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USACE / NAVFAC / AFCESA / NASA **UFGS-07 54 19 (April 2006)**

Preparing Activity: USACE **Replacing without change UFGS-07548 (August 2004)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 18 July 2006

Latest change indicated by CHG tags
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SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 54 19

POLYVINYL CHLORIDE (PVC) ROOFING

04/06

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SECTION 07 54 19

POLYVINYL CHLORIDE (PVC) ROOFING
04/06

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NOTE: This guide specification covers the requirements for reinforced polyvinyl chloride roofing membrane; loose laid and ballasted, fully adhered, or mechanically fastened.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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PART 1 GENERAL

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NOTE: This roofing system should not be used in direct physical contact with asphalt, coal tar pitches, petroleum products, nor where coal-tar fumes are present. For additional guidance on PVC roofing, the designer should consult the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual.

Roofs must be constructed to drain with a minimum slope of 20 mm per meter (1/4 inch per foot). The loose-laid 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.

Top of nailers for curbs, area dividers and expansion joints should be at least 200 mm (8 inches) above surface of finished roof and should not interfere with drainage. Do not use flush type joints.

Where PVC roofs collect drinking water, the manufacturer must certify that the materials are safe to use for this purpose.

Designer should require materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage of recycling and conserve natural resources.

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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.

ASTM INTERNATIONAL (ASTM)

ASTM C 29/C 29M	(1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D 4434	(2004) Poly(Vinyl Chloride) Sheet Roofing
ASTM D 448	(2003a) Sizes of Aggregate for Road and Bridge Construction

ASTM G 21	(1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi

FM GLOBAL (FM)

FM P7825a	(2005) Approval Guide Fire Protection
FM P9513	(2002) Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

SINGLE PLY ROOFING INDUSTRY (SPRI)

SPRI RP-4	(2002) Wind Design Standard for Ballasted Single-Ply Roofing Systems

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies
UL 790	(2004) Test Methods for Fire Tests of Roof Coverings

1.2 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. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" 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.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing System[; G][; G, [_____]]

Drawings showing arrangement of sheets, seam locations, and flashing details including waterproofing of joints where sheet metal flashings change direction. Shop drawings drawn by the manufacturer and certified by the Contractor for the specified system.

SD-03 Product Data

Installation

Manufacturer's instructions for preparing and installing the membrane, flashing, seams, insulation, nailers, and other accessories.

Protection of Finished Roofing[; G][; G, [_____]]

A protection plan showing areas to be protected, type of material used, a procedure to protect the membrane from damage until completion of work by other trades, and a description of the method of repairing the roofing.

Inspection

The inspection procedure for substrate suitability including decks, curbs and insulation installation, prior to start of the work. Inspection procedures during and after placement of the membrane, and after completion of work by other trades.

SD-07 Certificates

Materials

Certificates of compliance attesting that the materials meet specification requirements. The certificates shall list the components required for the specified rating.

Qualifications

Contractor's qualifications as specified.

1.3 GENERAL REQUIREMENTS

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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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Polyvinyl Chloride (PVC) roofing shall be [fully adhered] [mechanically fastened] [loose-laid ballasted] to the roof surfaces indicated. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical to minimize joints. Membrane shall be free of defects and foreign material. Flashing work shall be coordinated to permit continuous roof-surfacing operations. Insulation shall be applied and weatherproofed on the same day.

1.3.1 Delivery and Storage

Materials shall be delivered to the jobsite in the manufacturer's original unopened packages, clearly marked with the manufacturer's name, brand name, description of contents, and label for compliance with UL requirements. Time limited materials shall be used before shelf life expires. Materials other than ballast shall be stored in clean, dry areas. Storage temperatures shall be as specified by the manufacturer. A maximum of one day's supply of materials other than ballast may be stored on the roof when distributed so as not to exceed the roof live load limit. These materials shall be kept dry and clean until application. Ballast shall be stored uncovered, shall not be in contact with sod or earth, and shall not be stored on the roof.

1.3.2 Fire Resistance

The roofing system fire resistance shall be rated Class A as determined by UL 790 or Class 1 as determined by FM P7825a. Compliance of each component of the roofing system shall be evidenced by label or by written certification from the manufacturer.

1.3.3 Wind Uplift Requirements

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NOTE: Do not specify ballasted PVC membrane systems for buildings 90 meters (300 feet) tall or taller unless the design is in accordance with SPRI RP-4.

FM I-60 and I-90 ratings apply only to a fully adhered roof system over a steel deck. Placement of fasteners required for I-60 or I-90 should be shown on the drawings.

