Preparing Activity: USACE Superseding
UFGS-09 67 23.13 (November 2015)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 09 67 23.13

STANDARD RESINOUS FLOORING

11/19

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USACE / NAVFAC / AFCEC / NASA **UFGS-09 67 23.13 (November 2019)**

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SECTION 09 67 23.13

STANDARD RESINOUS FLOORING
11/19

****

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 item(s) or insert appropriate information.

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

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

****

PART 1 GENERAL

1.1 REFERENCES

****

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

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

to update the issue dates.

References not used in the text 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/A990M	(2021) Standard Specification for Castings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure-Retaining Parts for Corrosive Service
ASTM C881/C881M	(2020a) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM D445	(2019a) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D1475	(2013) 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; E 2012) Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2240	(2015; E 2017) 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	(2018) Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application
ASTM F1869	(2022) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Pre-installation Conference: Conduct conference at Project site.

1.2.2 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

1.2.3 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.

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification

technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

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

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

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

****

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

SD-02 Shop Drawings

Installation Drawings[; G[, [____]]]

[Fabrication Drawings[; G[, [____]]]
]

SD-03 Product Data

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

SD-04 Samples

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

Floor Topping[; G[, [____]]]

Mockups[; G[, [____]]]

SD-05 Design Data

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

SD-07 Certificates

Listing of Product Installations

Referenced Standards Certificates

SD-11 Closeout Submittals

Warranty[; G[, [____]]]

1.4 DELIVERY, STORAGE, AND HANDLING

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.

1.5 QUALITY CONTROL

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

1.5.1 Mockups

Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Apply full-thickness mockups on 2.44 meters96 inch square floor area selected by Contracting Officer. Simulate finished lighting conditions for the review of mockups.

1.5.2 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.

1.5.3 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.

1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

****
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: Coordinate with plumbing drawings for floor drains, slopes and details.
****

****
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.
****

Submit installation drawings for heavy duty epoxy flooring systems clearly designating the areas of application and the installation plan. Include in the installation plan, methods to control sand and dust if sand blasting is required.

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

]

2.2 MATERIALS

2.2.1 Mixes

2.2.1.1 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 polyglyceride 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:

PROPERTY	TEST METHOD	REQUIREMENT
	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

PROPERTY	TEST METHOD	REQUIREMENT
	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

2.2.1.2 Cured Epoxy Binder

Provide a cured epoxy binder with the following properties.

PROPERTY	TEST METHOD	REQUIREMENT
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/A990M	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
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		

PROPERTY	TEST METHOD	REQUIREMENT
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/A990M	0.016

PROPERTY	TEST METHOD	REQUIREMENT
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		

[2.2.1.3 Aggregate

Provide aggregate recommended by the resinous flooring manufacturer and approved by the Contracting Officer. Deliver aggregate to the site in three separate package gradations for blending. Gradations are:

	PERCENT	
SIEVE SIZE	MAXIMUM	MINIMUM
GRADUATION 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	-

	PERCENT	
SIEVE SIZE	MAXIMUM	MINIMUM
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
GRADUATION 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	-
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	-

]2.2.1.4 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 to prevent slip hazards.

The slip resistance of floor surfaces is an important consideration for resinous flooring. Static coefficient-of-friction (COF) requirements for walking surfaces are not stipulated in the ADA standards. Previous accessibility guidance for floor surfaces recommended COF values of not less than 0.6 for level surfaces and 0.8 for ramped surfaces, but did not indicate the test required to make the measurement.
****

Provide nonambering aliphatic or aromatic moisture-curing polyurethane surface sealer into which has been incorporated a 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 PREPARATION

****
NOTE: Select test per manufacturer's written instructions.
****

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

Verify that the concrete substrates are dry and the moisture-vapor emissions are within acceptable levels according to the manufacturer's written instructions.

[Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have a maximum moisture-vapor-emission rate of [1.36 kg of water/92.9 sq. meters3 lb of water/1000 sq. ft.][2.04 kg of water/92.9 sq. meters4.5 lb of water/1000 sq ft.][Insert emission rate] of slab area in 24 hours.

][Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [75] [Insert number] percent relative humidity level measurement.

][Alkalinity and Adhesion Testing: Verify that concrete substrates have a pH within an acceptable range. Perform tests recommended by the manufacturer. Proceed with the application only after the substrates pass testing.]

3.1.1 Safety Precautions

Prior to application in confined spaces of toppings and coatings containing flammable or toxic properties, institute safety precautions 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 the 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.

3.1.2 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][_____], 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.

3.1.3 Concrete Subfloor

[3.1.3.1 New Concrete Floors

Do not commence installation of the floor topping until the concrete has cured a minimum of 28 calendar days. Verify that the concrete floor is straight, properly sloped, and has [rough] [broom] [wooden float] type finish. Ensure that the concrete is moist cured with burlap or polyethylene. Before applying the prime coat, clean the concrete surface by an approved method.

][3.1.3.2 Existing Concrete Floors

Clean existing concrete floors, with hard troweled or contaminated areas in conformance with ASTM D4259. Ensure the 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. 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.

][3.1.4 Steel Subfloor

Clean surfaces of grease, rust, and mill scale by dry sand blasting in accordance with SSPC SP 6/NACE No.3. 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 the profile obtained by sand blasting is equivalent. Power brushing is not permitted.

]3.1.5 Mixing Of Materials

****
NOTE: Mixtures providing satisfactory density, trowelability, and surface texture are affected by variations in particle shapes, sizes, and size distribution.
****

Select the job mix proportions on the trial batch proportions used to prepare the floor topping samples as submitted and approved.

Use mechanical equipment for mixing of materials in accordance with the manufacturer's instructions.

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. Limit quantity of material mixed at one time to that which can be applied and finished within the working life of the mixtures. Verify that the temperature of materials at the time of mixing are between 18 and 30 degrees C 65 and 85 degrees F.

3.2 APPLICATION

3.2.1 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.

3.2.2 Application of Prime Coat and Troweling

Combine the epoxy binder 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, non-greasy 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:

Ensure that the 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 before 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. Prior to application of the prime/scratch coat, fill cracks in the concrete per manufacturer's instructions, 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 4.76 millimeter plus or minus 1.59 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 3.18 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.

3.2.3 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 that 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.

[3.2.4 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.

]3.3 FIELD QUALITY CONTROL

3.3.1 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.

3.4 ADJUSTING AND 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.

-- End of Section --