



Designation: C 494/C 494M – 05a

Standard Specification for Chemical Admixtures for Concrete¹

This standard is issued under the fixed designation C 494/C 494M; 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 materials for use as chemical admixtures to be added to hydraulic-cement concrete mixtures in the field for the purpose or purposes indicated for the seven types as follows:

- 1.1.1 *Type A*—Water-reducing admixtures,
- 1.1.2 *Type B*—Retarding admixtures,
- 1.1.3 *Type C*—Accelerating admixtures,
- 1.1.4 *Type D*—Water-reducing and retarding admixtures,
- 1.1.5 *Type E*—Water-reducing and accelerating admixtures,
- 1.1.6 *Type F*—Water-reducing, high range admixtures, and
- 1.1.7 *Type G*—Water-reducing, high range, and retarding admixtures.

1.2 This specification stipulates tests of an admixture with suitable concreting materials as described in 11.1–11.3 or with cement, pozzolan, aggregates, and an air-entraining admixture proposed for specific work (11.4). Unless specified otherwise by the purchaser, the tests shall be made using concreting materials as described in 11.1–11.3.

NOTE 1—It is recommended that, whenever practicable, tests be made using the cement, pozzolan, aggregates, air-entraining admixture, and the mixture proportions, batching sequence, and other physical conditions proposed for the specific work (11.4) because the specific effects produced by chemical admixtures may vary with the properties and proportions of the other ingredients of the concrete. For instance, Types F and G admixtures may exhibit much higher water reduction in concrete mixtures having higher cement factors than that listed in 12.1.1.

Mixtures having a high range water reduction generally display a higher rate of slump loss. When high-range admixtures are used to impart increased workability (6 to 8-in. slump [150 to 200-mm]), the effect may be of limited duration, reverting to the original slump in 30 to 60 min depending on factors normally affecting rate of slump loss. The use of chemical admixtures to produce high-slump (flowing) concrete is covered by Specification C 1017.

NOTE 2—The purchaser should ensure that the admixture supplied for use in the work is equivalent in composition to the admixture subjected to

test under this specification (see Section 6, Uniformity and Equivalence).

NOTE 3—Admixtures that contain relatively large amounts of chloride may accelerate corrosion of prestressing steel. Compliance with the requirements of this specification does not constitute assurance of acceptability of the admixture for use in prestressed concrete.

1.3 This specification provides for three levels of testing.

1.3.1 *Level 1*—During the initial approval stage, proof of compliance with the performance requirements defined in Table 1 demonstrates that the admixture meets the requirements of this specification. Admixtures (except for Types B, C, and E) shall qualify for provisional compliance when any of the alternative compressive strength requirements in Table 1 are met. If subsequent test results at 6 months or one year fail to meet the standard requirement of 100 % of reference strength, the compliance of the admixture to this standard is withdrawn and all users of the admixture shall be notified immediately. Uniformity and equivalence tests of Section 6 shall be carried out to provide results against which later comparisons can be made (See Note 4).

NOTE 4—Allowing for provisional compliance while retaining longer term compressive strength requirements promotes more rapid qualification of new materials, but also provides assurance that new admixture technologies will not exhibit unexpected longer term performance. The alternative compressive strength requirements in Table 1 are based on statistical analysis of 103 Specification C 494/C 494M evaluation tests. The alternative requirements correspond to a 99 % probability of passing subsequent test age requirements.²

1.3.2 *Level 2*—Limited retesting is described in 5.2, 5.2.1 and 5.2.2. Proof of compliance with the requirements of Table 1 demonstrates continued conformity of the admixture with the requirements of the specification.

1.3.3 *Level 3*—For acceptance of a lot or for measuring uniformity within or between lots, when specified by the purchaser, the uniformity and equivalence tests of Section 6 shall be used.

1.4 The values stated in either inch-pound or SI units shall be regarded separately as standard. The values stated in each

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² Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: C09-1030.



system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any way.

1.5 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.6 The following precautionary caveat pertains only to the test method sections, Sections 11-18 of this Specification: *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.*

2. Referenced Documents

2.1 ASTM Standards:³

C 33 Specification for Concrete Aggregates

C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C 78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates

C 138/C 138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C 143/C 143M Test Method for Slump of Hydraulic-Cement Concrete

C 150 Specification for Portland Cement

C 157/C 157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

C 183 Practice for Sampling and the Amount of Testing of Hydraulic Cement

C 192/C 192M Practice for Making and Curing Concrete

³ 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.

