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Preparing Activity: NASA Superseding  
UFGS-09 67 00.00 40 (January 2008)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2010

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### SECTION 09 67 23.13

#### STANDARD RESINOUS FLOORING 04/08

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NOTE: This guide specification covers the requirements for thin-set, troweled, heavy-duty, epoxy floor toppings.

Thin-set, heavy-duty, troweled floor topping is a mixture of a two-component epoxy-resin binder and a blend of several sizes of pregraded walnut-shell aggregate.

Drawings must show areas of application.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

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

Comments 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.

Submit recommended changes to a UFGS as a Criteria Change Request (CCR).

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## PART 1    GENERAL

### 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 are automatically 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 A 990	(2008) Standard Specification for Castings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure Retaining Parts for Corrosive Service
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM D 1475	(1998; R 2008) Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D 1544	(2004) Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)
ASTM D 1652	(2004) Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2471	(1999) Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
ASTM D 445	(2009) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM D 570	(1998; R 2005) Standard Test Method for Water Absorption of Plastics
ASTM D 638	(2008) Standard Test Method for Tensile Properties of Plastics

ASTM D 696

(2008) Standard Test Method for  
Coefficient of Linear Thermal Expansion of  
Plastics Between -30 degrees C and 30  
degrees C With a Vitreous Silica  
Dilatometer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6

(2007) Commercial Blast Cleaning

## 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. Keep submittals 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, use a code of up to three characters within the submittal tags 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 reviews the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Submit Fabrication Drawings in accordance with the paragraph entitled, "Drawings," of this section.

Submit installation drawings for heavy duty epoxy flooring systems in accordance with the paragraph entitled, "Application of Floor Topping," of this section.

#### SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Epoxy-Resin Binder/Matrix  
Cured Epoxy Binder  
Walnut Shell Aggregate  
Surface Sealing Coat

#### SD-04 Samples

Submit samples on [Hardboard](#) in accordance with paragraph entitled, "Sampling," of this section.

#### SD-05 Design Data

Submit mix designs (Contractor and job) for the following items including a complete list of ingredients and admixtures. Applicable test reports must verify that the mix has been successfully tested and meets design requirements.

Epoxy-Resin Binder/Matrix  
Cured Epoxy Binder  
Surface Sealing Coat

#### SD-06 Test Reports

A copy of the [Records of Inspection](#) after completion of the contract in accordance with paragraph entitled, "Quality Assurance," of this section.

#### SD-07 Certificates

Submit [Listing of Product Installations](#) in accordance with paragraph entitled, "Qualifications," of this section.

Submit certificates for the following showing conformance with the referenced standards contained in this section.

Epoxy-Resin Binder/Matrix  
Cured Epoxy Binder  
Walnut Shell Aggregate  
Surface Sealing Coat

### 1.3 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in original packages, containers, or bundles bearing brand name and name of material.

Maintain materials used in the installation of floor topping at a temperature between 18 and 30 degrees C 65 and 85 degrees F.

#### 1.4 QUALITY ASSURANCE

Submit a copy of the [Records of Inspection](#), as well as the records of corrective action taken.

##### 1.4.1 Qualifications

A [Listing of Product Installations](#) for heavy duty epoxy flooring must include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List must include purchaser, address of installation, service organization, and date of installation.

Applicators installing the floor topping must have had experience in the application of troweled walnut-shell aggregate thin-set floor topping.

##### 1.4.2 Sampling

Provide three samples on [Hardboard](#) not less than 300 millimeter 12 inch square for each required color.

Panels must show nominal thickness of finished toppings and color and texture of finished surfaces. Finished floor toppings must match the approved samples in color and texture.

##### 1.4.3 Drawings

Submit [Fabrication Drawings](#) for heavy duty epoxy flooring Systems consisting of fabrication and assembly details to be performed in the factory.

