
USACE / NAVFAC / AFCEA / NASA UFGS-09 67 23.13 (August 2010)
Change 1 - 11/12

Preparing Activity: NASA Superseding
UFGS-09 67 23.13 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2012

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08/10

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SECTION 09 67 23.13

STANDARD RESINOUS FLOORING 08/10

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

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 \(CCR\)](#).

PART 1 GENERAL

1.1 REFERENCES

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

Use the Reference Wizard's Check Reference feature when you add a 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.

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 A990 (2011) Standard Specification for
Castings, Iron-Nickel-Chromium and Nickel
Alloys, Specially Controlled for Pressure
Retaining Parts for Corrosive Service

ASTM C881/C881M (2010) Standard Specification for
Epoxy-Resin-Base Bonding Systems for
Concrete

ASTM D1475 (1998; R 2008) Standard Test Method for
Density of Liquid Coatings, Inks, and
Related Products

ASTM D1544 (2004; R 2010) Standard Test Method for
Color of Transparent Liquids (Gardner
Color Scale)

ASTM D1652 (2011) Standard Test Method for Epoxy
Content of Epoxy Resins

ASTM D2240 (2005; R 2010) Standard Test Method for
Rubber Property - Durometer Hardness

ASTM D2471 (1999) Standard Test Method for Gel Time
and Peak Exothermic Temperature of
Reacting Thermosetting Resins

ASTM D4259 (1988; R 2012) Standard Practice for
Abrading Concrete

ASTM D445 (2012) Standard Test Method for Kinematic
Viscosity of Transparent and Opaque
Liquids (and the Calculation of Dynamic
Viscosity)

ASTM D523 (2008) Standard Test Method for Specular
Gloss

ASTM D570 (1998; R 2010e1) Standard Test Method for
Water Absorption of Plastics

ASTM D638 (2010) Standard Test Method for Tensile
Properties of Plastics

ASTM D696 (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/NACE No.3

(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

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, 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.

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

Installation Drawings[; G][; G, [_____]]

[Fabrication Drawings[; G][; G, [_____]]
]

SD-03 Product Data

Manufacturer's Catalog Data[; G][; G, [_____]]

Cured Epoxy Binder[; G][; G, [_____]]

Epoxy-Resin Binder/Matrix[; G][; G, [_____]]

Aggregate[; G][; G, [_____]]

Surface Sealing Coat[; G][; G, [_____]]

SD-04 Samples

Hardboard Mounted Epoxy Flooring[; G][; G, [_____]]

SD-05 Design Data

Design Mix Data[; G][; G, [_____]]

Epoxy-Resin Binder/Matrix[; G][; G, [_____]]

SD-06 Test Reports

Records of Inspection[; G][; G, [_____]]

SD-07 Certificates

Listing of Product Installations[; G][; G, [_____]]

Referenced Standards Certificates[; G][; G, [_____]]

Warranty[; G][; G, [_____]]

1.3 ADMINISTRATIVE REQUIREMENTS

NOTE: 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
aggregate. Clearly designate on drawings areas of
application.

NOTE: Delete the second paragraph for projects
which are cast completely on site. Include the
second paragraph for projects requiring factory
assembly prior to site delivery.

1.3.1 Pre-Installation Meetings

Submit installation drawings for heavy duty epoxy flooring systems clearly designating the areas of application.

Submit fabrication drawings for heavy duty epoxy flooring Systems consisting of fabrication and assembly details to be performed in the factory.

1.3.1.1 Product Data

Within [30] [_____] days of contract award, submit [manufacturer's catalog data](#) for the following items:

- a. Epoxy-Resin Binder/Matrix
- b. Cured Epoxy Binder
- [c. Aggregate
-] d. Surface Sealing Coat

1.3.1.2 Design Mix Data

Within [30] [_____] days of contract award, submit [design mix data](#) for the following items, including a complete list of ingredients and admixtures:

- a. Epoxy-Resin Binder/Matrix
- b. Cured Epoxy Binder
- c. Surface Sealing Coat

Ensure applicable test reports verify the mix has been successfully tested and meets design requirements.

