**Designation: C 881 – 99**

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
Reprinted from the Annual Book of ASTM Standards. Copyright ASTM

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

This standard is issued under the fixed designation C 881; 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.

*This standard has been approved for use by agencies of the Department of Defense.*

## 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 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents, therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

1.3 *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:*

C 882 Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear[2]

C 884 Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay[2]

D 570 Test Method for Water Absorption of Plastics[3]

D 638 Test Method for Tensile Properties of Plastics[3]

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load[3]

D 695 Test Method for Compressive Properties of Rigid Plastics[3]

D 1259 Test Methods for Nonvolatile Content of Resin Solutions[4]

D 1652 Test Method for Epoxy Content of Epoxy Resins[5]

D 2393 Test Method for Viscosity of Epoxy Resins and Related Compounds[6]

D 2566 Test Method for Linear Shrinkage of Cured Thermosetting Casting Resins During Cure[6]

## 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.

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] 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

[1] This specification is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates, and is the direct responsibility of Subcommittee C09.25 on Organic Materials for Bonding.

Current edition approved Feb. 10, 1999. Published May 1999. Originally published as C 881 – 78. Last previous edition C 881 – 90.

[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 06.01.

[5] *Annual Book of ASTM Standards*, Vol 06.03.

[6] *Annual Book of ASTM Standards*, Vol 08.02.

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 with internal tendons 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

**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] | 5000[35.0] | 2000[14.0] | ... | 7000[50.0] | 6000[40.0] | ... | ... |
| Elongation at Break, %, min | 1 | 1 | 30 | 1 | 1 | ... | ... |
| Contact strength, psi [MPa] min | | | | | | | |
| 2 days | ... | ... | ... | ... | ... | 1000[7.0] | ... |
| 14 days | ... | ... | ... | ... | ... | ... | 1000[7.0] |