Preparing Activity: NAVFAC Superseding
UFGS-09 97 23 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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08/18

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USACE / NAVFAC / AFCEC / NASA	**UFGS-09 97 23 (August 2018)**

Preparing Activity: NAVFAC	**Superseding**
	UFGS-09 97 23 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 09 97 23

METALLIC TYPE CONDUCTIVE/SPARK RESISTANT CONCRETE FLOOR FINISH
08/18

****
NOTE: This guide specification covers the requirements for metallic type conductive/spark resistant concrete floor finish for ordnance and other similar structures over a bonded floor topping with a thickness of 2 inches or greater or a monolithic base slab. For other installation procedures, edit specification accordingly.

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).
****

****
NOTE: Do not use the type of floor finish specified in this section in hospitals, laboratories, or other similar occupancies where sanitation is a primary consideration. This guide specification does not cover tile or fluid-applied conductive flooring. Such systems may be found in Section 09 65 00 RESILIENT FLOORING or Section 09 67 23.14 CHEMICAL RESISTANT RESINOUS FLOORING.
****

****
NOTE: This is a very specialized product and must

be well researched before this specification is used. Check with using activity to ensure that this type of floor finish is chemically compatible with explosives and solvents contemplated for use in proposed facility.

****

****

NOTE: On the drawings, show:

1. Extent of metallic type conductive and spark resistant concrete floor finish.

2. Required slopes, floor drains, and appropriate details.

****

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 will automatically be 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.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates

ASTM C94/C94M	(2022a) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C494/C494M	(2019; E 2022) Standard Specification for Chemical Admixtures for Concrete
ASTM C1602/C1602M	(2022) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM E1155	(2020) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM F150	(2006; R 2013) Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring

1.2 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-03 Product Data

Graded Iron

Curing Compound

Water Reducing Admixture

High Range Water Reducing Admixture

SD-04 Samples

Conductive and Spark-Resistant Floor Finish

SD-05 Design Data

Mix Design

SD-06 Test Reports

Cement

Aggregate

Admixtures

Conductivity and Spark Resistance

Water

SD-08 Manufacturer's Instructions

Metallic Surfacing

Curing of Floor Finish

SD-10 Operation and Maintenance Data

Conductive Spark-Resistant Floor Finish, Data Package 1; G[, [_____]]

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Conductivity

****

NOTE: Include requirement for minimum resistance when electrical convenience outlets are provided around or above floor area. This usually occurs only in work and equipment assembly areas. Use 5000

ohms for 120 volt service, 10,000 ohms for 240 volt service, and 20,000 ohms for 440 volt service. If electrical service is greater than 440 volts, consult NAVSEA for guidance.
****

Floor finish must have a [minimum electrical resistance of [5,000] [10,000] [20,000] ohms and a] maximum average electrical resistance of 1,000,000 ohms. Measure electrical resistances on conditioned sample slab and on conditioned project slab using method of test specified herein.

1.3.2 Spark Resistance

Floor finish must produce no spark when tested using method of test specified herein.

1.4 ENVIRONMENTAL CONDITIONS

Do not start work unless environmental conditions conform to manufacturer's printed instructions. Maintain recommended environmental conditions without interruption during application and curing processes.

1.5 MANUFACTURER'S REPRESENTATIVE

****
NOTE: The requirements for the presence of a qualified technical representative of the metallic surfacing material manufacturer should be retained only for applications where strict compliance with installation procedures is considered to be critical.
****

Have manufacturer's technical representative present during start-up of each phase of work including inspection of grounding materials, preparation of base slab, mixing and placing concrete topping, application of dusted-on metallic surfacing, curing and testing.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver manufactured materials in manufacturer's original unbroken packages or containers plainly labeled with manufacturer's names, brands, lot numbers, and product expiration date. Use moisture-resistant containers. Store materials in dry, weathertight enclosures and handle in a manner that will prevent inclusion of foreign materials or damage by dampness.

1.7 CONDUCTIVE AND SPARK-RESISTANT FLOOR FINISH SAMPLE
****
NOTE: If the design thickness of the topping is less than 50 mm 2 inches, insert design thickness in the blank and remove the 50 mm 2 inch requirement.
****

Before work is started, prepare, test, and submit sample of conductive and spark-resistant floor finish, 1.22 meters 4 feet square and [50][_____] mm [2][_____] inches thick. Cast sample on 12 mm 1/2 inch thick plywood base covered with polyethylene film. Mix and apply topping in accordance with this specification, including troweling, curing, and protection.

Test floor finish sample for compliance with the conductivity and spark resistance requirements specified herein. Perform testing using an approved independent testing laboratory.

PART 2 PRODUCTS

2.1 FLOOR FINISH MATERIALS

2.1.1 Portland Cement

ASTM C150/C150M, Type I [or II]. Submit test report showing compliance with ASTM C150/C150M.