1.4 QUALITY ASSURANCE

Prior to commencement of work, submit [referenced standards certificates](#) for the following, showing conformance with the referenced standards contained in this section:

- a. Epoxy-Resin Binder/Matrix
- b. Cured Epoxy Binder
- c. Aggregate
- d. Surface Sealing Coat

Submit a sample [records of inspection](#) plan, including the records of corrective action to be taken.

1.4.1 Qualifications

Submit a [listing of product installations](#) for heavy duty epoxy flooring including 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. Identify purchaser, address of installation, service organization, and date of installation.

Ensure floor system applicators are experienced in the application of troweled [walnut-shell] [_____] aggregate thin-set floor topping.

1.4.2 Sampling

Submit [hardboard mounted epoxy flooring](#) samples not less than 300 millimeter 12 inch square for each required color.

Provide panels showing nominal thickness of finished toppings, color, and texture of finished surfaces. Finished floor toppings and the approved samples are to match in color and texture.

1.5 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.

PART 2 PRODUCTS

2.1 MIXES

2.1.1 Epoxy-Resin Binder/Matrix

Provide a clear two-component compatible system epoxy resin binder consisting of: (1) a liquid blend of a biphenyl-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. Ensure the two components and the cured epoxy binder 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 D445	3000 to 5000
Weight per epoxide, grams	ASTM D1652	205 to 225
Color (Gardner Color Scale), maximum	ASTM D1544	5
Weight per milliliter, grams	ASTM D1475	1.13 - 1.15
	COMPONENT B (CURING AGENT)	
Viscosity (kinematic), at 25 degrees C, square milliliter per second	ASTM D445	75 to 125
Weight per milliliter, grams	ASTM D1475	0.90 to 0.91
Color (Gardner Color Scale), maximum	ASTM D1544	8

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
COMPONENT A (EPOXY RESIN)		
Viscosity (kinematic), at 77 degrees F, centipoises	ASTM D445	3000 to 5000
Weight per epoxide, grams	ASTM D1652	205 to 225
Color (Gardner Color Scale), maximum	ASTM D1544	5
Weight per gallon, pounds	ASTM D1475	9.46 - 9.56
COMPONENT B (CURING AGENT)		
Viscosity (kinematic), at 77 degrees F, centistokes	ASTM D445	75 to 125
Weight per gallon, pounds	ASTM D1475	7.50 to 7.60
Color (Gardner Color Scale), maximum	ASTM D1544	8

2.1.1.2 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, having 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 D570	0.40
Hardness, Shore D	ASTM D2240	74 to 82
Linear shrinkage, millimeter/millimeter, maximum	ASTM C881/C881M	0.15
Shrinkage, glass bow, milli-meter divergence, maximum	ASTM A990	0.40
Coefficient of linear thermal expansion, mm/mm/degrees C, maximum	ASTM D696 0 degrees C to 40 degrees C	200 X 10 ⁻⁶

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
Gel time/peak exotherm at 25 degrees C, 100 gm mass in 120 millimeter metal container	ASTM D2471	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 D638	4500 to 6500
Tensile elongation, percent* at test temperature: 77 degrees F	ASTM D638	20 to 40
Water absorption, percent 24 hours at 77 degrees F, maximum	ASTM D570	0.40
Hardness, Shore D	ASTM D2240	74 to 82
Linear shrinkage, inch/inch maximum	ASTM C881/C881M	0.006
Shrinkage, glass bow, inch divergence, maximum	ASTM A990	0.016
Coefficient of linear thermal expansion, inch/inch/degree C, maximum	ASTM D696 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 D2471	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 Aggregate

Provide aggregate recommended by the resinous flooring manufacturer and approved by the Contracting Officer's technical representative. Deliver aggregate to the site in three separate package gradations for blending.

Gradations are:

	PERCENT	
SIEVE SIZE	MAXIMUM	MINIMUM
GRADATION NO. 1		
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	-

	PERCENT	
SIEVE SIZE	MAXIMUM	MINIMUM
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	-

SIEVE SIZE	PERCENT	
	MAXIMUM	MINIMUM
GRADATION NO. 2		
Retained on No. 16	0.0	-
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

NOTE: Glossy final finishes may cause a slip hazard under room conditions when exposed to water or oily lubricants, particularly in various labs or maintenance areas. Specify the type of final finish desired and the material required (grit) to be added so as to prevent slip hazards.

