible, include the bracketed option.

Delineate calculated values in the roof specification or drawings. Utilize independently tested and rated roof systems, such as Factory Mutual (FM), Underwriters Laboratory (UL), and Single Ply Roofing Industry (SPRI).

****

Provide a complete roof system assembly that is rated and installed to resist wind loads [indicated][calculated in accordance with ASCE 7-22] and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems, except as approved by the Contracting Officer. Submit Engineering calculations, signed, sealed, and dated by a Registered Engineer validating the wind resistance in accordance with ASCE 7-22, and ANSI/SPRI/FM 4435/ES-1 of non-rated roof system. Base wind uplift measurements on a design wind speed of [_____] km/h mph in accordance with ASCE 7-22 and other applicable building code requirements.

1.3.3 Solar Reflectance Index (SRI)

****

NOTE: Compliance with ASHRAE 90.1 is required on all projects. For ASHRAE 90.1 compliance, include the first bracketed sentences for projects in ASHRAE climate zones 0 thru 3. See ASHRAE 90.1 Chapter 5, section titled "Roof Solar Reflectance and Thermal Emittance", for exceptions when roof design conditions eliminate these requirements and this section can be deleted. When a designer desires IgCC compliance with cool roof requirements, include the second set of bracketed sentences for projects in ASHRAE climate zones 0 thru 3. See IgCC Chapter 5 for exceptions when design conditions eliminate these requirements.

****

SRI measures the roof's ability to reject solar heat, defined such that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. [Provide roof finishes for more than 75 percent of the roof surface having a minimum 3-year aged solar reflectance of 0.55, and a minimum 3-year aged thermal emittance of 0.75 when tested in accordance with ANSI/CRRC S100, or, a minimum 3-year

aged Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 6.62 W per m^2 2.1 BTU per h ft^2.] [Use roofing materials having minimum 3-year aged SRI for more than 75 percent of roof surface (less than or equal to 2:12 slope, SRI greater than 64; greater than 2:12 slope, SRI greater than 25).] SRI values are based on a minimum three-year aged solar reflectance and thermal emittance, as measured in accordance with ANSI/CRRC S100.

1.4 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

Roof Plan; G[, [_____]]

SD-03 Product Data

PVC Roofing Membrane; G[, [_____]]

[Heat Island Reduction; S]

Bonding Adhesive

Flashing

Membrane Fasteners and Plates

Roof Insulation

Protection Mat

Pre-Manufactured Accessories

Water Cutoffs

Information Card

SD-05 Design Data

****
NOTE: Coordinate with requirements of Wind Uplift Resistance paragraph. Include bracketed requirement where non-rated systems may be permissible.
****

Wind Uplift Resistance; G[, [_____]]

SD-07 Certificates

Qualification of Manufacturer

Qualifications of Applicator

Fire Resistance classification

Minimum Polymer Thickness

Sample Warranty; G[, [_____]]

SD-08 Manufacturer's Instructions

Application Method; G[, [_____]]

Membrane Flashing; G[, [_____]]

Perimeter and High Wind Attachment

Auxiliary Fasteners

Pre-Manufactured Accessories

Cold Weather; G[, [_____]]

SD-11 Closeout Submittals

Warranty; G[, [_____]]

Information Card; G[, [_____]]

Instructions to Government Personnel; G[, [_____]]

1.5 QUALITY ASSURANCE

****
NOTE: All projects with more than 1400 square meters 15,000 square feet of roof area or that is defined as critical use or mission critical in the project DD Form 1391 must have a Registered Roof Consultant (RRC) or a registered professional engineer (PE) or registered architect (RA) that derives his or her principal income from roofing design on the quality control staff of the design team.
****

1.5.1 Qualification of Manufacturer

****
NOTE: Specify minimum five years manufacturer experience unless directed otherwise.
****

Polyvinyl-Chloride sheet roofing system manufacturer must have a minimum of [5] [10] [___] years experience in manufacturing PVC roofing products.

1.5.2 Qualifications of Applicator

****
NOTE: Specify minimum five years as an approved Contractor unless directed otherwise
****

Roofing system applicator must be approved, authorized, or licensed in writing by the PVC sheet roofing system manufacturer and have a minimum of [five][_____] years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of five projects, within the previous three years, of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project.