Fully adhered protected membranes have performed well in hurricane areas, when ballasted as specified in SPRI RP-4. Roof deck must be adequate to support the weight of the ballast as a dead load.

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Wind uplift resistance of the complete roof assembly shall be rated Class I-[60] [90] in accordance with FM P9513 or Class [60] [90] in accordance with UL 580. Wind resistance of loose-laid ballasted system shall be in accordance with [FM P9513] [SPRI RP-4].

1.3.4 Warranty

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NOTE: Although a warranty does not prevent problems, the more reputable manufacturers will issue a warranty if the installation was applied by an approved applicator with experience in the installation of the materials.

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Manufacturer's standard warranty for [10] [15] [_____] years shall be furnished. Warranty shall provide for repair or replacement of the complete roofing system, including insulation and flashings, if leaking is caused by defects in materials or workmanship.

1.3.5 Qualifications

The Contractor shall submit documentation verifying that the Contractor has a minimum of 2 years experience with PVC roofing systems and has been certified by the PVC roofing manufacturer as an approved Installer for the specified PVC roofing system.

PART 2 PRODUCTS

2.1 SOLVENTS AND SEALANTS

Adhesives, welding solvents, and sealants shall be as recommended by the membrane manufacturer.

2.2 BALLAST

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NOTE: Ballast weight must be included in the design dead load of the roof structure. The type of ballast available in the area must be considered.

A protective mat is recommended, especially if the only available aggregate is crushed rock with angular faces and sharp edges. Crushed rock may be used over a protective layer of extruded polystyrene at least 10 mm (3/8 inch) thick and a filter fabric, at least 900 gm/sq. m (3 oz/sq. ft.), placed between the ballast and the membrane. Ballast laid directly on the membrane should be pavers or rounded-edge aggregate, and must not break during freeze-thaw cycles.

Determine ballast size and quantity using SPRI RP-4. This guide allows crushed stone over membrane protected by mat or insulation. Small aggregate will not be used in vicinity of aircraft operations or in high wind areas; however, rock or pavers may be used in such areas. Stone ballast dries better, and is usually cheaper than concrete pavers. There is no thermal incentive to use light colored ballast over PVC membrane.

Delete this paragraph when ballast is not required.

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Ballast shall be [concrete pavers] [and] [smooth round stone,] [screened gravel,] [or] [screened crushed stone,] with gradations complying with

ASTM D 448, [Size 4] [Sizes 2 and 4,] except that particles passing the 10 mm 3/8 inch sieve shall not exceed 2 percent. Unit weight of ballast shall be no less than 961 kg/cu. m 60 lbs/cu. ft when determined in accordance with ASTM C 29/C 29M. Concrete pavers shall be precast air-entrained concrete, minimum 38 mm 1-1/2 inches thick, having 21 MPa 3000 psi minimum compressive strength. Pavers other than walkways shall include drainage channels on their lower surfaces or shall rest on membrane pads extending at least 25 mm 1 inch beyond the paver edges.

2.3 FASTENERS

Fasteners for sheet-metal flashing shall be corrosion-resistant steel annular-ring type nails, or screws. Fasteners for anchoring the roofing membrane shall be as approved by the membrane manufacturer and identical to those used to obtain the wind uplift rating.

2.4 FLASHINGS

Flashings shall be ultra-violet resistant materials furnished by the membrane manufacturer, except as otherwise specified. Shaped flashing components shall be prefabricated. Sheared edges of metal flashings that will contact the membrane shall be turned into a tight hem.

2.5 MEMBRANE

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NOTE: Only membranes containing reinforcing materials will be used, as some unreinforced membranes can shrink to the point where flashings are torn loose from their fastenings.
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Membrane shall contain fibers or fabric, shall be at least [1] [1.5] mm [45] [60] mils thick, and shall comply with ASTM D 4434, Type II or III. Membrane shall be fungi resistant as demonstrated by "non sustained growth" or discoloration after 21 days exposure as specified in ASTM G 21.

2.6 PREFABRICATED ACCESSORIES

Pipe seals and expansion joint covers shall be types and sizes recommended by the membrane manufacturer.

2.7 SLIP SHEET

Slip sheets between insulation and membrane shall be as recommended by the membrane manufacturer.

2.8 WALKWAYS

Walkways shall be concrete pavers, at least 38 mm 1-1/2 inches thick, with a non-skid top surface and as specified in paragraph BALLAST. Pavers for walkways less than 1.2 m 4 feet wide around mechanical equipment, or other features except drains, may rest directly on the membrane unless underlayment is specified by the manufacturer. Alternate walkway material may be used if recommended by the manufacturer and approved by the Contracting Officer.