Provide nonambling aliphatic or aromatic moisture-curing polyurethane surface sealer into which has been incorporated a suitable flatting agent. Add flatting agent not more than 24 hours prior to actual application of the coating. Ensure cured coating with flatting agent yields 60-degree specular gloss of 10 to 20 when tested in accordance with [ASTM D523](#).

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.

Provide personnel required to handle, mix, or apply toppings containing toxic or flammable properties with such items of personal protective equipment and apparel for eye, skin, and respiratory protection as are recommended by the manufacturer of the product. Ensure all personnel are trained in the appropriate use and wearing of personal protection equipment.

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

3.2 PREPARATION

Prior to applying resinous flooring material, inspect substrate and immediately report any unsatisfactory conditions that exist and repair.

3.2.1 Concrete Subfloor

[3.2.1.1 New Concrete Floors

Do not commence installation of floor topping until concrete has cured a minimum of 28 calendar days. Verify concrete floor is straight, properly sloped, and has [rough] [broom] [wooden float] type finish. Ensure concrete is moist cured with burlap or polyethylene. Do not use curing agents, methods, or materials which prevent proper bonding of resinous flooring. Prior to applying the prime coat, clean concrete surface by an approved method.

] [3.2.1.2 Existing Concrete Floors

Clean existing concrete floors, with hard troweled or contaminated areas in conformance with ASTM D4259, and ensure concrete is free of all paint, sealers, curing agents, oil, grease, moisture, dirt or any other contaminants. Remove any loose or corroded segments of existing concrete and patch with a grouting compound as recommended by the resinous flooring manufacturer. Fill all cracks with an elastomeric jointing compound compatible with the resinous flooring system used.

] [3.2.2 Steel Subfloor

Clean surfaces of grease, rust, and mill scale by dry sand blasting in accordance with SSPC SP 6/NACE No.3 for commercial sand blasting. Prime all surfaces with a primer as recommended by the resinous flooring manufacturer, the same day or before there are any visible signs of oxidation, which ever is sooner. Using other means of surface preparation is optional, as approved by the Contracting Officer, 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 as 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. Ensure mixing times are 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 by the Contracting Officer, 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. Verify temperature of materials at the time of mixing are between 18 and 30 degrees C 65 and 85 degrees F.

3.2.4 Protection of Adjacent Surfaces

In addition to the protection of adjacent surfaces during installation, provide areas used to store and mix materials with 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-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. Place vegetable fiberboard, plywood, or other suitable material that does not mar the flooring 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

3.3.1 Areas Of Application

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.

3.3.2 Application of Prime Coat and Troweling

Ensure prepared subfloor surface is 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. Use only an air compressor 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, form a scratch coat by sprinkling a minimum quantity of

the walnut shell aggregate on the prime coat surface immediately following the prime coat application. Prime coat application rate is 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. Ensure all finished surfaces are free of ridges, hollows (bird-baths), trowel marks, and smoothness varies no 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.

3.3.3 Sealer Coat

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, ensure the surface is dust-free. Depending on relative humidity, allow the applied sealer to cure to a tack-free condition in 2 to 4 hours. Do not apply second coat 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.

[3.3.4 Integral Cove Base

**NOTE: Use the following paragraph if project
requires an integral cove base.**

Provide a [10.16] [] cm [4] [] inch high cove base to all wall surfaces as indicated on the drawings. Install so as to provide a [1.27] [] cm [1/2] [] inch radius at the juncture of the floor and the wall.

] 3.4 FIELD QUALITY CONTROL

3.4.1 Repairing

Remove and replace damaged or unacceptable portions of completed work 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. Remove all equipment, surplus materials, and rubbish associated with the work from the site.

3.6 WARRANTY

Submit a [2] [_____] year written warranty for all materials and installation work to the Contracting Officer.

-- End of Section --