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USACE / NAVFAC / AFCESA / NASA **UFGS-07 54 19 (November 2008)**

Preparing Activity: USACE **Superseding UFGS-07 54 19 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2012
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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 54 19

POLYVINYL-CHLORIDE (PVC) ROOFING

11/08

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SECTION 07 54 19
POLYVINYL-CHLORIDE (PVC) ROOFING
11/08

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NOTE: This guide specification covers the requirements for ENERGY STAR labeled reinforced polyvinyl chloride roofing membrane.

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 items(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).
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PART 1 GENERAL

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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.

Custom-color PVC membrane roofing materials, such as those not bearing the ENERGY STAR label, are available. The use of PVC membrane roofing in alternative colors (other than those bearing the ENERGY STAR label) is discouraged, but is

appropriate with specific operational justification.

The standard application method for installing ENERGY STAR-labeled PVC membrane roof systems include the construction of both adhered and mechanically fastened roof system assemblies.

For excessive wind loading conditions, the mechanically fastened PVC membrane roofing system included in this section provides a special, engineered bar and coverstrip application wherein an anchoring bar is placed at calculated intervals over loose laid, hot-air-welded, PVC membrane. The mechanically fastened anchoring bars are subsequently weatherproofed with a hot-air-welded PVC membrane coverstrip creating a finished roofing surface. Also included in this section is a mechanically fastened PVC membrane roofing system that provides a double-weld seaming technique that involves a method for encapsulating a mechanically fastened polymer batten within the area of the membrane seam. When specifying mechanically fastened roof systems for excessive wind loading conditions, the PVC membrane roofing system manufacturer should be consulted for roof system attachment guidance and wind engineering and uplift calculation requirements.

Provided in this section are additional PVC membrane roofing system assemblies and component configurations. Protective design and roof system configuration can be appropriate for utilization by designers to help protect, with pavers, an underlying PVC membrane roofing system from potential damage caused by extreme weather events that might produce wind-blown projectile conditions. These conditions can be experienced with greater regularity in certain geographic areas. For such conditions, designers may choose to rely on a special, combination adhered/protected PVC membrane roofing system configuration that utilizes the membrane roofing manufacturer's supply of roofing pavers to help protect the underlying, adhered PVC membrane roofing system from airborne debris.

Another option provided by this section for buildings that experience excessive wind loading conditions is a PVC membrane roofing system assembly that can be designed to utilize a felt-backed PVC membrane that is adhered to cellular lightweight insulating concrete. Roofing systems comprised of felt-backed PVC roofing membrane that is adhered to cellular lightweight concrete have the highest ratings tested and exceed the stringent Dade County Florida building code by providing the demonstrated performance functionality that is encountered in this hurricane prone geographic area.

A loose-laid, paver ballasted PVC membrane roofing system assembly is also included in this section that can be utilized and adapted by roof system designers. Loose-laid PVC roofing membranes with specialized system component assemblies can also be configured to accommodate inverted roof membrane assemblies (IRMA) that are suitable for installations with high interior humidity conditions (such as pools)and for garden-style ("Green") roofing systems. Loose-laid/paver ballasted, and IRMA PVC membrane roofing systems can be utilized for other roof system design purposes, including the existence of limited and/or restrictive flashing heights.

PVC membrane roofing materials bearing the ENERGY STAR label are not mandatory for unexposed roof membrane systems such as paver ballasted, IRMA, combination adhered/protected membrane, or garden-style roofing systems because the reflective surface of an ENERGY STAR-labeled PVC roofing membrane is obscured from view and/or from the sun's direct radiation in such configurations.

The use of stone and gravel as ballast is not allowed in conjunction with any PVC membrane roofing system assembly and should never be designed or installed in conjunction with any PVC membrane roofing system.

This section must be coordinated with other roof system component specifications including drains/plumbing, elevated metal walkways and platforms, rough carpentry, insulation, and flashing and sheet metal flashing sections.

All components of the specified PVC membrane roofing system including, but not limited to the roof membrane, the roof system insulation, any/all insulation overlayment, the adhesives and fasteners, as well as the integration and installation of all other roof system components, must be in accordance with the PVC membrane roofing manufacturer's printed roof system installation instructions and should always be subject to, and in compliance with, all applicable state and local building codes and/or otherwise code-compliant as evidenced by the governing code official's acceptance of the design of the PVC membrane roofing system.

PVC membrane roofing should not be adhered directly to polystyrene, perlite or standard wood fiber insulation. Facer material on polyisocyanurate roof insulation boards, or insulation overlayment boards can only be assumed compatible with the adhesive of the specified PVC membrane roofing materials if and when the roofing adhesives, roof insulation, overlayment boards and all other roof system components are procured from the same PVC membrane

roof manufacturer. Glass mat, 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.