PART 3 EXECUTION

3.1 ENVIRONMENTAL CONDITIONS

Membrane shall not be installed in high wind, inclement weather or when there is visible ice, frost or moisture on the deck or membrane. Unless otherwise specified by the manufacturer, membrane shall not be installed when air temperature is below 4 degrees C 40 degrees F or within 3 degrees C 5 degrees F of the dew point.

3.2 PREPARATION

The substrate of any bay or section of the building shall be complete and suitable for insulation and membrane installation before roofing is begun. Roofing on lightweight insulating concrete shall not begin until the concrete passes the air-dry density test specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. Insulation under roofing shall comply with Section 07 22 00 ROOF AND DECK INSULATION. Surfaces on or against which membrane is applied shall be smooth, clean, and free from oil, grease, sharp edges, standing water, and construction debris. Joints over 6 mm 1/4 inch wide shall be filled with insulation material. Wood nailers shall comply with Section 06 10 00 ROUGH CARPENTRY.

3.3 INSTALLATION

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NOTE: Coordinate installation requirements with Section 07 22 00 ROOF AND DECK INSULATION and Section 06 10 00 ROUGH CARPENTRY. Asphalt and the asphalt-coated side of any insulation should not be used in contact with PVC membrane.

Any treatment for lumber listed in AWPA U1 and AWPA T1, except acid copper chromate, may be allowed. Surfaces of wood cut in the field should be treated with copper napthenate solution.

Nailers should be anchored to resist a minimum of 270 N/m (200 pounds per foot) in any direction for the anticipated life of the roof; except that nailers for mechanically fastened systems should withstand 300 N/m (300 pounds per foot) in any direction. Nailing pattern should be shown on the drawings, and may then be deleted from these paragraphs. In no case should the fastening rate be less than that specified by the manufacturer. Both layers of insulation are usually mechanically fastened because asphalt and many adhesives are not compatible with PVC. Bituminous products should not be used where they might contact PVC membrane.

PVC roofing installations should be monitored; problems or noteworthy benefits encountered should be brought to the attention of HQUSACE (CEMP-ET), WASHINGTON, DC 20314-1000 for information and possible dissemination.

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Installation shall comply with the manufacturer's approved instructions

except as otherwise specified.

3.3.1 Membrane

Membrane shall not be placed directly on concrete deck or other hard surface which may damage the membrane. Unless otherwise specified by the manufacturer, the membrane shall be rolled out on the surface and allowed to relax for at least 1/2 hour when ambient temperature is 15 degrees C 60 degrees F or higher or 2 hours when ambient temperature is below 15 degrees C 60 degrees F prior to other installation activities. Membrane shall be overlapped a minimum of 75 mm 3 inches at sides and minimum 100 mm 4 inches at ends. 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 joints shall be probe-tested and corrected during the day of installation. Defective areas shall be re-sealed. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a 75 mm 3 inch seam on all sides. Repairs shall be probe-tested for continuity. Bonded areas of seams shall be a minimum 75 mm 3 inches wide for bonded seams and 50 mm 2 inches wide for heat-welded seams.

3.3.2 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.

3.3.3 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam between the flashing and the membrane shall be completed before the flashing is bonded to vertical surfaces. The seam shall be sealed a minimum of 75 mm 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashings 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.

3.3.4 Expansion Joints

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

3.3.5 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.

3.3.6 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.

3.4 BALLAST APPLICATION

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NOTE: Delete this paragraph when ballast is not required.
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Ballast shall be applied as the membrane is installed to prevent wind uplift, except that seams and terminations shall be left uncovered until completion of inspection and repair. Membrane shall be protected from mechanical damage during ballast application. Minimum ballast weight shall not be less than [required by FM P9513 or UL 580] [indicated]. Ballast shall be spread as [indicated] [recommended by the membrane manufacturer for the anticipated wind conditions]. Unless otherwise specified, size 2 ballast shall be applied at a rate of 620 to 720 Pa 13 to 15 psf and size 4 ballast shall be applied at a rate of 480 to 575 Pa 10 to 12 psf.

3.5 PROTECTION OF FINISHED ROOFING

The roofing membrane shall be protected from damage by other trades. After completion of work by other trades, the protection shall be removed and the roof shall be inspected. Any damage shall be repaired in accordance with the recommendation of the roofing manufacturer.

3.6 INSPECTION

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NOTE: Delete this requirement for small jobs and at sites where nondestructive inspection equipment is not available.
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If non-destructive surveys by the Government indicate presence of wet insulation during the [first year] [first 2 years] after completion of the work, the Contractor shall take samples to verify the extent of the moisture, and shall replace wet insulation and the defective membrane.

-- End of Section --