### PART 2 PRODUCTS

#### 2.1 MIXES

##### 2.1.1 [Epoxy-Resin Binder/Matrix](#)

Epoxy-resin binder to be a clear two-component compatible system consisting of: (1) a liquid blend of a biphenol-based epoxy resin and an aliphatic polyglyceridyl ether, and (2) a liquid blend of two modified amine curing agents, which individually cures the epoxy resin at room temperature to a glossy smooth film. Two components and the cured epoxy binder must have the following physical properties:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
COMPONENT A (EPOXY RESIN)		
Viscosity (kinematic), at 25 degrees C, millipascal-second	ASTM D 445	3000 to 5000
Weight per epoxide, grams	ASTM D 1652	205 to 225
Color (Gardner Color Scale), maximum	ASTM D 1544	5
Weight per milliliter, grams	ASTM D 1475	1.13 - 1.15

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
	COMPONENT B (CURING AGENT)	
Viscosity (kinematic), at 25 degrees C, square milliliter per second	ASTM D 445	75 to 125
Weight per milliliter, grams	ASTM D 1475	0.90 to 0.91
Color (Gardner Color Scale), maximum	ASTM D 1544	8

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
	COMPONENT A (EPOXY RESIN)	
Viscosity (kinematic), at 77 degrees F, centipoises	ASTM D 445	3000 to 5000
Weight per epoxide, grams	ASTM D 1652	205 to 225
Color (Gardner Color Scale), maximum	ASTM D 1544	5
Weight per gallon, pounds	ASTM D 1475	9.46 - 9.56
	COMPONENT B (CURING AGENT)	
Viscosity (kinematic), at 77 degrees F, centistokes	ASTM D 445	75 to 125
Weight per gallon, pounds	ASTM D 1475	7.50 to 7.60
Color (Gardner Color Scale), maximum	ASTM D 1544	8

#### 2.1.2 Cured-Epoxy Binder

Combine components A and B in the proportions specified by the manufacturer to form a clear compatible system immediately on mixing. Cure combined components to a clear film possessing a glossy, nongreasy surface at relative humidities less than 80 percent, and have the following properties after curing 24 hours at 25 degrees C 77 degrees F, followed by 24 hours at 52 degrees C 125 degrees F:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
Water absorption, percent 24 hours at 25 degrees C, maximum	ASTM D 570	0.40
Hardness, Shore D	ASTM D 2240	74 to 82
Linear shrinkage, millimeter/ millimeter, maximum	ASTM C 881/C 881M	0.15
Shrinkage, glass bow, milli- meter divergence, maximum	ASTM A 990	0.40

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
Coefficient of linear thermal expansion, mm/mm/degrees C, maximum	ASTM D 696 0 degrees C to 40 degrees C	200 X 10-6
Gel time/peak exotherm at 25 degrees C, 100 gm mass in 120 millimeter metal container	ASTM D 2471	20 to 40 minutes at 150 degrees C, maximum

\*3 millimeter thick castings

\*\*3 by 25 by 80 millimeter castings, aged in forced draft oven

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
Tensile strength, psi* at test temperature: 77 degrees F	ASTM D 638	4500 to 6500
Tensile elongation, percent* at test temperature: 77 degrees F	ASTM D 638	20 to 40
Water absorption, percent 24 hours at 77 degrees F, maximum	ASTM D 570	0.40
Hardness, Shore D	ASTM D 2240	74 to 82
Linear shrinkage, inch/inch maximum	ASTM C 881/C 881M	0.006
Shrinkage, glass bow, inch divergence, maximum	ASTM A 990	0.016
Coefficient of linear thermal expansion, inch/inch/degree C, maximum	ASTM D 696 0 degrees C to 40 degrees C	200 X 10-6
Gel time/peak exotherm at 77 degrees F, 100 gm mass in 4-ounce metal container	ASTM D 2471	20 to 40 minutes at 300 degrees F, maximum

\*1/8 inch thick castings

\*\*1/8 by 1 by 3 inch castings, aged in forced draft oven

### 2.1.3 Walnut Shell Aggregate

Walnut shell aggregate must be delivered to the site in three separate package gradations for blending. Gradations to be furnished to be:

<u>SIEVE SIZE</u>	<u>PERCENT</u>	
	<u>MAXIMUM</u>	<u>MINIMUM</u>

GRADATION NO. 1



<u>SIEVE SIZE</u>	PERCENT	
	<u>MAXIMUM</u>	<u>MINIMUM</u>
Retained on 3.35 millimeter	0.0	-
Passing 3.35 millimeter, retained on 2.36 millimeter	5.0	0.0
Passing 2.36 millimeter, retained on 1.7 millimeter	100.0	74.0
Passing 850 micrometer	1.0	-