Reinforced PVC membrane roofing should not be used in direct physical contact with asphalt, coal tar pitches, nor petroleum-based products. For additional guidance on ENERGY STAR-labeled PVC roofing membrane and material compatibility, the designer should always consult the PVC roofing membrane manufacturer.

The integrity of hot-air-welded seams are characteristic of the unique utility of an ENERGY STAR-labeled PVC roofing membrane and allow for reliable performance under common hydrostatic pressure conditions (beneath standing/ponded water). The occurrence of standing/ponded water does not void or nullify the warranty coverage of most PVC membrane roofing system warranties, but its functionality is limited, and subject always, to the structural capacity of both the roof deck and the underlying building. Unlike the guarantees supplied by many alternative roofing systems, the specified ENERGY STAR-labeled PVC membrane roofing manufacturer offers a warranty that does not nullify its performance guarantee due to the occurrence of standing/ponded water.

All roofs should be constructed to drain with a minimum slope of 20 mm per meter (1/4 inch per foot). Subject always to building code compliance and/or code official's approval, ENERGY STAR-labeled PVC roofing membrane can be specified for existing buildings in need of reroofing in situations where the existing conditions are restrictive to a designer's options. Such conditions might include the inheritance of limited structural slope (less than 20 mm per meter (1/4 inch per foot)) and/or limited flashing heights, or when designer preference or certain project-specific conditions dictate and/or prohibit the use of elaborate, tapered insulation systems.

The combination adhered/protected PVC membrane roofing system can be applied to roofs having slopes up to 165 mm per meter (2 inches per foot).

Roof expansion joints must be provided at each expansion joint in the structure, at each change in deck material, and at each intersection where a roof deck changes direction. Expansion joints and curb dividers in the membrane should be located at high points where practicable.

All flashing heights, including but not limited to top of nailers for curbs and area dividers should be

at least 200 mm (8 inches) above surface of finished roof. Expansion joints should not interfere with drainage. Do not use flush type joints.

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1.1 REFERENCES

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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 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.

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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	(2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D4434/D 4434M	(2011) Poly(Vinyl Chloride) Sheet Roofing
ASTM D6754/D6754M	(2010) Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
ASTM E108	(2011) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	(2010) 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 ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2012) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

SPRI RP-4	(2008) Wind Design Standard for Ballasted Single-Ply Roofing Systems

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004; Reprint Oct 2008) Standard Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2012) Roofing Materials and Systems Directory

1.2 SYSTEM DESCRIPTION

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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.

Stone and/or gravel ballast will not be utilized 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.

Combination adhered/protected roof membrane attachment should only be specified 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, it should be applied 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.

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[Adhered] [Mechanically fastened] [Combination adhered/protected membrane] [Loose-laid, paver ballasted] [IRMA] [Garden-style] PVC roof membrane system applied over [insulation] [recovery board] [concrete roof deck] [cellular lightweight insulating concrete] [PVC membrane roofing manufacturer-accepted] substrate. [Incorporate air barrier in the roof assembly as specified in Section 07 22 00 ROOF AND DECK INSULATION.]

[_____]: [Adhered] [Mechanically fastened] [Combination adhered/protected membrane] [Loose-laid, paver ballasted] [IRMA] [Garden-style] PVC roof membrane system applied over [insulation] [recovery board] [concrete roof deck] [cellular lightweight concrete] [PVC membrane roofing manufacturer-accepted] substrate. [Incorporate air barrier in the roof assembly as specified in Section 07 22 00 ROOF AND DECK INSULATION.]

1.2.1 General

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

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Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be 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. Insulation shall be applied and weatherproofed on the same day.

1.2.2 Fire Resistance

For this and the next paragraph submit roof system assembly [wind uplift and] fire rating classification listings. Complete roof system assembly shall be:

a. Class A rated in accordance with ASTM E108, FM 4470, or UL 790.

b. Listed as part of Fire-Classified roof deck construction in the UL RMSD or Class I roof deck construction in the FM APP GUIDE or FM

RoofNav (www. roofnav.com).

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

1.2.3 Wind Uplift Resistance

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

The specified FM approval rating incorporates a safety factor of 2 over the maximum calculated uplift pressure in inch-pound units. Therefore, a FM approval rating of 1-90 correlates to a maximum uplift calculation of 2.2 kPa (45 psf). When specifying an FM rated system, ensure the designed roof system is capable of providing the specified FM approval rating. Where non-rated systems may be permissible, include the bracketed portion of the second sentence and the third sentence.

Paver ballast for combination adhered/paver ballasted application, or for loose-laid membrane applications should be designed in accordance with ANSI/RMA/SPRI RP-4. Where paver ballasted systems are specified, include the bracketed option at the end of the paragraph.