2.1.2 Aggregate

ASTM C33/C33M, except as specified below. Provide pea gravel, silica, traprock, or other approved materials of equivalent hardness. Conform to the following gradation:

Mesh	Percent Passing
9.5 mm 3/8 inch	100
4.75 mm No. 4	95-100
2.36 mm No. 8	65-80
1.18 mm No. 16	45-65
0.60 mm No. 30	25-45
0.30 mm No. 50	5-15
0.15 mm No. 100	0-5

Submit test report showing compliance with ASTM C33/C33M.

2.1.3 Admixtures

****

NOTE: Specify these admixtures where increased slump is beneficial with respect to ease of placement, consolidation, metallic hardener application, or where a delay of initial set is desirable due to high temperature and low humidity conditions.

****

ASTM C494/C494M. Water reducing, normal setting (Type A); water reducing admixture (Type D); or high range water reducing admixture (Type F). Admixtures must not contain more than 0.05 percent chloride ions. Submit product data for water reducing admixture and high range water reducing admixtures. Submit test report showing compliance with ASTM C494/C494M.

2.1.4 Water

Provide water complying with the requirements of ASTM C1602/C1602M. Provide [potable]water for mixing, free of injurious amounts of oil, acid, salt, or alkali. Submit test report showing water complies with ASTM C1602/C1602M.

2.2 GROUNDING MATERIALS

****
NOTE: Ground rods should be specified for slabs on grade. Grounding studs should be specified for suspended slabs. Division 3, "Concrete" sections of project specification should specify that ground rods or grounding studs be maintained in position to prevent misalignment before and during placement of structural concrete.
****

2.2.1 Ground Rods

****
NOTE: Specify hard copper or copper clad steel rods for normal conditions. Specify brass or stainless steel rods where electrolytic corrosion will be encountered.
****

[Hard copper][Copper-clad steel][Brass][Stainless steel] not less than 20 mm 0.75 inch in diameter, 3 meters 10 feet long. Die stamp each ground rod near top with name or trademark of manufacturer and length of rod in meters feet.

2.2.2 Grounding Studs

Hard copper, or brass, 12 mm 1/2 inch diameter and of such length as to project into structural concrete base slab not less than 75 mm 3 inches when installed.

2.2.3 Grounding Connector Disks

Approximately 50 to 100 mm 2 to 4 inch diameter or 50 to 100 mm 2 to 4 inch square pieces of copper or brass hardware cloth, 4 mesh, 1.2 mm 0.047 inch wire diameter.

2.3 METALLIC SURFACING MATERIAL

2.3.1 Graded Iron Mixture

A factory-prepared dry mixture of graded iron particles, cement, and chemicals; suitable for application by the dusted-on method; and free from nonferrous metal particles, oils, grease, soluble alkaline compounds, rust and materials intended to disguise rust, and any other contaminants. Submit product data for graded iron mixture.

Submit conductive spark-resistant floor finish, Data Package 1, in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.3.2 Water Content

Provide water absorbent metallic aggregate containing not more than 0.075 percent water soluble materials.

2.3.3 Cement Dispersing Agent

Combine a cement-dispersing agent, a pozzolanic material capable of combining with free lime to form a water insoluble compound, and an approved binder with metallic aggregate.

2.3.4 Purity

Do not add material to factory-prepared product at job site.

2.4 CURING COMPOUND

A product of the manufacturer of the metallic surfacing material or a type recommended by the manufacturer of the metallic surfacing material. Submit product data for curing compound.

PART 3 EXECUTION

3.1 INSTALLATION OF GROUNDING MATERIALS

Provide at least one ground [rod] [or] [stud] for each 37 square meters 400 square feet or less of floor area. Place grounding materials at least 50 mm 2 inches clear and free of pipes, conduits, sleeves, anchor bolts, floor drains, or other metal building material that projects through floor finish. Place tops of [rods] or [studs] at an elevation not more than 10 mm 3/8 inch below top surface of finish floor. Do not allow [rods] or [studs] to project above finish floor elevation. Center grounding connector disks on top of [rods] [or] [studs]. Braze disks to tops of [rods] [or] [studs]. Connect each ground [rod] [or] [stud] electrically to concrete slab reinforcement steel. Connect using a copper or brass braided strap. Braze to both reinforcing steel and ground [rod] [or] [stud].

3.1.1 Ground Rods

Drive ground rods vertically into earth. The maximum resistance to ground of driven ground rod must not exceed 25 ohms when tested in accordance with paragraph GROUNDING TESTS.

3.1.2 Ground Studs

****
NOTE: The last sentence presumes ground studs used with an existing concrete base slab. Other site conditions require a different design and wording.
****

Connect studs together electrically using a continuous No. 6 AWG copper wire brazed to each stud and to a common ground wire connected electrically to an approved ground. Place stud interconnecting wire on, shape, and fasten to existing concrete base slab to prevent wire from lifting when concrete topping is placed.