Test Specimens in the Laboratory

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C 260 Specification for Air-Entraining Admixtures for Concrete

C 403/C 403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

C 666/C 666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing

C 1017/C 1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete

D 75 Practice for Sampling Aggregates

D 1193 Specification for Reagent Water

E 100 Specification for ASTM Hydrometers

Manual of Aggregate and Concrete Testing

2.2 American Concrete Institute Standard:

ACI 211.1–91 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete⁴

3. Terminology

3.1 Definitions:

3.1.1 *accelerating admixture*—an admixture that accelerates the setting and early strength development of concrete.

3.1.2 *retarding admixture*—an admixture that retards the setting of concrete.

3.1.3 *water-reducing admixture*—an admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

3.1.4 *water-reducing admixture, high range*—an admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12 % or greater.

3.1.5 *water-reducing and accelerating admixture*—an admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

⁴ Available from the American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331.

TABLE 1 Physical Requirements^A

	Type A, Water Reducing	Type B, Retarding	Type C, Acceler- ating	Type D, Water Reducing and Retarding	Type E, Water Reducing and Accelerating	Type F, Water Reducing, High Range	Type G, Water Reducing, High Range and Retarding
Water content, max, % of control	95	...	...	95	95	88	88
Time of setting, allowable deviation from control, h:min:							
Initial: at least	...	1:00 later	1:00 earlier	1:00 later	1:00 earlier	...	1:00 later
not more than	1:00 earlier nor 1:30 later	3:30 later	3:30 earlier	3:30 later	3:30 earlier	1:00 earlier nor 1:30 later	3:30 later
Final: at least	...	...	1:00 earlier	...	1:00 earlier	...	...
not more than	1:00 earlier nor 1:30 later	3:30 later	...	3:30 later	...	1:00 earlier nor 1:30 later	3:30 later
Compressive strength, min, % of control: ^B							
1 day	...	...	...	...	...	140	125
3 days	110	90	125	110	125	125	125
7 days	110	90	100	110	110	115	115
28 days	110 (120) ^C	90	100	110 (120) ^C	110	110 (120) ^C	110 (120) ^C
90 days	(117) ^C	n/a	n/a	(117) ^C	n/a	(117) ^C	(117) ^C
6 months	100 (113) ^C	90	90	100 (113) ^C	100	100 (113) ^C	100 (113) ^C
1 year	100	90	90	100	100	100	100
Flexural strength, min, % control: ^B							
3 days	100	90	110	100	110	110	110
7 days	100	90	100	100	100	100	100
28 days	100	90	90	100	100	100	100
Length change, max shrinkage (alternative requirements): ^D							
Percent of control	135	135	135	135	135	135	135
Increase over control	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Relative durability factor, min ^E	80	80	80	80	80	80	80

^A The values in the table include allowance for normal variation in test results. The object of the 90 % compressive strength requirement for a Type-B admixture is to require a level of performance comparable to that of the reference concrete.

^B The compressive and flexural strength of the concrete containing the admixture under test at any test age shall be not less than 90 % of that attained at any previous test age. The objective of this limit is to require that the compressive or flexural strength of the concrete containing the admixture under test shall not decrease with age.

^C Alternative requirement. If any of the measured relative strengths are greater than the requirement in parentheses, the admixture shall be considered provisionally qualified until the 1-year strength test results are obtained.

^D Alternative requirements, see 17.1.4, % of control limit applies when length change of control is 0.030 % or greater; increase over control limit applies when length change of control is less than 0.030 %.

^E This requirement is applicable only when the admixture is to be used in air-entrained concrete which may be exposed to freezing and thawing while wet.

3.1.6 *water-reducing and retarding admixture*— an admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

3.1.7 *water-reducing, high range, and retarding admixture*—an admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12 % or greater and retards the setting of concrete.

4. Ordering Information

4.1 The purchaser shall specify the type of chemical admixture desired.

5. General Requirements

5.1 For initial compliance with this specification, test concrete in which each type of admixture shown in 1.1 is used shall conform to the respective requirements prescribed in Table 1.

5.2 The purchaser is allowed to require a limited retesting to confirm current compliance of the admixture to specification requirements. The limited retesting will cover physical properties and performance of the admixture.

5.2.1 The physical properties retesting shall consist of uniformity and equivalence tests for infrared analysis, residue by oven drying and specific gravity.

5.2.2 The performance property retesting shall consist of water content of fresh concrete, setting time and compressive strength at 3, 7 and 28 days. Purchasers having special requirements are allowed to require additional tests currently in this standard.

5.3 At the request of the purchaser, the manufacturer shall state in writing that the admixture supplied for use in the work is identical in all essential respects, including concentration, to the admixture tested under this specification.

5.4 At the request of the purchaser, when the admixture is to be used in prestressed concrete, the manufacturer shall state in