Designation: C 722 – 04

Standard Specification for Chemical-Resistant Monolithic Floor Surfacings[1]

This standard is issued under the fixed designation C 722; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the requirements for aggregate-filled, resin-based, monolithic surfacings for use over concrete floors in areas where chemical resistance and the protection of concrete are required.

1.2 The application methods for these floor surfacings include troweled, broadcast, slurry broadcast, self-leveling, sprayed, and reinforced. The resin chemistries include epoxy, urethane, polyester, and vinyl ester.

1.3 Floor surfacings used as vessel linings are excluded from this specification.

1.4 The values stated in SI units are to be regarded as the standard. The values in parenthesis are provided for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 267 Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes

C 307 Test Method for Tensile Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings

C 413 Test Method for Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings

C 579 Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C 580 Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C 811 Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacings

C 904 Terminology Relating to Chemical Resistant Non-Metallic Materials

C 1028 Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

C 1486 Practice for Testing Chemical-Resistant Broadcast and Slurry-Broadcast Resin Monolithic Floor Surfacings

D 638 Test Method for Tensile Properties of Plastics

D 790 Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D 1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes

D 2047 Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

D 6132 Test Method for Nondestructive Measurement of Dry Film Thickness of Organic Coatings Over Concrete Using an Ultrasonic Gauge

2.2 *ESD Association Standard:*

ESD-S7.1 ESD Association Standard for Protection of Electrostatic Discharge Susceptible Items—Floor Materials—Resistive Characterization of Materials

3. Terminology

3.1 *Definitions*—For definitions of terms used in this standard, see Terminology C 904.

4. Significance and Use

4.1 This standard specification covers the requirements for floor surfacing products. When specifying surfacing over concrete according to this standard, the floor surfacing shall be classified by the application method, resin chemistry, aggregate type, and applied thickness.

4.2 The specifier must consider service conditions such as chemical exposure, traffic, and temperature conditions in selecting the flooring system.

[1] This specification is under the jurisdiction of ASTM Committee C03 on Chemical-Resistant Nonmetallic Materials and is the direct responsibility of Subcommittee C03.02 on Mortar and Monolithics.

Current edition approved March 1, 2004. Published March 2004. Originally approved in 1972. Last previous edition approved in 1994 as C 722 – 94.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4.3 Other items that are not specified in this standard but are important to the performance of the floor surfacing include condition of the concrete, concrete surface preparation, surfacing installation, and finished floor slope and surface texture.

4.4 Additional items that may be required for specific applications but are not specified in this standard include floor surfacing electrical conductivity, spark generation properties, and flatness and levelness.

5. Classification

5.1 Classification by application method includes: troweled (TR), broadcast (BC), slurry broadcast (SBC), self-leveling (SL), spray (SP), and reinforced (RF).

5.2 Classification by resin chemistry includes epoxy (EP), urethane (UR), polyester (PE), and vinyl ester (VE).

6. Materials

6.1 Most of these systems include three components: a resinous liquid, a liquid setting agent, and an aggregate component.

6.2 The resinous liquid shall be epoxy, urethane (polyol), polyester or vinyl ester.

6.3 The setting agents for these materials are usually amines (for epoxies), isocyanates (for urethanes), and peroxides (for polyesters and vinyl esters).

6.4 The aggregates or fillers are usually siliceous or carbonaceous materials. These materials are selected to have adequate resistance to the chemicals that are in the area where they are installed and are properly sized to provide ease of application.

6.4.1 Other aggregates and/or filler components are frequently used to obtain specific properties. Aluminum oxide and silicon carbide are used to provide increased abrasion and/or slip resistance properties in the flooring system.

6.5 Reinforcing materials used with these flooring systems must themselves be chemical resistant. Such materials include synthetic, carbon or fiberglass materials in mats, strands or rovings.

6.6 The surfacing materials for TR, SL and SP systems are usually installed by mixing the resin with the setting agent, blending in the aggregate component until uniform and homogenous, and then placing and finishing the mixture onto a properly prepared concrete substrate as per Practice C 811.

6.7 The surfacing materials for BC systems are usually installed by mixing the resin with the setting agent (called liquids here), and then spreading onto a properly prepared concrete substrate. This is followed by broadcasting the aggregate to excess into the wet film. The application is allowed to harden. The excess aggregate is removed. The surface is then topcoated with the same liquids or the application process is repeated until the desired thickness is reached, and then the surface is topcoated.

6.8 In a SBC system, the resin, setting agent and aggregate are blended and applied on a properly prepared concrete substrate. More aggregate is then broadcast into this slurry and allowed to harden. The excess aggregate is removed and the system is then topcoated.