3.2 PREPARATION OF BASE SLAB

****

NOTE: This guide specification is based on use of a bonded floor topping with thickness of 50 mm 2 inches or greater or a monolithic base slab. For other installation procedures, edit specification accordingly. For a monolithic base slab delete paragraphs PREPARATION OF BASE SLAB, CLEANING, BOND COAT, PROPORTIONING AND MIXING OF CONCRETE TOPPING, PROPORTIONING AND MIXING.

****

3.2.1 Cleaning

****

NOTE: Choose from one of the following three paragraphs. Use first paragraph for wet cured slabs less than 3 days old. Use second paragraph for cured slabs between 3 days and a week old. Use third paragraph for cured slabs more than a week old.

****

Wash dirt and debris from surface of base slab.

Remove dirt, oil, grease, laitance or other foreign matter from surface of base slab. Scrub surface and rinse thoroughly with clean water. Keep base slab wet for a period of not less than 12 hours preceding application of topping.

Remove dirt, oil, grease, laitance or other foreign matter from surface of base slab. Scrub surface with a 10 percent muriatic acid solution and rinse thoroughly with clean water. After rinsing, a litmus test of the wet surface must indicate no trace of acid solution.

3.2.2 Bond Coat

Remove excess water or dry slab until there is no free water. Apply a cement paste, latex, latex cement, or epoxy bond coat.

3.3 PROPORTIONING AND MIXING OF CONCRETE TOPPING

****

NOTE: Where bonded topping or base slab is of very low slump (less than 75 mm 3 inches) consider deletion of reference to excess water. Metallic surfacing material, which is a dry shake material, will require sufficient water to adequately mix with concrete topping or base slab.

****

3.3.1 Proportioning

****

NOTE: Use either compressive strength option or specified mix design.

****

[Proportion concrete topping mix to provide a 28-day compressive strength

of 34.5 kPa 5,000 psi, with a maximum slump of 75 mm 3 inches or less. If high range water reducing admixture is used, slump may be increased to 200 mm 8 inches.][Proportion concrete topping mixture by volume with one part portland cement and 2 3/4 parts 10 mm 3/8 inch maximum size aggregate. Use a maximum water-cement ratio of 0.45 including moisture contained in aggregates.] Topping mix may be modified, as approved, to conform to requirements of manufacturer of metallic surfacing material. Submit concrete mix design for topping slab.

3.3.2 Mixing

Perform mixing in mechanical mixers of a type in which quantities of water can be controlled accurately and uniformly. Introduce and mix aggregates so that materials are distributed uniformly throughout the mass. Add water gradually. After cement, aggregates, and water are in mixer drum, mix for two minutes. Ready-mixed concrete must conform to ASTM C94/C94M. Do not retemper topping mixture with water. Additional dosage with high range water reducing admixture may be permitted with prior approval of the Contracting Officer as to methods and procedures. Use only admixture specified and approved in proposed mix design.

3.4 PLACING, FINISHING, AND CURING

3.4.1 Placing Concrete Topping

****
NOTE: For bonded toppings, use as thick a bonded topping as design constraints will allow. A 25 mm one inch bonded topping is extremely difficult to install. Bonded toppings of 50 mm 2 inches to a maximum of 75 mm 3 inchesare much easier to construct. Generally, the thinner the bonded topping, the more problems that will be encountered during construction and in future use. When using a monolithic base slab delete this paragraph.
****

Place, compact and strike-off topping mixture to the full depth of the [50] [_____] mm [2] [_____] inch screed strips. Tamp thoroughly with a grill-faced tamper (do not use a flat-faced tamper) or vibrate with a small vibrator to compact concrete topping, force out entrapped air, and ensure maximum density. Take extreme care in placing and tamping so that grounding system will not be damaged or misaligned. Form a slight cup-shaped pocket or depression, about 75 mm 3 inches in diameter and 20 mm 3/4 inch in depth in topping finish surrounding grounding connector disks on tops of [rods] [and] [studs]. Keep disk free of topping mix by protecting disk with a plastic sheet. After compacting, screeding and leveling floor surface, remove excess water by an approved method. Mechanically float surface.

[3.4.2 Placing and Finishing Base Slab

****
NOTE: Use this paragraph for monolithic slab placement.
****

Where metallic surfacing is to be placed directly upon base slab, place slab in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. Take

extreme care in placing and consolidating concrete so that grounding system is not damaged or misaligned. Form a slight cup-shaped pocket or depression, about 75 mm 3 inches in diameter and 20 mm 3/4 inch in depth in the finish surrounding grounding connector disks on the tops of the [rods] [and] [studs]. Keep disk free of concrete and mortar by protecting disk with plastic sheet. After placing, consolidating, striking off and leveling, remove excess water by an approved method. Mechanically float the surface.

