Designation: ~~C881/C881M – 14~~ C881/C881M – 15

Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete[1]

This standard is issued under the fixed designation C881/C881M; 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 two-component, epoxy-resin bonding systems for application to portland-cement concrete, which are able to cure under humid conditions and bond to damp surfaces.

1.2 This specification does not cover epoxy-resin-base bonding systems that have been modified by addition of components such as cement, fine aggregate, or fiber reinforcement. Additional testing may be required to meet applicable specifications for these applications.

1.3 This specification does not address the effects of creep on epoxy-resin-base bonding systems while under load or the potential for creep rupture. Additional testing is required for applications where creep and creep rupture are critical.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. ~~Some values have only SI units because the inch-pound equivalents are not used in practice. Within the text, the SI units are shown in brackets.~~ The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with ~~this standard.~~the standard. Some values have only SI units because the inch-pound equivalents are not used in practice.

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 limitations prior to use.* For specific hazards statements, see Section 9.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C882 Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear

C884/C884M Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay

D570 Test Method for Water Absorption of Plastics

D638 Test Method for Tensile Properties of Plastics

D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position (Withdrawn 2016)[3]

D695 Test Method for Compressive Properties of Rigid Plastics

D2556 Test Method for Apparent Viscosity of Adhesives Having Shear-Rate-Dependent Flow Properties Using Rotational Viscometry

D2566 Test Method for Linear Shrinkage of Cured Thermosetting Casting Resins During Cure (Withdrawn 1993)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *binder, n*—the cementitious part of a grout, mortar, or concrete that binds the aggregate or filler into a cohesive mass.

3.1.2 *bonding system, n*—the product resulting from the combination of all the components supplied for use as a bonding material.

3.1.3 *component, n*—a constituent that is intended to be combined with one or more other constituents to form a bonding system.

---

[1] This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.25 on Organic Materials for Bonding.

Current edition approved ~~Nov. 15, 2014~~Dec. 15, 2015. Published ~~January 2015~~February 2016. Originally approved in 1978. Last previous edition approved in ~~2013~~2014 as C881/C881M–~~13.~~14. DOI: ~~10.1520/C0881_C0881M-14.~~10.1520/C0881_C0881M-15.

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

3.1.4 *contact strength, n*—bond strength measured by slant shear after a specified contact and cure time.

3.1.5 *contact time, n*—specified time between when the epoxy system is applied and when the two segments are bonded together and still achieve a specified bond strength after a specified curing time and temperature.

3.1.6 *curing agent, n*—a substance that causes the conversion of a fluid resin system to a solid cured resin by means of a chemical reaction.

3.1.7 *epoxy equivalent, n*—the weight of resin containing one molecular weight of epoxy groups.

3.1.8 *epoxy resin, n*—a resin that contains or did contain epoxy groups principally responsible for its polymerization.

3.1.9 *filler, n*—a finely divided solid, predominantly passing the ~~No. 200 [75-µm]~~75-µm [No. 200] sieve, that is used to improve certain properties of the bonding system or to reduce cost.

3.1.10 *formulator, n*—the agency responsible for preparing the separate components and for recommending the proportions to be used in preparing the final bonding system.

3.1.11 *lot or batch, n*—that quantity of manufactured material which has been subjected to the same unit chemical or physical processes intended to make the final product substantially uniform.

3.1.12 *manufacturer, n*—a producer of a basic constituent part of a component.

3.1.13 *reactive diluent, n*—a relatively free flowing liquid used to reduce the viscosity of the liquid resin or resin mixture, and which contains reactive groups that cause it to become an integral part of the cured resin.

3.1.14 *working (pot) life, n*—the time after mixing during which a bonding system or mixture containing it retains sufficient workability for proper use.

4. Classification

4.1 This specification provides for the classification of epoxy-resin bonding systems by type, grade, class, and color.

4.2 *Types*—Seven types of systems that are distinguished by the requirements of Table 1 are recognized:

4.2.1 *Type I*—For use in non-load bearing application for bonding hardened concrete to hardened concrete and other materials, and as a binder in epoxy mortars or epoxy concretes.

4.2.2 *Type II*—For use in non-load bearing applications for bonding freshly mixed concrete to hardened concrete.

4.2.3 *Type III*—For use in bonding skid-resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concretes used on traffic bearing surfaces (or surfaces subject to thermal or mechanical movements).

4.2.4 *Type IV*—For use in load bearing applications for bonding hardened concrete to hardened concrete and other materials and as a binder for epoxy mortars and concretes.

4.2.5 *Type V*—For use in load bearing applications for bonding freshly mixed concrete to hardened concrete.

4.2.6 *Type VI*—For bonding and sealing segmental precast elements, as in segment-by-segment erection, and for span-by-span erection when temporary post tensioning is applied.

4.2.7 *Type VII*—For use as a nonstress carrying sealer for segmental precast elements when temporary post tensioning is not applied as in span-by-span erection.

NOTE 1— Epoxy resin systems will adhere to a wide variety of materials, including wood, metals, masonry, and most plastics. Polyethylene, TFE-fluorocarbon, cellophane, and greased or waxed surfaces are among the few materials to which these systems will not adhere.

4.3 *Grades*—Three grades of systems are defined according to their flow characteristics and are distinguished by the viscosity and consistency requirements of Table 1.

4.3.1 *Grade 1*—Low viscosity.

4.3.2 *Grade 2*—Medium viscosity.

4.3.3 *Grade 3*—Non-sagging consistency.