Incorporate this submittal for loose-laid paver ballasted systems, IRMA systems, garden-style roofing systems and anytime non-FM rated systems are permissible and always for roofs subject to excessive wind loading conditions including all 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. Coordinate with requirements of "Wind Uplift" paragraph.

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Complete roof covering assembly, including insulation, shall be rated Class 1-[60] [90] [_____] in accordance with FM RoofNav (www. roofnav.com) or FM APP GUIDE and capable of withstanding an uplift pressure of [2.85] [4.30] [_____] kPa/square m [60] [90] [_____] psf. Non-rated systems shall not be installed[, except as approved by the Contracting Officer]. Provide wind load calculations and submit engineering calculations and substantiating data to validate wind resistance of any non-rated roof system. Base wind uplift calculations on a design wind speed of [_____] km/h mph in accordance with ASCE 7[or applicable building code requirements]. [Resistance to wind uplift for combination adhered/protected membrane (paver ballasted) application shall be in accordance with requirements of SPRI RP-4.] Submit engineering calculations validating the wind resistance of roof system.

1.3 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation 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][; G, [_____]]

SD-03 Product Data

PVC Roofing Membrane[; G][; G, [_____]]
Bonding Adhesive
Flashing
Membrane Fasteners and Plates
[Ballast Pavers]
Roof Insulation
[Protection Mat]
[Pre-manufactured accessories]
Water Cutoffs
Information Card

SD-05 Design Data

Wind uplift calculations[; G][; G, [_____]]

SD-07 Certificates

Qualification of ENERGY STAR-labeled PVC[; G][; G, [_____]]
Qualifications of Applicator[; G][; G, [_____]]
[Wind Uplift Resistance[; G][; G, [_____]]]
Fire Resistance[; G][; G, [_____]]
Minimum Polymer Thickness[; G][; G, [_____]]
Warranty[; G][; G, [_____]]

SD-08 Manufacturer's Instructions

Application Method[; G][; G, [_____]]
Membrane Flashing[; G][; G, [_____]]
Perimeter Attachment
Auxiliary Fasteners
[Protection mat]
[Pre-manufactured accessories]
Cold weather[; G][; G, [_____]]

SD-10 Operation and Maintenance Data

Instructions to Government Personnel

1.4 QUALITY ASSURANCE

1.4.1 Qualification of ENERGY STAR-labeled PVC

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NOTE: The EPA's ENERGY STAR Roof Products Program has established baseline qualification criteria for roof surfaces that are attenuated at specific energy efficient characteristics. The energy efficiency characteristics of the ENERGY STAR Roof Products Program also address and affirm the durability of the prescribed energy efficient characteristics in terms and conditions that ensure consistency thresholds that established minimum thresholds to confirm the demonstrated performance capabilities established by EPA. With respect to QUALITY ASSURANCE hereunder - and for continuity with EPA's ENERGY STAR Roof Products Program - designers shall, at a minimum, only specify ENERGY STAR-labeled PVC membrane roofing products that provide a finished roof that offer a surface formulation possessing, at a minimum, a 3-year performance history on installed roofs located within the geographic boundaries of the United States. However, designers are also required to specify a demonstrated PVC membrane roofing product with a performance capability - measured in duration of years - that is at least as long, with respect to the time-length specified, as the desired warranty/guarantee covering the entire PVC membrane roofing system.
****

ENERGY STAR labeled PVC membrane roofing product shall have at least [3] [_____] years of demonstrated performance experience. Submit certificate from PVC membrane roofing manufacturer certifying that the roof membrane,

meets specified requirements.

1.4.2 Qualifications of Applicator

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NOTE: Specify 3 years as an authorized Contractor unless directed otherwise by the Government
****

PVC membrane roofing system Applicator shall be approved, authorized, or licensed in writing by the PVC membrane roof manufacturer and shall have a minimum of [three] [_____] years experience as an approved, authorized, or licensed applicator with that manufacturer's PVC membrane roofing materials and be approved at a level capable of providing the specified warranty. The applicator shall supply the names, locations and client contact information of 5 projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years. Submit certificate stating that the applicator meets requirements specified.

1.4.3 Conformance and Compatibility

The entire roofing and flashing system (including edge metal) shall be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements shall be in general accordance with recommendations of the NRCA RoofMan, membrane manufacturer published recommendations and details and shall be compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the Contracting Officer and PVC roof membrane manufacturer for approval prior to installation.

1.4.4 Preroofing Conference

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

a. Drawings, specifications and submittals related to the roof work;

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the 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;

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 plan for the roof system installation;

f. Safety requirements.

Preroofing conference scheduling shall be coordinated with the Contracting Officer. The conference shall 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, 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.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels shall bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.5.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's instructions, except as specified otherwise. Keep materials clean and dry. Store and maintain adhesives, sealants, primers and other liquid materials above 15 degrees C 60 degrees F. Insulated hot boxes or other enclosed warming devices may be required in cold weather subject to PVC membrane roofing manufacturer's printed instruction. Submit detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover material materials stored outdoors. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction. Remove unused materials from the roof at the end of each days work.