1.5.3 Conformance and Compatibility

Provide an entire roofing and flashing system that is in accordance with specified and indicated requirements, including fire and wind resistance.

1.5.4 Preroofing Conference

After approval of submittals and before performing roofing [and insulation] system installation work, hold a preroofing conference to review the following:

****
NOTE: Delete the following bracketed statement if the roof work is for a new structure.
****

a. Drawings, including roof plan, specifications and submittals related to the roof work. [Field inspection and verification of existing conditions, including fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.]

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative to roof manufacturer;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control(NRCA 3621) plan for the roof system installation;

f. Safety requirements.

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing[and insulation], flashing and sheet metal work, [[mechanical] [and] [electrical] work], other trades interfacing with the roof work, designated safety personnel trained to enforce and copy with ASSP A10.24,[Fire Marshall,] and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.6 DETAIL DRAWINGS

Submit roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, [location of perimeter half-sheets] [, spacing of perimeter, corner, and infield fasteners,] as applicable. Provide drawings that reflect the project roof plan of each roof level and conditions indicated. Submit bids with approved detail drawings and specifications approved and furnished by the PVC membrane manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery

Deliver materials in the manufacturer's original, unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification number, the container must bear the specification number, type, class, and shelf life expiration date where applicable. Deliver

materials in sufficient quantity to allow work to proceed without interruption.

1.7.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 10 degrees C 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

a. Maintain a minimum distance of 10.67 meters 35 foot for stored flammable materials, including materials covered with shrink wraps, craft paper or tarps from torch/welding applications.

b. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.7.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.8 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 4.5 degrees C 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

1.9 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing in accordance with NRCA 3740, are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. [Apply roofing immediately following application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that roof insulation applied each day is covered with roof membrane installation the same day.]

1.10 WARRANTY

Provide roof system material and workmanship warranties. Provide revision

or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years. Submit sample certificate.

1.10.1 Roof Membrane Manufacturer Warranty

****

NOTE: Insulated and routinely occupied facilities or facilities containing sensitive equipment or operations require a warranty of not less than 15 years. Designer may specify a 5 or 10 year manufacturer warranty on facilities of small roof area and of minor importance where interiors and contents are not severely impacted by potential water intrusion. Require minimum 10 year warranty on environmentally controlled interiors regardless of small size.

****

Furnish the roof membrane manufacturer's 20-year, no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories included in Section 07 60 00 FLASHING AND SHEET METAL. Provide warranty directly to the Government commencing at the time of Government's acceptance of the building. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.10.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.10.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as

to restore the integrity of the roof system assembly and validity of the manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

****

NOTE: Edit the product data submission requirements as necessary for the PVC membrane roof system specified. Include bracketed requirements as applicable to the system being specified.

****

2.1.1 PVC Roof Membrane

Provide a minimum polymer thickness 2.03 mm 0.08 inch reinforced PVC as specified herein. Provide PVC system capable of obtaining 20 year warranties and as listed in the applicable wind uplift and fire rating classification listings.

Submit Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Provide data that includes written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer.

a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Provide materials free of defects and suitable for the service and climatic conditions of the installation. Provide warranted roof system in which all components are sourced from the PVC roof membrane manufacturer, including but not limited to all insulation, coverboards, accessories, adhesives and edge metal.

b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm 0.032 inch thick aluminum card for exterior display. Provide card that is 215 by 275 mm 8 1/2 by 11 inches minimum. On the information card identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