6.9 RF systems are usually applied as the TR, SL or SP systems. The reinforcement is usually embedded in this layer and then the reinforcement is saturated with liquids. A second TR, SL, or SP layer is then applied.

6.10 The components of the floor surfacing systems are usually formulated to perform optimally at specified mixing ratios. They are usually either packaged by the manufacturer in the required proportions (weight or volume) or mixing instructions include guidelines for mixing proportions.

6.11 Any of these systems may be topcoated. At the recommendation of the manufacturer of the system, this topcoat may be mandatory for optimal appearance and performance.

6.12 Many floor surfacings include some type of finish texture or profile incorporated into the design of the surface that can range from relatively smooth to extremely aggressive. TR systems without a sealing topcoat, BC and SBC systems inherently produce surfaces with a texture. SL systems usually produce a smooth surface. Other common methods for incorporating texture include: broadcasting an aggregate into a topcoat (and optionally, resealing); or mixing an aggregate directly into the topcoat before application.

6.13 Occasionally, floor surfacings are required to have specific conductive or static dissipative electrical properties for personnel or product protection. Specific requirements for electrical resistance are not covered in this standard. Refer to ESD-S7.1 for test methods to determine this property.

6.14 In areas where flammable materials are present, it may be required that floor surfacings be non-sparking when impacted with metallic or other hard materials. Specific requirements for non-sparking properties are not covered in this standard.

7. Physical Properties, Chemical Resistance and Performance Requirements

7.1 Requirements for Troweled (TR) systems are listed in Table 1.

7.2 Requirements for Broadcast (BC) and Slurry Broadcast (SBC) systems are listed in Table 2.

7.3 Requirements for Self-Leveling (SL) systems are listed in Table 3.

7.4 Requirements for Sprayed (SP) systems are listed in Table 4.

7.5 Requirements for Reinforced (RF) systems are listed in Table 5.

8. Test Methods

8.1 The referenced test methods are performed on laboratory constructed specimens of the flooring material and/or simulated flooring panel sections. The tests and property requirements may not represent the actual properties of the installed flooring, but are intended for basic qualification of properties as they may relate to desired floor performance.

8.2 Refer to the table for the specific system to be tested to ensure that the test is applicable.

C 267 Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings

C 307 Test Method for Tensile Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings

C 413 Test Method for Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings

TABLE 1 Requirements for Troweled (TR) Systems

Test Description	Units	Temperature	Test Method	Epoxy	Urethane	Polyester or Vinyl Ester
Thickness[A]	mm (in.)		[A]	[A]	[A]	[A]
Working Time, min.	min	23 ± 2°C (73 ± 4°F)		30	30	30
Time until Foot Traffic, max.	h	23 ± 2°C (73 ± 4°F)		24	24	24
Time until All Traffic, max.	h	23 ± 2°C (73 ± 4°F)		72	72	48
Time until Chemical Exposure, max.	days	23 ± 2°C (73 ± 4°F)		7	7	4
Compressive Strength at 7 days, min.[B]	MPa (psi)	23 ± 2°C (73 ± 4°F)	C 579	40 (6000)	40 (6000)	40 (6000)
Tensile Strength at 7 days, min.[B]	MPa (psi)	23 ± 2°C (73 ± 4°F)	C 307	10 (1500)	7 (1000)	14 (2000)
Flexural Strength at 7 days, min.[B]	MPa (psi)	23 ± 2°C (73 ± 4°F)	C 580	17 (2500)	14 (2000)	21 (3000)
Shrinkage, max.	%		C 531	0.5	0.5	1.0
Water Absorption, max.	%		C 413	1.0	1.0	1.0
Coefficient of Friction, min.		23 ± 2°C (73 ± 4°F)	D 2047 C 1028	0.5	0.5	0.5
Chemical Resistance, Immersion[C]		[C]	C 267	[C]	[C]	[C]
Chemical Resistance, Spot[C]		[C]	D 1308	[C]	[C]	[C]

[A] Typical thickness for TR Floor Surfacings is 6 mm (0.25 in.). Thickness is measured by direct measurement during application or after final cure (destructive) or calculated as an average thickness by coverage rates. Alternately, Test Method D 6132 may be used to measure the thickness of the hardened floor surfacing.

[B] For troweled flooring systems requiring a wet primer, and/or sealing coats, the test specimens may be prepared with these components included. Alternately, for the tensile, flexural, and flexural modulus testing, the test specimens may be cut from unbonded, laboratory prepared flooring sections including all these components.