]3.4.3 Metallic Surfacing

Before opening, shake surfacing material containers to ensure uniformity of ingredients. After floating floor surface, dust dry metallic surfacing material uniformly on surface at a rate of not less than 4.4 kilograms per square meter 0.9 pound per square foot of surface. When metallic aggregate has absorbed surface moisture, mechanically float surface. After floating, uniformly dust on surface remaining dry metallic surfacing material to achieve a total rate of not less than 8.8 kilograms per square meter 1.8 pound per square foot of surfacing material for the two dusting operations. Apply second shake at right angles to first for even application. Repeat floating operation. Submit manufacturer's instructions for application of metallic surfacing.

3.4.4 Finishing

****
NOTE: Use 6 mm in 3 meters 1/4 inch in 10 feet unless operational requirements dictate the flatter floor. For floors where floor flatness is critical, use the bracketed paragraph in place of the first paragraph. The numbers provided in brackets are typical numbers, but A/E should research and select F numbers high enough to get desired results but not so high as to cause undue cost increases and construction problems. Ff/FL 20/15 is equivalent to 8 mm in 5.05 mm 5/16 inches in 10 feet. This test method is not suitable for unshored deck. Fitted partitions need FL greater than or equal to 25.
****

Finish floor to a smooth surface, free from blemishes. Test floor surface with a straight edge to ensure a tolerance of plus or minus [6 mm 1/4 inch] [3 mm1/8 inch] in 3 meters 10 feet.

[Construct in accordance with one of the methods recommended in ACI 302.1R, Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI 117 for tolerance tested by ASTM E1155.

a. Specified Conventional Value:

Floor Flatness (Ff) [20] [_____] [13] [_____] minimum
Floor Levelness (FL) [15] [_____] [10] [_____] minimum

b. Specified Industrial:

Floor Flatness (Ff) [30] [_____] [15] [_____] minimum
Floor Levelness (FL) [20] [_____] [10] [_____] minimum

Test slab within 24 hours of the final troweling. Provide tests to

Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E1155.

] Take extreme care so that conductive metallic aggregate contained in surfacing material is in full and firm contact with disks attached to top of grounding [rods][and][studs]. Do not float or trowel surfaces excessively in a manner that buries metallic aggregate or contaminates surfacing material during floating and trowelling operations. Protect flooring from contamination by subgrade material, tracked or spilled concrete, sand, stone, or other material during finishing operations. Remove flooring contaminated and replace with new flooring. Match approved finish floor sample in all respects.

3.4.5 Curing and Protection

Cure and protect floor finish for not less than 30 days unless a longer period is recommended by the manufacturer's printed instructions. Strip floor finish of conductive curing compounds only in those areas where acceptance tests will be performed. Strip non-conductive curing compounds completely. Submit manufacture's printed instructions for curing the floor finish.

3.5 FIELD TESTS

Conduct testing in the presence of the Contracting Officer.

3.5.1 Grounding Tests

Test ground [studs][and][rods] and interconnecting ground wire before the concrete slab is placed and again before the topping finish is placed. Before final wiring is connected to the ground rods, test each rod or group of rods for ground resistance using a portable ground testing megohmmeter developing an A.C. voltage. Equip the instrument with a meter reading directly in ohms. Use two reference ground rods of 20 mm 3/4 inch copper clad steel, not less than 1.2 meters 4 feet in length, driven 1 meter 3 1/2 feet deep. Install rods in a straight line from the ground being tested. Connect No. l4 AWG stranded wire leads with at least 600-volt insulation to the ground being tested and the two reference grounds and to proper binding posts on the instrument. Where there is more than one ground within a circle of 3 meters 10 feet at a particular location, use reference rods as driven for the "first" test for tests on the other rods without changing their location.

3.5.2 Acceptance Tests

Make tests for conductivity and spark resistance of metallic finish after floor finish has been cured and dried for 30 days. Perform at least one test for each 37 square meters 400 square feet or less of floor area for conductivity and for spark resistance. Submit test reports showing compliance with the conductivity and spark test criteria.

3.5.2.1 Conductivity Tests

Conduct conductivity tests of finished floor surface in accordance with

ASTM F150. For compliance, the average of maximum resistances must be within the limits specified with no value greater than 5 megohms.

3.5.2.2 Spark Tests

Determine spark resistance of finished floor surfaces in a darkened space by stroking the floor vigorously with a 300 mm 12 inch metal file in a 1.8 meter 6 foot arc. Perform spark test five times in each 37 square meters 400 square feet or less of flooring area. Areas with no visible spark production will be accepted as having necessary spark resistance.

-- End of Section --