2.1.2 Energy [and Cool Roof] Performance

****

NOTE: Standards such as UFC 1-200-02 promote the use of cool roofing, and increased energy conservation through additional insulation. Design cool roofs following the requirements in UFC 3-110-03 "Roofing" Chapter 1, Cool Roofs. Design insulation for cool roofs to meet at a minimum the ASHRAE 90.1 Chapter 5 zone requirements. Consider that when cool roofing is used with insulation R values greater than 24, the 'cool roof' surface has little if no influence on the energy performance of the building. Additionally, designers should be aware of the possible negative impacts of using cool roofing that may result in unintended consequences. Design mechanically-fastened single-ply roof systems following the requirements in UFC 3-110-03 Roofing, Chapter 2. Condensation on the underside of mechanically-fastened systems can result in ice build-up in winter, mold growth on the facers, moisture dripping into the interior, and replacement of the roofs with less than four years of service. See Appendix B of UFC 3-110-03 for more information. Poor design of cool roofs in ASHRAE climate zones 4 and higher have resulted in the unintended consequence of condensation below the membrane-a result of the material's inability to warm and drive moisture downward. Roofs that experience this condensation have had to be replaced. Other unintended consequences include the overheating of masonry walls, interior spaces, roof top piping and mechanical equipment as a result of the reflected UV rays.

****

****

NOTE: If a cool roof is selected, meet the ASHRAE 90.1 Chapter 5 values for roof insulation, roof solar reflectance and thermal emittance. If a cool roof is not selected in zones 1-3, meet one of the exception requirements listed in ASHRAE 90.1 Chapter 5 or provide thermal insulation above the deck with an R value of 33 or greater. Retain the last bracketed sentence for project with sustainable third party certification credit requirement for reduced heat island effect.

****

Install a roof system that meets an overall performance as specified on the drawings or by insulation specified in other sections. [The roofing system must meet the criteria for Cool Roof Products. [Provide emittance and reflectance percentages, solar reflectance index values, [and] slopes [_____], to meet sustainable third party certification requirements for Heat Island Reduction.]]

2.1.3 Bonding Adhesive

****

NOTE: Bonding adhesive is used for adhering PVC membrane to materials other than PVC.

Coordinate work restrictions when working on occupied buildings. For these instances, write in a description of the adhesive required. Consider peel and stick adhesion of PVC membranes in these instances.

****

Provide PVC membrane manufacturer's recommended adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of PVC membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

2.1.4 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.5 Membrane Flashing

Provide membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, of a minimum polymer thickness 1.8 mm 0.072 inch reinforced PVC for 20 year warranties, and utilized as recommended and supplied by the roof membrane manufacturer or minimum 1.8 mm 0.072 inch thick reinforced PVC roof membrane and flashings for 20 year warranties. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.

2.1.6 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended and supplied by the PVC roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www. roofnav.com) or FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. Fasteners and plates to be supplied and warranted for the substrate type(s) by PVC membrane manufacturer and recommended by PVC membrane manufacturer's printed data.

2.1.6.1 Stress Plates, Bar or Rail for Fasteners

Utilize corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470. Stress plates to be supplied by PVC roof membrane manufacturer. Form stress plates to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.

2.1.6.2 Auxiliary Fasteners

Provide corrosion resistant screws, nails, or anchors suitable for intended attachment purpose and be recommended and supplied for use by the PVC roof membrane manufacturer.

[2.1.7 Protection Mat

****
NOTE: Specify protection mat for application between roof membrane and paver ballast when combination adhered/protected membrane and loose-laid PVC membrane roofing systems are specified without pedestals and for application between roof membrane and insulation or other growth medium and system components for IRMA and garden-style PVC membrane roofing systems.
****

Minimum [154] [200] gram/square m [4.5] [6] ounce/square yard ultraviolet resistant polypropylene, non-woven, needle punched fabric for use as protection mat under ballast system or as recommended and supplied by the roof membrane manufacturer.

][2.1.8 Pre-manufactured Accessories

****
NOTE: Edit, delete, and insert accessory materials requirements as required for the specific project and components to be installed.
****

****
NOTE: Specify aluminum or stainless steel in humid locations or project locations with Environmental Severity Classifications (ESC) of C3 thru C5. AZ55 galvalume and G90 galvanized are allowed in ESC C1 and C2 project locations. Humid locations are those in ASHRAE climate zones 0A, 1A, 2A, 3A, 3C, 4C and 5C (as identified in ASHRAE 90.1). See UFC 1-200-01 for determination of ESC for project locations.
****

Provide pre-manufactured accessories that are manufacturer's standard for intended purpose, comply with the applicable specification section, are compatible with the membrane roof system and approved for use and supplied by the PVC roof membrane manufacturer. Provide pre-fabricated curbs of [_____] gauge [G90 galvanized] [AZ55 galvalume] [_____] with minimum 100 mm 4 inch flange for attachment to roof nailers. Provide curbs of minimum height of 250 mm 10 inches above the finished roof membrane surface.