1.5.3 Handling

Prevent damage to roll materials. Damaged materials shall not be installed in the work. Select and operate material handling equipment so as not to damage materials or applied roofing. Do not use materials contaminated by exposure, incompatible materials or moisture. Remove contaminated materials from the site. When hazardous materials are involved, conform with the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame.

1.6 ENVIRONMENTAL REQUIREMENTS

Follow manufacturer's printed instructions for installation during cold weather conditions.

1.7 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 are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. [Application of roofing shall immediately follow application of insulation as a continuous

operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.]

1.8 WARRANTY

Provide a Full System Roof Warranty covering all PVC membrane roof system components as well as their installation workmanship and meeting all specified requirements. Revision or amendment to standard full system PVC membrane manufacturer warranty shall be provided as required to comply with the specified requirements. Submit sample certificate.

1.8.1 PVC Membrane Manufacturer's Full Roof System Warranty

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NOTE: Insulated and routinely occupied facilities or facilities containing sensitive equipment or operations shall 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. Environmentally controlled interiors shall require minimum 10 year warranty regardless of facility size.

****

Furnish roof membrane manufacturer's [5] [10] [15] [20]-year, no dollar limit, full roof system materials and installation workmanship warranty, including all flashing, insulation, and accessory materials necessary to construct a complete, watertight roof system. The warranty shall run directly from the roof system manufacturer to the Government and commence at time of Government's acceptance of the roof work. The warranty shall 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, shrinks to the point of significant bridging or tenting membrane at transitions, 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 shall be the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the roof membrane manufacturer.

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

1.8.2 Roofing System Installer Warranty

The roof system installer shall warrant for a period of not less than five (5) years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, all attachments, including installation of all PVC membrane manufacturer-supplied edge metal which is always integral to a

complete watertight roof system assembly. The warranty shall run directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials shall be the responsibility of the roof system installer. All costs associated with the repair or replacement work shall be the responsibility of the installer.

1.8.3 Continuance of Warranty

Any repair or replacement work that becomes necessary within the warranty period shall be approved by the roof membrane manufacturer and accomplished in a manner so as to restore the integrity of the roof system assembly and the validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.8.4 Single-Source Contract Liability Warranty

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NOTE: Designers of ENERGY STAR-labeled PVC membrane roofing systems have the option of specifying specific contracting requirements, hereunder, that establish the qualification requirements for procuring a roofing system with either a Single-Source Contract Liability Warranty (which encompasses the Qualification of Applicator), or to specify contracting requirements for procuring said roofing system via conventional contracting methodologies that establish the Qualification of Applicator. According to conventional contracting methodologies, the primary contract for a roof system application procured by the Government is signed with an Applicator who furnishes a "third-party" guarantee with an extended duration, in years. Typically, the "third-party" is the roof system manufacturer, but the guarantee so furnished is contingent upon items outside the realm of the roof system manufacturer's own contractual liability - which is limited.

Single-Source Contract Liability Warranties shall cover all roof system-related guarantees, in whole and in part, related to all roof system component products, as well as roof system design and roof system installation labor and workmanship. The Single-Source Contract Liability Warranty shall assign all responsibility and liability, including roof system component repair and/or replacement up to and including, potentially, complete roof system or component roof system replacement, as necessary, to return the condition of the procured roof to its accepted functionality. The contractual assignment of responsibility for all associated roof system guarantees related to a specified roofing system shall inure to a single entity the roof system manufacturer. In making this type of contract, the Government will thereby streamline and assign potential culpability to the PVC membrane (roof system weatherproofing) manufacturer for any potential discovery, at time of project delivery and acceptance or therein after, of any

post-construction discovery of deficiencies in roofing materials, design, and workmanship. Contract shall not include damage to the roofing caused by others and shall be governed by all terms and conditions of the roof system's underlying Full System Warranty. The guarantee of a single-source contract liability warranty and contract methodology will eliminate the "latent defect" assertion often used by roofing material manufacturers to nullify roof system warranty coverage. Warranty-nullifying assertions of latent defects has been a repetitive problem that has, historically, been encountered by, and adjudicated to the detriment of the Government.

Absent force majeure, casualty, neglect or abuse, a single-source contract liability warranty provides the Government with a vehicle for assigning complete roof system performance responsibility and liability with respect to multiple underlying guarantees to the roof weatherproofing manufacturer, inclusive of all components of the supplied roofing system, as well as the roofing system's design and installation workmanship. As an instrument for wrapping liability, single-source contract liability warranties deliver a clean guarantee to the Government for all roof system warranty obligations and offer the Government a turn-key procurement vehicle while providing a substantial risk management tool both during and after construction that clearly assigns all appropriate and associated roof system liability to the roof system weatherproofing material manufacturer. When specifying the single-source contract liability warranty, designers must require roof system manufacturers to comment on, or create, and/or modify all roof system specifications and detail drawings and to accept and present the complete roof system design specification package to qualified roofing subcontractors prior to project bidding and furnish same to the Government prior contract award.