[C] Specific chemicals, temperatures and times used for testing and pass/fail criteria to be specified for each application.

TABLE 2 Requirements for Broadcast (BC) Systems and Slurry Broadcast (SBC) Systems

Test Description	Units	Temperature	Test Method	Epoxy	Urethane	Polyester or Vinyl Ester
Thickness[A]	mm (in)		[A]	[A]	[A]	[A]
Working Time, min.	min	23 ± 2°C (73 ± 4°F)		30	30	30
Time until Foot Traffic, max.	h	23 ± 2°C (73 ± 4°F)		24	24	24
Time until All Traffic, max.	h	23 ± 2°C (73 ± 4°F)		72	72	48
Time until Chemical Exposure, max.	days	23 ± 2°C (73 ± 4°F)		7	7	4
Tensile Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 638 C 1486	10 (1500)	7 (1000)	14 (2000)
Flexural Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 790 C 1486	14 (2000)	10 (1500)	17 (2500)
Water Absorption, max.	%		C 413	1.0	1.0	1.0
Coefficient of Friction, min		23 ± 2°C (73 ± 4°F)	D 2047 C 1028	0.5	0.5	0.5
Chemical Resistance, Spot[B]		[B]	D 1308	[B]	[B]	[B]
		[B]	C 1486	[B]	[B]	[B]

[A] Typical thickness for BC Floor Surfacings is 2 to 3 mm (0.08 to 0.13 in.) and for SBC Floor Surfacings is 3 to 6 mm (0.13 to 0.25 in.). Thickness is measured by direct measurement during application or after final cure (destructive) or calculated as an average thickness by coverage rates. Alternately, Test Method D 6132 may be used to measure thickness of the hardened floor surfacing.

[B] Specific chemicals, temperatures and times used for testing and pass/fail criteria to be specified for each application.

TABLE 3 Requirements for Self-Leveling (SL) Systems

Test Description	Units	Temperature	Test Method	Epoxy	Urethane
Thickness[A]	mm (in)		[A]	[A]	[A]
Working Time, min.	min	23 ± 2°C (73 ± 4°F)		30	30
Time until Foot Traffic, max.	h	23 ± 2°C (73 ± 4°F)		24	24
Time until All Traffic, max.	h	23 ± 2°C (73 ± 4°F)		72	72
Time until Chemical Exposure, max.	days	23 ± 2°C (73 ± 4°F)		7	7
Tensile Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 638	10 (1500)	7 (1000)
Flexural Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 790	14 (2000)	10 (1500)
Shrinkage, max.	%		C 531	0.5	0.5
Water Absorption, max.	%		C 413	1.0	1.0
Coefficient of Friction, min		23 ± 2°C (73 ± 4°F)	D 2047 C 1028	0.5	0.5
Chemical Resistance, Spot[B]		[B]	D 1308	[B]	[B]

[A] Typical thickness for SL Floor Surfacings is 2 to 3 mm (0.08 to 0.13 in.). Thickness is measured by direct measurement during application or after final cure (destructive) or calculated as an average thickness by coverage rates. Alternately, Test Method D 6132 may be used to measure thickness of the hardened floor surfacing.

[B] Specific chemicals, temperatures and times used for testing and pass/fail criteria to be specified for each application.

C 579 Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C 580 Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

C 1028 Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method*

C 1486 Practice for Testing Chemical-Resistant Broadcast and Slurry-Broadcast Resin Monolithic Floor Surfacings

D 638 Test Method for Tensile Properties of Plastics

TABLE 4 Requirements for Sprayed (SP) Systems

Test Description	Units	Temperature	Test Method	Epoxy	Urethane	Polyester or Vinyl Ester
Thickness[A]	mm (in)		[A]	[A]	[A]	[A]
Working Time, min.	min	23 ± 2°C (73 ± 4°F)		30	30	30
Time until Foot Traffic, max.	h	23 ± 2°C (73 ± 4°F)		24	24	24
Time until All Traffic, max.	h	23 ± 2°C (73 ± 4°F)		72	72	48
Time until Chemical Exposure, max.	days	23 ± 2°C (73 ± 4°F)		7	7	4
Tensile Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 638	10 (1500)	7 (1000)	14 (2000)
Flexural Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 790	14 (2000)	10 (1500)	17 (2500)
Shrinkage, max.	%		C 531	0.5	0.5	1.0
Water Absorption, max.	%		C 413	1.0	1.0	1.0
Coefficient of Friction, min.		23 ± 2°C (73 ± 4°F)	D 2047 C 1028	0.5	0.5	0.5
Chemical Resistance, Spot[B]		[B]	D 1308	[B]	[B]	[B]

[A] Typical thickness for SP Floor Surfacings is 3 mm (0.13 in.). Thickness is measured by direct measurement during application or after final cure (destructive) or calculated as an average thickness by coverage rates. Alternately, Test Method D 6132 may be used to measure thickness of the hardened floor surfacing.
[B] Specific chemicals, temperatures and times used for testing and pass/fail criteria to be specified for each application.