][2.1.9 PVC Walk Tread

****
NOTE: Use PVC Walk Tread as pedestrian walkways where the roof, or areas of the roof, are intended to bear foot traffic for maintenance or other purposes once per month or more frequently.
****

Scrim reinforced 2.4 mm 0.096 inch thickness PVC membrane with a textured surface, compatible with and supplied by manufacturer of the PVC roof membrane.

][2.1.10 Elevated Metal [Walkways] [and] [Platforms]

As specified in Section 08 31 00 ACCESS DOORS AND PANELS, and as approved by the roof membrane manufacturer.

]2.1.11 Roof Insulation

****

NOTE: If the roofing system contains insulation, coordinate with the appropriate insulation specification section. The insulation specification should include materials and installation up to the substrate on which the roof membrane is applied and must be supplied by the PVC membrane manufacturer and guaranteed under the PVC membrane roof manufacturer's full system warranty.

Do not adhere single ply PVC roof membrane to perlite, polystyrene, or standard wood fiber insulation board.

Coordinate insulation system attachment with the wind resistance requirements. In many instances, insulation system must be adhered or mechanically fastened to deck with increased frequency in corner and perimeter areas, if not throughout the field of the roof.

****

Provide insulation system and facer material compatible with membrane application specified and be approved and supplied by the PVC membrane roof manufacturer[and as specified in Section 07 22 00 ROOF AND DECK INSULATION].

2.1.12 Wood Products

****

NOTE: Coordinate with Section 06 10 00 ROUGH CARPENTRY. Some fire retardant treatment (FRT) chemicals may affect PVC materials. SDS listing active ingredients for the FRT wood must be submitted to PVC manufacturer prior to applying PVC materials in contact with FRT wood.

****

As specified in Section 06 10 00 ROUGH CARPENTRY, except that fire retardant treated materials must not be in contact with PVC membrane or PVC accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.2 REINFORCED, PVC MEMBRANE

****

NOTE: Refer to Designer Note in PART 1 for guidance regarding membrane attachment method and in editing the membrane materials' requirements.

Specify minimum 2.03 mm 0.08 inch thickness PVC membrane for all applications.

Specify adhered membrane systems only to acceptable substrates (consult PVC membrane manufacturer) or mechanically fastened PVC membrane roof systems (in all wind zones). For adhered roof membrane application (typically, not located in extreme wind zones), specify reinforced roofing membrane that is particularly suitable, due to the reinforcement's dimensional stability characteristics, for adhered PVC roof membrane system application. Similar adhered membranes that utilize a peel and stick release paper are also acceptable.

Specify a minimum 2.03 mm 0.08 inch membrane thickness that complies with either ASTM D4434/D4434M Type II, Grade I, or TYPE III or Type IV, or ASTM D6754 reinforced PVC membrane roofing specifications. A reinforced membrane is required on vegetative roofs, as well as in cold climate locations.

Minimum 2.03 mm 0.08 inch thickness ASTM D4434/D4434M Type II, Grade I membrane with fleece-backing may be used in certain adhered applications where the adhesive is typically an applied compound, spray foam adhesive, or when PVC fleecebacked membrane roofing is to be adhered to lightweight cellular insulating concrete. Modify this specification for proper adhesive and application parameters in accordance with PVC roof membrane manufacturer's requirements and recommendations when adhered fleeceback PVC membrane is specified.

Minimum membrane thickness is not inclusive of fleece.

2.4 mm 0.096 inch PVC membrane is also available. Specify 2.4 mm 0.096 inch membrane for applications that experience regular heavy traffic conditions or regular extreme wind conditions that can experience airborne debris. 2.4 mm 0.096 inch membrane may be adhered or mechanically fastened. Alternately, a combination adhered/protected membrane system can be utilized for high wind locations that can experience airborne debris.