****

[_____]The specified, single-source contract liability warranty of a PVC membrane roofing system manufacturer shall be furnished to the Government upon project completion. The single-source contract liability warranty shall encompass all roof system components' warranty performance coverage's, including all performance guarantees for roof system materials, roof system design and all roof system installation labor and workmanship. The single-source contract liability warranty shall be a Full Roof System Warranty that is issued by either the PVC membrane roof system manufacturer, or by a direct affiliate of the PVC membrane roof system manufacturer (100 percent owned affiliate), or by an agent of the PVC membrane roof system manufacturer possessing the authority to contractually bind the PVC membrane roof system manufacturer (manufacturer, affiliate and agent are collectively referred to as "Roofing System Supplier") and to, at said agent's discretion, underwrite and/or provide for insurance covering all of the respective warranty obligations of the PVC membrane manufacturer's Full Roof System Warranty.

a. The Government intends to sign a contract binding all warranty and associated roof system performance guarantees of the roofing system directly with the PVC membrane roofing manufacturer, or it's subsidiary, or an exclusive agent capable of enjoining said PVC membrane manufacturer; and

b. This roofing system shall be applied only by a roofing system Applicator authorized by the PVC membrane roofing manufacturer prior to bid; and

c. The roofing system Applicator shall arrange with, and make arrangements to the satisfaction and discretion of the PVC Roofing System Supplier, to have the services of a Technical Field Representative on site full time to observe the total roof application, including removal of pre-existing roofing (if applicable). The Technical Field Representative shall provide written daily reports to the Roofing System Supplier and Applicator. The roofing system Applicator shall include the cost of the full-time Technical Field Representative in his/her bid price; and

d. 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. The drawing shall 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, and

e. There shall be no deviation made from the contract specification or the approved shop/detail drawings without prior written approval by the both PVC membrane roofing material manufacturer/subsidiary and by the Government; and

f. Complete all work by personnel trained and authorized by the PVC membrane roof manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

****
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.
****

Submit Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Data shall include 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. Provide products as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

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. All warranted roof system components shall be 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. Card shall be 215 by 275 mm 8 1/2 by 11 inches minimum. Information card shall 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.

2.1.1 Bonding Adhesive

****

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

Low VOC materials may be required in some geographic locations and for use upon occupied buildings in order to minimize potential irritation to occupants. For these instances, include the first bracketed option as applicable, delete the second bracketed option, and write in a description of the adhesive required. Consider peel & stick adhesion of PVC membranes in these instances.

****

Provide PVC membrane manufacturer's [low volatile organic compound (VOC)] [standard] membrane 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. Bonding adhesive shall not be used to bond membrane materials to each other.

2.1.2 Water Cutoff Mastic/Water Block

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

2.1.3 Membrane Flashing

Membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, shall be minimum polymer thickness 1.1 mm 0.045 inch reinforced PVC for 5, 10, 15 year warranties, and shall be utilized as recommended and supplied by the roof membrane manufacturer or minimum 1.5 mm 0.060 inch thick reinforced PVC roof membrane and flashing's for 20 year warranties. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.

2.1.4 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.

2.1.4.1 Stress Plates, Bar or Rail for Fasteners

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

2.1.4.2 Auxiliary Fasteners

Corrosion resistance screws, nails, or anchors must be suitable for intended attachment purpose and be recommended and supplied for use by the PVC roof membrane manufacturer.

[2.1.5 Ballast Pavers

****
NOTE: There is danger of wind-blown, airborne objects jeopardizing property and life safety on facilities in wind zones exceeding 160 km/h (100 mph), within 8 km (5 miles) of coastline, within 457 m (1500) feet of open body of water, and on or adjacent to critical facilities such as hospitals, or when heavy foot traffic over large areas of roof is expected.

Specify paver pedestals for pavers without drainage channels. Specify adjustable pedestals for systems required to be elevated to a level plane such as a plaza or observation deck.
****

Weather resistant, precast [interlocking] concrete roof pavers [with drainage channels on the underside], and as recommended by the PVC roof membrane manufacturer. Pavers shall be minimum [20,680] [51,700] kPa [3000] [7500] psi compressive strength, weigh not less than[[58] [88] kg/per square m [12] [18] psf] [_____], not less than [30] [50] mm [1-1/4] [2] inches thick and nominal [600 mm 24 inches] [_____] in length and width and without sharp edges and projections. [Elevate pavers above the roof membrane surface with paver manufacturer's recommended [adjustable] pedestal system [to provide for level walking surface] as required by the roof membrane manufacturer.]