GRADATION NO. 2

Retained on 1.18 millimeter	0.0	-
Passing 1.18 millimeter, retained on 1.0 millimeter	5.0	0.0
Passing 1.0 millimeter, retained on 425 micrometer	100.0	85.0
Passing 425 micrometer, retained on 250 micrometer	9.0	0.0
Passing 250 micrometer	1.0	-

GRADATION NO. 3

Retained on 850 micrometer	0.0	-
Passing 850 micrometer, retained on 500 micrometer	5.0	0.0
Passing 500 micrometer, retained on 250 micrometer	100.0	80.0
Passing 250 micrometer, retained on 150 micrometer	13.0	0.0
Passing 150 micrometer	2.0	-

<u>SIEVE SIZE</u>	PERCENT	
	<u>MAXIMUM</u>	<u>MINIMUM</u>

GRADATION NO. 1

Retained on No. 6	0.0	-
Passing No. 6, retained on No. 8	5.0	0.0
Passing No. 8, retained on No. 12	100.0	74.0
Passing No. 20	1.0	-

GRADATION NO. 2

Retained on No. 16	0.0	-
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<u>SIEVE SIZE</u>	<u>PERCENT</u>	
	<u>MAXIMUM</u>	<u>MINIMUM</u>
Passing No. 16, retained on No. 18	5.0	0.0
Passing No. 18, retained on No. 40	100.0	85.0
Passing No. 40, retained on No. 60	9.0	0.0
Passing No. 60	1.0	-

#### GRADATION NO. 3

Retained on No. 20	0.0	-
Passing No. 20, retained on No. 35	5.0	0.0
Passing No. 35, retained on No. 60	100.0	80.0
Passing No. 60, retained on No. 100	13.0	0.0
Passing No. 100	2.0	-

#### 2.1.4 Surface Sealing Coat

Surface sealer must be nonambering aliphatic or aromatic moisture-curing polyurethane into which has been incorporated a suitable flatting agent. Add flatting agent not more than 24 hours prior to actual application of the coating. Cured coating with flatting agent must give 60-degree specular gloss of 10 to 20 when tested in accordance with [ASTM D 523](#).

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Safety Precautions

Prior to application in confined spaces of toppings and coatings containing flammable or toxic properties, provide forced ventilation to ensure that vapor concentration is kept at acceptable limits recommended by the manufacturer of the product.

Erect "NO SMOKING" signs, and prohibit smoking or use of spark- or flame-producing devices within [15 meter](#) [50 feet](#) of any mixing or placing operation involving flammable materials.

Personnel required to handle, mix, or apply toppings containing toxic or flammable properties must be provided with, and required to wear, such items of personal protective equipment and apparel for eye, skin, and respiratory protection as are recommended by the manufacturer of the product.

Accomplish sand blasting under approved controlled conditions with respect to sand and dust control to prevent damage to personnel and facility.

#### 3.2 PREPARATION

##### 3.2.1 Concrete Subfloor

Installation of floor topping must not commence until concrete has cured a

minimum of 28 calendar days. Concrete to have rough or broom type finish. Prior to applying the prime coat, clean concrete surface by an approved method.

#### 3.2.2 Steel Subfloor

Clean surfaces of grease, rust, and mill scale by dry sand blasting in accordance with **SSPC SP 6** for commercial sand blasting. Using other means of surface preparation is optional, as approved, provided the degree of cleanliness and profile obtained by sand blasting is equaled. Power brushing is not permitted.

#### 3.2.3 Mixing Of Materials

Job mix proportions are based on the trial batch proportions used to prepare the floor topping samples submitted and approved. Binder aggregate ratio normally range from 1:2 to 1:2.3 (by weight), since mixtures providing satisfactory density, trowelability, and surface texture are affected by variations in particle shapes, sizes, and size distribution. Blend three different walnut shell aggregate gradations (by weight) as follows: 1 part No. 1; 1.15 parts No. 2; and 1.15 parts No. 3. Minor adjustments of the mix proportions of the approved floor topping samples are permitted, subject to approval.

Use mechanical equipment for mixing of materials. Use rotating replaceable **20 to 60 liter 5- to 16-gallon** pail mixers for blending components A (epoxy resin) and B (curing agent) of epoxy binder.