TABLE 5 Requirements for Reinforced (RF) Systems

Test Description	Units	Temperature	Test Method	Epoxy	Polyester or Vinyl Ester
Thickness,[A] typical	mm (in)		[A]	[A]	[A]
Working Time, min.	min	23 ± 2°C (73 ± 4°F)		30	30
Time until Foot Traffic, max.	h	23 ± 2°C (73 ± 4°F)		24	24
Time until All Traffic, max.	h	23 ± 2°C (73 ± 4°F)		72	48
Time until Chemical Exposure, max.	days	23 ± 2°C (73 ± 4°F)		7	4
Tensile Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 638	28 (4000)	28 (4000)
Flexural Strength at 7 days, min.	MPa (psi)	23 ± 2°C (73 ± 4°F)	D 790	28 (4000)	28 (4000)
Shrinkage, max.	%		C 531	0.5	1.0
Water Absorption, max.	%		C 413	1.0	1.0
Coefficient of Friction, min.		23 ± 2°C (73 ± 4°F)	D 2047 C 1028	0.5	0.5
Chemical Resistance, Immersion[B]		[B]	C 267	[B]	[B]
Chemical Resistance, Spot[B]		[B]	D 1308	[B]	[B]

[A] Typical thickness for RF Floor Surfacings is 3 to 6 mm (0.13 to 0.25 in.). Thickness is measured by direct measurement during application or after final cure (destructive) or calculated as an average thickness by coverage rates. Alternately, Test Method D 6132 may be used to measure thickness of the hardened floor surfacing.
[B] Specific chemicals, temperatures and times used for testing and pass/fail criteria to be specified for each application.

D 790 Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D 1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*

D 2047 Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine*

NOTE 1—Where a topcoat and/or surface texture is recommended by the manufacturer for use with the system, of the tests listed in 8.2, the tests marked by an asterisk (*) shall be performed on specimens that include the topcoat and/or surface texture.

9. Packaging and Package Marking

9.1 Each component shall be clearly labeled and shall be packaged to conform to all applicable shipping regulations and to prevent deterioration during storage.

9.2 At the discretion of the manufacturer, the packages may be marked that the product, when installed according to the manufacturer's instructions, conforms to the requirements of this specification.

10. Keywords

10.1 broadcast; chemical-resistant; chemical-resistant flooring; chemical-resistant surfacing; monolithic flooring; reinforced; self-leveling; slurry broadcast; surfacing; topping; troweled

APPENDIX

(Nonmandatory Information)

X1. OTHER (OPTIONAL) METHODS FOR SPECIFIC APPLICATIONS

X1.1 Where required for specific applications additional tests may be specified as requirements for the Floor Surfacing System. The test methods are shown in X1.2 and X1.3.

X1.2 *Optional Tests (ASTM Methods)*:

C 531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings

C 884 Test Method for Thermal Compatibility between Concrete and an Epoxy Resin Overlay

C 905 Test Method for Apparent Density of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings

D 635 Test for the Rate of Burning and/ or Extent and Time of Burning of Self-Supporting Plastics in a horizontal Position*

D 2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)*

D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Tabor Abraser*

E 648 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*

X1.3 *Optional Tests (Other Methods)*:

MIL D 3134 Deck Covering Materials

ESD-S7.1 ESD Association Standard for Protection of Electrostatic Discharge Susceptible Items—Floor Materials—Resistive Characterization of Materials*

ESD-STM 97.1 ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items—Floor Material and Footwear—Resistance Measurement in Combination with a Person*

ESD-STM 97.2 ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items—Floor Material and Footwear—Voltage Measurement in Combination with a Person*

NFGS-09965C Naval Facilities Guide Specification—Metallic Type Conductive/Spark Resistant Concrete Floor Finish (section 3.5.2.2 only)*

NOTE X1.1—Where a topcoat and/or surface texture is recommended by the manufacturer for use with the system, the tests marked by an asterisk (*) should be performed on specimens that include the topcoat and/or surface texture.