][2.1.6 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.

][2.1.7 Pre-manufactured Accessories

****

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

****

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

][2.1.8 [PVC Walk Tread] [and] [Precast Concrete Paver Block Walkways]

****

NOTE: Use pavers or 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.

****

Provide [either of] the following:

2.1.8.1 PVC Walk Tread

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.

2.1.8.2 Precast Concrete Paver Block

Precast concrete blocks (subject always to structural capacity), [450 by 450] [600 by 600] mm [18 by 18] [24 by 24] inch, without sharp edges and projections, and weighing no more than [20] [36] kg [45] [80] pounds each.

][2.1.9 Elevated Metal [Walkways] [and] [Platforms]

As specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS, and as approved by the roof membrane manufacturer.

]2.1.10 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.
****

Insulation system and facer material shall be 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].

2.1.11 Wood Products

****
NOTE: Coordinate with Section 06 10 00 ROUGH CARPENTRY. Some fire retardant treatment (FRT) chemicals may affect PVC materials. MSDS listing active ingredients for the FRT wood shall 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 shall not be in contact with PVC membrane or PVC accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.2 ENERGY STAR-Labeled, 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 1.1 mm (0.045 inch) thickness ASTM D4434 Type III, ASTM D4434 Type IV or ASTM D6754 reinforced ENERGY STAR labeled PVC membrane for mechanically fastened applications in wind zones exceeding 160 km/h (100 mph), within 8 km (5 miles) of coastline or within 457 m (1500 feet) of open body of water. Alternately, for roof applications in wind zones exceeding 160 km/h (100 mph), within 8

km (5 miles) of coastline or within 457 m (1500 feet) of open body of water, designers can specify combination adhered/protected membrane systems (utilizing interlocking pavers) acceptable to PVC membrane roof manufacturer.

For 20 year warranty, 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 ASTM D4434 Type II, Grade I 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.

For 20 year warranty, designers must specify a minimum 1.5 mm (0.060 inch) membrane thickness that in all other respect complies with either ASTM D4434 Type II, Grade I, or TYPE III or Type IV, or ASTM D6754 reinforced PVC membrane roofing specifications and that also bears the ENERGY STAR label.

Reinforced, minimum 1.1 mm (0.045 inch) PVC roof membrane thickness is required for ASTM D4434 Type III membrane, ASTM D4434 Type IV membrane, and similar ASTM D6754 membranes with fleece-backing. Such PVC membranes may be used on certain mechanically fastened installations over acceptable substrates. Thickness of PVC membrane is measured and labeled independent of contribution by fleece backing.

Minimum 1.1 mm (0.045 inch) thickness ASTM D4434 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. This specification shall be modified for proper adhesive and application parameters in accordance with PVC roof membrane manufacturer's requirements and recommendations when adhered fleeceback PVC membrane is specified.

1.8, 2.0, or 2.4 mm (0.072, 0.080, or 0.096 inch) PVC membrane is also available. Specify 1.8, 2.0, or 2.4 mm (0.072, 0.080, or 0.096 inch) membrane for applications that experience regular heavy traffic conditions or regular extreme wind conditions that can experience airborne debris. 1.8, 2.0, or 2.4 mm (0.072, 0.080, or 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.

****

Reinforced polyvinyl chloride (PVC) membrane shall contain fibers or scrim, and shall comply with ASTM D4434/D 4434M, [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 shall provide [1.1] [1.5] [1.8] [2.0] [2.4] mm [0.045] [0.060] [0.072] [0.080] [0.096] inch minimum thickness for [adhered] [mechanically fastened] [combination adhered/protected membrane] [loose-laid, paver ballasted] [IRMA] [garden-style] application. Not withstanding the ASTM standards referenced, reinforced PVC roof membranes provided under this section shall have the minimum, labeled thickness specified. PVC membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Principal polymer used in manufacture of the membrane sheet shall be PVC. Width and length of PVC membrane roofing sheet shall be consistent with membrane attachment methods and wind uplift requirements, and shall be 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.

PART 3 EXECUTION

3.1 EXAMINATION

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

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

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

c. Substrate is sloped to provide positive drainage.

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

e. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 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.

****

f. 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.]

g. 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.
****

[h. Venting shall be provided if required by, and in accordance with the cellular lightweight concrete manufacturer's requirements and recommendations.]

[i. 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.]]

[j. 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.]

3.2 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.
****

Apply entire PVC membrane roofing utilizing [adhered] [mechanically fastened] [combination adhered/protected membrane] [loose-laid, paver ballasted] [IRMA] [garden-style] 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

3.2.1 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 any 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.