****

Provide reinforced polyvinyl chloride (PVC) membrane containing fibers or scrim, and complying with ASTM D4434/D4434M, [Type II, Grade I] [Type III] [Type IV] [Type II, Grade I or Type III or Type IV, fleece backed], or ASTM D6754/D6754M, and in all cases provide 2.03 mm 0.08 inch minimum thickness for [adhered] [mechanically fastened] [combination adhered/protected membrane] application. Not withstanding the ASTM standards referenced, provide reinforced PVC roof membranes having the minimum, labeled thickness specified. PVC membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Provide principal polymer used in manufacture of the membrane sheet as PVC, with width and length of PVC membrane roofing sheet

consistent with membrane attachment methods and wind uplift requirements, and sheet size as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced PVC membrane roofing sheet dimensions to be the maximum width obtainable from PVC membrane roof manufacturer in order to minimize seams in the field of the roof.

2.3 PHOTOVOLTAIC (PV) SYSTEMS - RACK MOUNTED SYSTEMS

****

NOTE: The installation of a PV roof system over existing roof systems should be undertaken with extreme caution. Do not install PV systems on roofs with a shorter expected service life than the new PV system. Prior to the design of such systems the following must be undertaken:
a. Determine if the existing roof structure can handle the anticipated roof load increase.
b. Inspect and determine that the existing roof system has at least 10 years of service life remaining. If not, remove the existing roof and provide a new replacement roof system design in tandem with the photovoltaic system.
c. If 10 years remaining service life remains, ensure the design of the intersecting details, required roof protection, re-inspections, and warranty requirements for maintaining the roof system has been coordinated with the installation and manufacturers' warranties.
d. Design the roof related details for anticipated roof replacement work. Coordinate with the PV system designer to anticipate and plan for future roof replacement.
e. PV equipment on a rooftop creates additional roof protection requirements during initial installation and throughout the PV life-cycle. Ensure a roof protection program is specified during the PV system installation.
f. Permanently affix PV supports to stanchions which are anchored to the building structure.

****

Adhere to NRCA 3906.

PART 3 EXECUTION

[3.1 CONCRETE SURFACE DRYNESS

****

NOTE: Delete this Article unless roofing system is being installed on a concrete deck.

****

Prior to installing roof system on a concrete deck, including application of insulation or membrane materials, conduct a test for surface dryness in accordance with ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

]3.2 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Do not install items that show visual evidence of biological growth.

b. [Drains,] [curbs,] [control joints,] [expansion joints,] [perimeter walls,] [roof penetrating components,] [and] [equipment supports] are in place.

c. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

d. Substrate is sloped to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 200 mm 8 inches above finished roofing surface.

****
NOTE: Coordinate with Section 06 10 00 ROUGH CARPENTRY to ensure that preservative treatment is specified for wood which will be in contact with roofing components.
****

g. Pressure-preservative treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. [Embedded nailers are flush with deck surfaces.] [Surface-applied nailers are the same thickness as the roof insulation.]

h. PVC materials are not in contact with fire retardant treated wood, except as approved by the PVC membrane roof manufacturer and Contracting Officer.

****
NOTE: Include venting provision for wet fill substrate materials like lightweight cellular concrete where required by cellular lightweight concrete manufacturer.
****

[i. If required or recommended by the cellular lightweight concrete manufacturer's requirements and recommendations, provide venting.]

[j. Exposed nail heads in wood substrates are properly set. Warped and split [boards] [sheets] have been replaced. There are no cracks or end joints 6 mm 1/4 inch in width or greater. [Joints in plywood substrates are taped or otherwise sealed to prevent air leakage from the underside.]]

[k. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6 mm 1/4 inch in width. Insulation is attached as specified in Section 07 22 00 ROOF AND DECK INSULATION. Insulation is being roofed over on the same day the insulation is installed.]

3.3 APPLICATION METHOD

****

NOTE: Coordinate application method with paragraphs "Description of Roof Membrane System" and appropriate subparagraph under "PVC Membrane Roofing".

Edit the manufacturers instructive submission requirements as necessary for the system specified. Include bracketed requirements only as applicable to the system being specified.