Use rotating paddle-type masonry mortar mixers for preblending the three sizes and color pigment, if any, of the walnut shell aggregate and addition of the mixed epoxy resin binder. Mixing times to be as recommended by the materials supplier(s), provided mixing times result in homogeneous mixtures. In case the equipment used does not provide uniform mixtures in the times recommended, with approval, adjust the mixing times. Limit quantity of material mixed at one time to that which can be applied and finished within the working life of the mixtures. Temperature of materials at the time of mixing must be between **18 and 30 degrees C 65 and 85 degrees F**.

#### 3.2.4 Protection

In addition to the protection of adjacent surfaces during installation, areas used to store and mix materials must have a protective covering under the materials. After application of the sealer coats, protect finished flooring during the remainder of the construction period. In areas of expected minimum or moderate traffic, cover floors with **12300 newton per meter (70 pounds) 70-pound** kraft paper, a 30-30-30 waterproof kraft paper, or an approved substitute, with strips taped together and edges secured to prevent roll-up. Vegetable fiberboard, plywood, or other suitable material that does not mar the flooring must be placed over the paper to protect areas used as passages by workmen and areas subject to floor damage because of subsequent building operations. Upon completion of construction, remove the protection, clean flooring and, where necessary, repair, reseal, or both, at no additional cost to the Government.

### 3.3 APPLICATION OF FLOOR TOPPING

Anchor plates set with the top surface at or above the finished epoxy floor level do not require coverage with this flooring material. Extend flooring

under equipment, except when the equipment base is indicated to be flush against the structural floor. Cover and/or mask surfaces not to receive the epoxy floor topping, such as equipment or cabinets installed prior to surface-preparation efforts and adjacent to the flooring installation.

Prepared subfloor surface must be dry and at a temperature of not less than 16 degrees C 60 degrees F when application of the floor topping is initiated. Immediately prior to application of the prime/scratch coat on the prepared surface, remove dust or other loose particles by blowing with compressed air or vacuum cleaned. Air compressor used must be equipped with an efficient oil-water trap to prevent oil contamination or wetting of surface.

Apply a thin roller coat of the epoxy binder specified to the prepared subfloor as a prime coat. As an aid to placing, compacting, and finishing the floor topping, the forming of a scratch coat by sprinkling a minimum quantity of the walnut shell aggregate on the prime coat surface immediately following the prime coat application is allowed. Prime coat application rate must be approximately 3.7 square meter per liter 150 square feet per gallon. Prior to application of the prime/scratch coat, fill cracks in the concrete, and make provisions to keep control or expansion joints open.

Place the floor topping prior to final gelling of the prime/scratch coat. Immediately after the materials are mixed as specified, dump the mixture in the placement area and spread to prolong troweling life. Screed or rough trowel placed materials to the specified thickness and then compact by the use of a smooth roller prior to finish troweling to a nominal thickness of 4.7 millimeter plus or minus 1.58 millimeter 3/16 inch plus or minus 1/16 inch. Finished surface must be free of ridges, hollows (bird-baths), and trowel marks, and smoothness must vary not more than 3 millimeter 1/8 inch when tested with an 2500 millimeter 8-foot straightedge. Make provisions to maintain the work areas in a relatively dust-free environment during curing of the topping.

After the floor topping has set firmly (approximately 6 to 16 hours depending on subfloor temperature) in a relatively dust-free environment, apply two thin coats of the sealer coat, by means of brush, roller, squeegee, or notched trowel to provide a pore-free, easy-to-clean surface. At the time of sealer application, the surface must be dust-free. Depending on relative humidity, the applied sealer must cure to a tack-free condition in 2 to 4 hours. Second coat must not be applied until after the initial coat has cured to a tack-free, hard film. Maintain topping areas in a relatively dust-free environment during curing of the sealer coats.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Repairing

Damaged and unacceptable portions of completed work must be removed and replaced with new work to match adjacent surfaces at no additional cost to the Government.

### 3.5 CLEANING

Clean surfaces of the new work, and adjacent surfaces soiled as a result of

the work. Equipment, surplus materials, and rubbish from the work must be removed from the site.

-- End of Section --