3.2.2 PVC Roofing Membrane

Only felt-backed membrane shall be placed directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Non-felt-backed PVC membrane roofing sheet shall not be placed directly on concrete deck or other hard surface which may damage the membrane. Membrane shall be overlapped a minimum of 75 mm 3 inches at sides for adhered applications and 140-180 mm 5.5-7 inchesfor mechanically fastened applications and minimum 100 mm 4 inches at ends. Where possible, direction of laps shall allow water to flow over and not into the lap. Membrane joints shall be free of wrinkles and fishmouths. The entire length of hot-air-welded seams shall be probe-tested and corrected during the day of installation. Defective areas shall be re-welded. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a continuous hot-air-welded seam on all sides. Repairs shall be probe-tested for continuity. Hot-air-welded seams are to be accomplished in accordance with the PVC membrane roofing manufacturer's published requirements.

3.2.2.1 Nailing

Membrane shall be fastened to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, nails shall be staggered on 100 mm 4 inch centers maximum; screws for sheet metal shall be staggered on 200 mm 8 inch centers maximum; and a row of fasteners shall be at least 13 mm 1/2 inch from edges of sheet metal.

3.2.2.2 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam shall be sealed a minimum of 75 mm 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashing's shall be secured at the top of the flashing a maximum of 300 mm 12 inches on centers under the counterflashing or cap. Where possible,

prefabricated components shall be used for pipe seals and flashing accessories.

3.2.2.3 Expansion Joints

Expansion joints shall be covered using Prefabricated covers or elastomeric flashing in accordance with the recommendations of the manufacturer.

3.2.2.4 Cutoffs

If work is terminated prior to weatherproofing the entire roof, the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work and cut insulation sheets used for fill-in shall be removed. Asphalt or coal-tar products shall not be used for sealing.

3.2.2.5 Walkways

Walkways shall be installed 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. Stone ballast shall not be placed below or above walkways.

[3.2.3 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 & 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.

][3.2.4 Mechanically Fastened Membrane Application

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

Membrane side lap depends on method of mechanical attachment, wind resistance testing of the specific system provided, and requirements of the membrane manufacturer. Generally, attachments shall be positioned 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 and laps and/or coverstrips, as specified. Check all seams and ensure full/continuous lap seal.

][3.2.5 Paver Ballasted Membrane Application

****
NOTE: Delete this paragraph unless a loose-laid, paver ballasted application is specified.
****

Layout membrane and side lap adjoining sheets with the minimum seam and lap widths recommended by and according to membrane manufacturer's printed instructions. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Form field all hot-air-welded laps and seams as specified and at width required by the membrane manufacturer's installation instructions. Check seams to ensure continuous seal before proceeding with further work.

][3.2.6 Combination Adhered/Protected Membrane Application

****
NOTE: Delete this paragraph unless a combination adhered/protected membrane application is specified.
****

In sequence, apply an adhered PVC membrane roofing system and subsequently apply a protection mat/slip sheet and with paver system on top of pedestals

and install roof system components as instructed by manufacturer's printed instructions and recommendations and specified above.

][3.2.7 Inverted Roof Membrane Assembly Application

****
NOTE: Delete this paragraph unless an Inverted Roof Membrane Assembly (IRMA) application is specified.
****

Confirm with membrane manufacturer that substrate is suitable for membrane application. Refer to manufacturer's printed instructions regarding suitable substrate for direct membrane application and/or apply a protection map/slip sheet according to manufacturer's recommendations. Layout membrane and side lap adjoining sheets with the minimum seam and lap widths recommended by and according to membrane manufacturer's printed instructions. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Form field all hot-air-welded laps and seams as specified and at width required by the membrane manufacturer's installation instructions. Check seams to ensure continuous seal before proceeding with further work. Apply a protection mat/slip sheet above deck membrane and subsequently install insulation according to specification and in accordance with manufacturer's instructions and printed literature. Apply pavers on top of insulation.