Mechanically fastening methods can have limitations on the roof warranty and require additional securement measures across the field of the installation.

As per UFC 3-110-01 section titled "Mechanically Fastened Weldable Thermoplastic Systems", Cool roofs in ASHRAE Climate Zones 4-8 must be fully adhered and not mechanically fastened.

****

Apply entire PVC membrane roofing utilizing [adhered] [mechanically fastened] [combination adhered/protected membrane] application method[s]. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Submit instructions including pattern and frequency of mechanical attachments required in the field for roof, corners, and perimeters to provide for the specified wind resistance

3.3.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning PVC sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 15 to 27 degrees C 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the PVC membrane roofing sheet.

h. Shut down air intakes and related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

i. Identify any combustible materials at or near heat seaming devices. Remove the combustible material and use particular caution around those combustible materials throughout the installation.

j. At no time will torch equipment be used for seams, repairs, or welding installations. Install all welded components and seams using heat guns within the strict written instructions of the membrane manufacturer.

k. All heat welding must be performed by an individual that has and maintains a NFPA 101 Hot Work Safety Certificate.

l. Upon completion of the heat seaming, establish a fire watch with the use of a thermal heat imager during the watch.

3.3.2 PVC Roofing Membrane

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Provide and install only felt-backed membrane directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Do not place non-felt-backed PVC membrane roofing sheet directly on concrete deck or other hard surface which may damage the membrane. Provide membrane overlap of a minimum of 75 mm 3 inches at sides for adhered applications and 140-180 mm 5.5-7 inches for mechanically fastened applications and minimum 100 mm 4 inches at ends. Direction of laps must allow water to flow over and not against the lap. Install membrane joints that are free of wrinkles and fishmouths. During the day of installation, probe the entire length of hot-air-welded seams and correct deficiencies. Reweld defective areas. Cut out fishmouths, or damaged areas and cover the area with membrane using a continuous hot-air-welded seam on all sides. Probe test repairs for continuity. Hot-air-welded seams are to be accomplished in accordance with the PVC membrane roofing manufacturer's published requirements.

3.3.2.1 Nailing

Fasten membrane to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, stagger nails on 100 mm 4 inch centers maximum; stagger screws for sheet metal on 200 mm 8 inch centers maximum; and install rows of fasteners at least 13 mm 1/2 inch from edges of sheet metal.

3.3.2.2 Flashing

Flash all roof edges, projections through the roof and changes in roof planes. Seal the seam a minimum of 75 mm 3 inches beyond the fasteners which attach the membrane to nailers. Secure the installed flashing at

the top of the flashing a maximum of 300 mm 12 inches on centers under the counterflashing or cap. Where possible, install prefabricated components for pipe seals and flashing accessories.

3.3.2.3 Expansion Joints

Cover expansion joints using Prefabricated covers or elastomeric flashing in accordance with the recommendations of the manufacturer.

3.3.2.4 Cutoffs

If work is terminated prior to weatherproofing the entire roof, seal the membrane to the roof deck. Also, seal flutes in metal decking along the cutoff edge. Pull the membrane free or cut to expose the insulation when resuming work and remove the cut insulation sheets used for fill-in. Do not use asphalt or coal-tar products for sealing.

3.3.2.5 Walkways

Install walkways on a loose-laid pad of the membrane material extending at least 25 mm 1 inch beyond the walkway material, and as specified by the manufacturer. Do not place stone ballast below or above walkways.

[3.3.3 Adhered Membrane Application

****

NOTE: Delete this paragraph unless an adhered or combination adhered and mechanically fastened application is specified.

Delete the bracketed option in the fourth sentence and delete the fifth sentence when non-standard adhesives are specified such as sprayed foam or hot asphalt used with fleece-backed membrane.