4.4 *Classes*—Classes A, B, and C are defined for Types I through V, and Classes D, E, and F are defined for Types VI and VII, in accordance with the range of temperatures for which they are suitable (Note 2).

4.4.1 *Class A*—For use below ~~40 °F [4 °C]~~ 4°C [40°F] the lowest allowable temperature to be defined by the manufacturer of the product.

4.4.2 *Class B*—For use between ~~40 and 60 °F [4 and 15 °C].~~4 and 15°C [40 and 60°F].

4.4.3 *Class C*—For use above ~~60 °F [15 °C]~~ 15°C [60°F] the highest allowable temperature to be defined by the manufacturer of the product.

4.4.4 *Class D*—For use between ~~40 and 65 °F [4 and 18 °C]~~ 4 and 18°C [40 and 65°F] for Type VI and VII applications.

4.4.5 *Class E*—For use between ~~60 and 80 °F [15 and 30 °C]~~ 15 and 30°C [60 and 80°F] for Type VI and VII applications.

4.4.6 *Class F*—For use above ~~75 °F [25 °C]~~ 25°C [75°F] for Type VI and VII applications, the highest allowable temperature to be defined by the manufacturer of the product.

NOTE 2—The temperature in question is usually that of the surface of the hardened concrete to which the bonding system is to be applied. This temperature may be considerably different from that of the air. Where unusual curing rates are desired it is possible to use a class of bonding agent at a temperature other than that for which it is normally intended. For example, a Class A system will cure rapidly at room temperature.

TABLE 1 Physical Requirements of Bonding Systems

Property	Type						
	I	II	III	IV	V	VI	VII
~~Viscosity, P [Pa·s]:~~							
~~Grade 1, max~~	~~20[2.0]~~	~~20[2.0]~~	~~20[2.0]~~	~~20[2.0]~~	~~20[2.0]~~	...	...
~~Grade 2, min~~	~~20[2.0]~~	~~20[2.0]~~	~~20[2.0]~~	~~20[2.0]~~	~~20[2.0]~~	...	...
~~max~~	~~100[10]~~	~~100[10]~~	~~100[10]~~	~~100[10]~~	~~100[10]~~	...	...
~~Consistency, in [mm]:~~							
~~Grade 3, Types I, II, III, IV, V, VI, VII, max~~	~~¼ [6.0]~~	~~¼ [6.0]~~	~~¼ [6.0]~~	~~¼ [6.0]~~	~~¼ [6.0]~~	~~¼ [6.0]~~	~~¼ [6.0]~~
~~Gel time, minutes, min~~	~~30~~	~~30~~	~~30~~	~~30~~	~~30~~	~~30~~	~~30~~
~~Bond strength, min, psi [MPa]:~~							
~~2 days (moist cure)~~	~~1000[7.0]~~	...	...	~~1000[7.0]~~	...	~~1000[7.0]~~	...
~~14 days (moist cure)~~	~~1500[10.0]~~	~~1500[10.0]~~	~~1500[10.0]~~	~~1500[10.0]~~	~~1500[10.0]~~	...	~~1000[7.0]~~
~~Absorption, 24 h max, %~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	...	...
~~Heat Deflection Temperature, min, °F [°C]:~~							
~~7 days~~	...	...	...	~~120[50]~~	~~120[50]~~	...	...
~~14 days~~	...	...	...	...	...	~~120[50]~~	~~120[50]~~
~~Thermal compatibility~~	...	...	~~passes test~~	...	...	...	...
~~Linear coefficient of shrinkage on cure, max~~	~~0.005~~	~~0.005~~	...	~~0.005~~	~~0.005~~	...	...
~~Compressive Yield Strength, min, psi [MPa]:~~							
~~24 h~~	...	...	...	...	...	~~2000[14.0]~~	...
~~36 h~~	...	...	...	...	...	...	~~1000[7.0]~~
~~48 h~~	...	...	...	...	...	~~6000[40.0]~~	...
~~72 h~~	...	...	...	...	...	...	~~2000[14.0]~~
~~7 days~~	~~8000[55.0]~~	~~5000[35.0]~~	...	~~10 000[70.0]~~	~~8000[55.0]~~	...	...
~~Compressive Modulus, psi [MPa]~~							
~~Min~~	~~150 000[1000]~~	~~90 000[600]~~	...	~~200 000[1400]~~	~~150 000[1000]~~	...	...
~~Max~~	...	...	~~130 000[896]~~	...	...	...	...
~~Tensile Strength, 7 days min, psi [MPa]~~[A]	~~5000[35.0]~~	~~2000[14.0]~~	...	~~7000[50.0]~~	~~6000[40.0]~~	...	...
~~Elongation at Break, %, min~~[A]	~~1~~	~~1~~	~~30~~	~~1~~	~~1~~	...	...
~~Contact strength, psi [MPa] min~~							
~~2 days~~	...	...	...	...	...	~~1000[7.0]~~	...
~~14 days~~	...	...	...	...	...	...	~~1000[7.0]~~

TABLE 1 Physical Requirements of Bonding Systems

Property	Type						
	I	II	III	IV	V	VI	VII
Viscosity, Pa·s [P]:							
Grade 1, max	2.0 [20]	2.0 [20]	2.0 [20]	2.0 [20]	2.0 [20]	. . .	. . .
Grade 2, min	2.0 [20]	2.0 [20]	2.0 [20]	2.0 [20]	2.0 [20]	. . .	. . .
Grade 2, max	10 [100]	10 [100]	10 [100]	10 [100]	10 [100]	. . .	. . .
Consistency, mm [in.]:							