][3.2.8 Garden-Style PVC Membrane Roof System Assembly

In general, Garden-Style Membrane Roof System Assemblies are also commonly referred to as "Green " or "Vegetated" roof systems. These roof systems are characterized by the depth of the growing media (soil or growth medium) installed above the waterproofing/roofing system assembly. There are two categories of Garden-Style Roof systems; Extensive Systems (light weight/less than 150 mm 6 inch in depth of soil/growth medium), and Intensive Systems (not light weight/greater than 150 mm 6 inch in depth of soil/growth medium). The depth of the growth medium predicates the designers options with respect to type of plantings utilized. The type and load capacity of the underlying structure & roof deck often dictates the designer's options with respect to the suitability of designing Intensive or Extensive Garden-Style roofing systems. In all cases, the structural capacity of the roof/deck/building shall be determined by a structural engineer for system suitability when designing such systems. In all instances, the waterproofing/roofing system components are installed above the roof deck and support the subsequent application of soil/growth medium/plantings. In addition to growth medium and plantings, both Extensive and Intensive Garden-Style PVC Membrane Roof System Assemblies are comprised of similar system components. These components typically include; insulation, drainage layer, protection/separation layers, filter fabric, root barrier, a thermal barrier and a reinforced PVC roofing/waterproofing membrane (Note: certain PVC roofing/waterproofing membranes that are utilized on Garden-Style Roofs do not require root barriers but, in all instances, the reinforced PVC roof/waterproofing membrane does not need to bear the ENERGY STAR label due to the membrane's obscured placement in the overall system configuration). The thickness of the reinforced PVC roof/waterproofing membrane utilized within Garden-Style Roof System Assemblies is 2 mm 80 mils minimum, and the seaming method of the reinforced PVC membrane is as described in earlier sections of this specification under the sections describing Inverted Roof Membrane Assembly Application and/or Paver Ballasted Membrane Application; and shall be in accordance with the manufacturers printed instructions. In

general, Extensive (light weight) Garden-Style PVC Roof System Assemblies can be installed over both steel and structural concrete decks, whereas Intensive (not light weight) Garden Style PVC Roof System Assemblies are limited to structural concrete deck construction. In all cases, it is recommended that designers consult with the PVC membrane roof system manufacturer.

][3.2.9 Perimeter Attachment

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

Adhesive bond or mechanically secure roof membrane sheet at roof perimeter 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 shall be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

][3.2.10 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 fasteners with a layer of flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

][3.2.11 Membrane Flashing

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

Include paragraphs c. and d. when roof drains are indicated.
****

a. 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 reinforced PVC membrane flashing and prefabricated accessory flashing's as recommended by the roof membrane manufacturer.

b. Completely adhere flashing sheets in place. Hot-air-weld the seams of 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. Mechanically

fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 300 mm 12 inches on center. Sheet metal counter-flashing shall be installed 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 reinforced PVC flashing membrane 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. Metal flashing's are specified under Section 07 60 00 FLASHING AND SHEET METAL.

c. Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, are specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide a tapered insulation sump into the drain bowl area. Tapered slope shall not exceed 15 degrees (3:12) for fiberglass reinforced PVC membrane. Tapered insulation shall have surface suitable for adhering membrane in the drain sump area. Avoid field seams running through or within 600 mm 24 inches of roof drain, or as otherwise recommended by the roof membrane manufacturer.

d. Adhere the membrane to the tapered insulation in the drain sump area. Apply PVC membrane manufacturer's compatible sealant 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. Membrane shall be 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.

][3.2.12 Pre-fabricated Curbs

Prefabricated curbs shall be securely anchored to nailer or other base substrate and flashed with PVC membrane flashing materials.

3.2.12.1 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.

3.2.12.2 Lightning Protection

Lightning protection system components shall be flashed or attached to the roof membrane in a manner acceptable to the PVC membrane roof manufacturer and compliant with Code requirements.

][3.2.13 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.

][3.2.14 Elevated Metal [Walkways] [and] [Platforms]

Install over completed roof system in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. 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.

][3.2.15 Isolated Paver Blocks

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

][3.2.16 Paver Ballast

****
NOTE: Indicate the appropriate paver ballast type. Indicate ballast weight required based on wind loading conditions.

In some instances paver ballast may be used in perimeter and corner areas in combination with an adhered PVC roofing system. If so, include the [Paver] option in item "a".

Where elevated paver system is required, refer to as "Paver System" in the paragraph title. The paver type and weight shall be as specified in Part 2.
****

Complete all membrane and membrane flashing work, including inspection and repair of all membrane and seams in the area of paver application prior to applying paver system. [Install protection mat over roof membrane in accordance with roof membrane manufacturer's recommendations. Provide minimum 75 mm 3 inch side and end laps. Immediately after placement of protection mat,] [Install and level pedestal system in accordance with manufacturer's requirements and] apply paver system [at the following coverage rates:

a. [Pavers:] [_____] Papsf for perimeter and corner areas of roof.

b. [_____] Papsf for field of roof.

In no case apply pavers at a coverage rate less than 480 Pa 10 psf or more than [_____] Pa psf.]

][3.2.17 Correction of Deficiencies

Where any form of deficiency is found, additional measures shall be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions shall be as directed by the Contracting Officer.

]3.2.18 Clean Up

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

3.3 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.

[3.3.1 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.

]3.3.2 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.

3.3.3 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.

3.4 FIELD QUALITY CONTROL

3.4.1 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.

[3.4.2 Manufacturer's Inspection

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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 shall [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 shall 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 shall be performed as requested by the Contracting Officer.] After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the roofing Contractor to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

]3.5 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions 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. Submit copies of Material Safety Data Sheets for maintenance/repair materials.

[3.6 ROOF DRAIN TEST

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