****

Layout membrane and side lap adjoining sheets in accordance with membrane manufacturer's printed installation instructions. Allow for sufficient membrane to form proper membrane terminations. Remove dusting agents and dirt from membrane and substrate areas where bonding adhesives are to be applied. Apply specified adhesive evenly and continuously to substrate [and underside of sheets] at rates recommended by the roof membrane manufacturer's printed application instructions. When adhesive is spray applied, roll with a paint roller to ensure proper contact and coverage. Do not apply bonding adhesive to surfaces of membrane in seam or lap areas. Allow adhesive to flash off or dry to consistency prescribed by manufacturer before adhering sheets to the substrate. When adhesive is peel and stick release paper-activated, follow manufacturer's printed instructions. Roll each sheet into adhesive slowly and evenly to avoid wrinkles; broom or roll the membrane to remove air pockets and fishmouths and to ensure adequately uniform bonding of sheet to substrate. Form field hot-air-welded laps or seams as specified and ensure that hot-air welded dimension is at width required by the membrane manufacturer's installation instructions. Check all seams and continuous hot-air-weld of all seams and lap seals.

][3.3.4 Mechanically Fastened Membrane Application

****

NOTE: Delete this paragraph unless a mechanically fastened application is specified.

As per UFC 3-110-01 section titled "Mechanically Fastened Weldable Thermoplastic Systems", Cool roofs in ASHRAE Climate Zones 4-8 must be fully adhered and not mechanically fastened.

Membrane side lap depends on method of mechanical attachment, wind resistance testing of the specific system provided, and requirements of the membrane manufacturer. Generally, position attachments such that minimum 75 mm 3 inch seam width remains beyond the outer edge of the attachment plate or batten strip. Fastener and plate attachment typically requires 140 mm to 180 mm 5.5 to 7 inch membrane overlap. Batten attachment typically requires 100 mm to 150 mm 4 to 6 inch membrane overlap.

****

Layout membrane and lap adjoining sheets in accordance with membrane manufacturer's printed instructions such that the minimum recommended seam width is maintained and to ensure that seam width is as required by tested assembly meeting specified wind resistance requirements. Account for additional overlap required for placement of fasteners and plates or battens beyond the closed seam. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Mechanically secure the membrane sheet with specified fasteners in the lap area. Space fasteners as required to provide the wind uplift resistance specified and in accordance with submitted fastener patterns for the field, corner, and perimeter roof areas. Set fasteners firm to plate or batten. Form field hot-air-welded seams, laps and coverstrips, as specified. Check all seams and ensure full/continuous lap seal.

][3.3.5 Perimeter and High Wind Attachment

****

NOTE: All application methods of PVC membranes require mechanical fastening of the membrane to wood nailers at the roof perimeters, at angular penetrations, at circular penetrations, or other roof features/components, except roof drains greater than 456 mm 18 inches in diameter.

****

Adhesive bond and mechanically secure roof membrane sheet at roof perimeter and other areas in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond must be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

][3.3.6 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angles greater than 4 degrees (1:12). Space fasteners a maximum of 300 mm 12

inches on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Cover over all exposed fasteners with a layer of roof manufacturer's flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

][3.3.7 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flashed with PVC membrane flashing materials.

3.3.7.1 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

][3.3.8 Roof Walkways

Install walkways at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the PVC membrane roof manufacturer's printed instructions. Provide minimum 150 mm 6 inch separation between adjacent walkways to accommodate drainage.

][3.3.9 Elevated Metal [Walkways] [and] [Platforms]

Install over completed roof system in accordance with Section 08 31 00 ACCESS DOORS AND PANELS. Provide for protection of roof membrane by placing reinforced membrane or walkpad material, or other material approved by the PVC membrane roof manufacturer and Contracting Officer, at all surface bearing support locations.

][3.3.10 Isolated Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Set paver block on a layer of reinforced PVC membrane or walkway applied over the completed PVC roof membrane.

]3.4 FLASHINGS

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

3.4.1 General

Provide a one-ply flashing membrane, as specified for the system used, and install immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings must be stepped where vertical surfaces abut sloped roof surfaces. Provide sheet metal reglet in which sheet metal cap flashings are installed of not more than 400 mm 16 inch nor less than 200 mm 8 inch above the roofing

surfaces. Exposed joints and end laps of flashing membrane must be made and sealed in the manner required for roofing membrane.

3.4.2 Membrane Flashing

****

NOTE: Coordinate flashing requirements with Section 07 60 00 FLASHING AND SHEET METAL and details. Ensure Section 07 60 00 FLASHING AND SHEET METAL is properly edited for application to PVC roofing systems and for inclusion of flashing conditions of the project.

****

3.4.2.1 Installation

Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize cured PVC membrane flashing and prefabricated accessory flashings to the maximum extent recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flashing scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical. Extend base flashing not less than 200 mm 8 inch above roofing surface and as necessary to provide for seaming overlap on roof membrane as recommended by the roof membrane manufacturer.

3.4.2.2 Sealing

Seal flashing membrane for a minimum of 75 mm 3 inch on each side of fastening device used to anchor roof membrane to nailers. Completely adhere flashing sheets in place. Seam flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Reinforce all corners and angle transitions by applying uncured membrane to the area in accordance with roof membrane manufacturer recommendations. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 300 mm 12 inch on center. Install sheet metal flashing over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.4.3 Flashing at Roof Drain

****

NOTE: Include this paragraph when roof drains are indicated.

****

Provide a tapered insulation sump into the drain bowl area. Do not exceed tapered slope of (4:12) 18 degrees for unreinforced membrane and (1:12) 5 degrees for reinforced membrane. Provide tapered insulation with surface suitable for adhering membrane in the drain sump area. Avoid field seams

running through or within 600 mm 24 inch of roof drain, or as otherwise recommended by the roof membrane manufacturer. Adhere the membrane to the tapered in the drain sump area. Apply water block mastic and extend membrane sheets over edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Ensure membrane is free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 20 mm 3/4 inch of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.5 ROOF WALKPADS

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the roof membrane manufacturer's printed instructions. Provide minimum 150 mm 6 inch separation between adjacent walkpads to accommodate drainage.

3.5.1 Elevated Metal [Walkways][and][Platforms]

Provide for protection of roof membrane by placing reinforced membrane or walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

3.6 CORRECTION OF DEFICIENCES

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and provide corrective action recommendations. Perform corrective action as directed by the Contracting Officer.

3.7 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

[3.7.1 Water Cutoffs

****
NOTE: Include this paragraph when roof insulation is a substrate for the reinforced PVC membrane roofing.
****

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane system in an effective manner. [Seal off flutes in metal decking along the cutoff edge.] Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

]3.7.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.7.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied

roofing system. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

(2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(3) The proper number, type, and spacing of fasteners are installed.

(4) Materials comply with the specified requirements.

(5) All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.

(6) Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required[, including additional fastening of membrane in corner and perimeter areas as required.]

(7) Membrane is properly overlapped.

(8) Membrane seaming is as specified by PVC membrane manufacturer. All seams are checked at the end of each work day.

(9) Applied membrane is inspected and repaired as necessary prior to paver installation.

[(10) Membrane is adhered without ridges, wrinkles, kinks, fishmouths.]

(11) Installer adheres to specified and detailed application parameters.

(12) Associated flashing's and sheet metal are installed in a timely manner in accord with the specified requirements.

(13) Paver ballast is within the specified weight range.

(14) Temporary protection measures are in place at the end of each

work shift.

[3.8.2 Manufacturer's Inspection

****
NOTE: Include this paragraph when manufacturer's guarantee is required. Select desired frequency of manufacturer inspection and coordinate with text of optional 2nd and 3rd bracketed sentences.
****

Manufacturer's technical representative must [be present full time when Single Source Contract Liability Warranty is desired] [visit the site a minimum of [[3] [_____] times] [once per week] during the installation for purposes of reviewing materials installation practices and adequacy of work in place].[Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections need not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer.] After each inspection, a report, signed by the manufacturer's technical representative to the roofing Contractor and then to the Contracting Officer within 3 working days. Within the report state the overall quality of work, deficiencies and any other concerns, and recommended corrective action.

]3.9 CLEAN UP

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.10 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Verbal instructions must be provided by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations. Include copies of Safety Data Sheets for maintenance/repair materials.

[3.11 ROOF DRAIN TEST

****
NOTE: Include this paragraph when roof drains are required. Consult with structural engineer to verify loading capability of roof structural system.
****

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a

properly installed watertight flashing seal. Repeat test until there is no water leakage.

] -- End of Section --