



Designation: C1602/C1602M – 22

Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete¹

This standard is issued under the fixed designation C1602/C1602M; 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 compositional and performance requirements for water used as mixing water in hydraulic cement concrete. It defines sources of water and provides requirements and testing frequencies for qualifying individual or combined water sources. In any case where the requirements of the purchaser differ from these in this specification, the purchaser's specification shall govern.

1.2 This specification does not purport to cover methods of storage, transportation, or blending of water, or to address the development and maintenance of quality control programs sponsored or managed by the manufacturer.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.40 on Ready-Mixed Concrete.

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2. Referenced Documents

2.1 ASTM Standards:²

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C33/C33M Specification for Concrete Aggregates

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C94/C94M Specification for Ready-Mixed Concrete

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)

C114 Test Methods for Chemical Analysis of Hydraulic Cement

C125 Terminology Relating to Concrete and Concrete Aggregates

C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

C1603 Test Method for Measurement of Solids in Water

2.2 ACI Documents:³

ACI 318 Building Code Requirements for Structural Concrete and Commentary

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology C125.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *combined water, n*—a mixture of two or more sources of water blended together, before or during introduction into the mixture, for use as mixing water in the production of concrete.

3.2.2 *non-potable, adj*—water sources that are not fit for human consumption, or if it contains quantities of substances

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 Available from American Concrete Institute (ACI), 38800 Country Club Dr., Farmington Hills, MI 48331-3439, <http://www.concrete.org>.

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

that discolor it or make it smell or have objectionable taste but does not contain water from concrete production operations.

3.2.3 *potable water, n*—water suitable for human consumption

3.2.4 *water from concrete production operations, n*—water recovered from processes of hydraulic cement concrete production that includes wash water from mixers or that was a part of a concrete mixture; water collected in a basin as a result of storm water runoff at a concrete production facility; or water that contains quantities of concrete ingredients.

4. Requirements for Use

4.1 Mixing water shall consist of:

4.1.1 Batch water (water weighed or metered through the batch plant),

4.1.2 Ice,

4.1.3 Water added by truck operator,

4.1.4 Free moisture on the aggregates, and

4.1.5 Water introduced in the form of admixtures when this water increases the water-cementitious materials ratio by more than 0.01.

4.2 Potable water is permitted to be used as mixing water in concrete without testing for conformance with the requirements of this specification.

4.3 Mixing water that is wholly or partially composed of sources of water that are non-potable or from concrete production operations are permitted to be used in any proportions to the limits qualified to meet the requirements of **Table 1**. At the option of the purchaser and when appropriate for the construction, any of the optional limits found within **Table 2** shall be specified at the time of concrete ordering according to the section on *Ordering Information* of Specification **C94/C94M**.

4.3.1 Non-potable sources of water shall be qualified for use in accordance with **5.1**. When required by the purchaser, requirements of **5.4** shall also apply. When the non-potable water source is blended with a potable source, the qualification of the mixing water shall be at the highest percentage of the non-potable source in the combined mixing water anticipated during production.

4.3.2 Combined water blended from two or more sources, where one of the sources includes that from concrete production, shall be qualified for use in accordance with **5.2**. When required by the purchaser, requirements of **5.4** shall also apply. The combined water shall be qualified at the highest solids content in the total mixing water anticipated during

production. Mixing water containing total solids equal to or less than the level qualified by testing shall be permitted.

5. Testing and Requirements

5.1 For sources of non-potable mixing water (as defined in **3.2.2**) proposed for use as total mixing water or in the combined mixing water (as defined in **3.2.1**), the following shall apply to the total combined mixing water:

5.1.1 Water shall be tested for compliance with **Table 1** before first use and thereafter every three months or more often when there is reason to believe that a change has occurred in the characteristics of the source. Testing is permitted to be at a lower frequency, but not less than annually when results from four consecutive tests indicate compliance with **Table 1**. Testing shall be in accordance with **5.3**.

5.2 For sources of water from concrete production operations (as defined in **3.2.4**) proposed for use as the total mixing water or in the combined mixing water (as defined in **3.2.1**), the following shall apply to the total combined mixing water:

5.2.1 The density of the water from concrete production operations shall be tested at least on a daily basis in accordance with Test Method **C1603** or monitored with a hydrometer that has been verified in accordance with Test Method **C1603**. Manufacturers that use automated devices shall maintain at the production facility documentation on the procedures and calibration of systems, as needed (see **Note 1**).

NOTE 1—Blending proportions of water sources can be determined in accordance with Appendix X1 of Test Method **C1603** for achieving a target solids content.

5.2.2 Combined water shall be tested for compliance with the requirements of **Table 1**, in accordance with **5.3**, at the highest solids content anticipated to be used during production in accordance with the following testing frequencies:

5.2.2.1 When the density of the combined water is less than 1.01 g/mL, the water shall be tested before first use and thereafter once every six months. Testing frequency is permitted to be reduced to once every 12 months when the results of two consecutive tests indicate compliance with the requirements of **Table 1** (see **Note 2**).

NOTE 2—This condition is intended to cover the use of clarified wash water that has been passed through a settling pond system.

5.2.2.2 When the density of the combined water is between 1.01 and 1.03, the water shall be tested before first use and thereafter monthly. Testing frequency is permitted to be reduced to once every three months when the results of four consecutive tests indicate compliance with the requirements of **Table 1** (see **Note 3**).

NOTE 3—Water density of 1.03 approximately represents a total solids content of 50 000 ppm.

5.2.2.3 When the density of the combined water exceeds 1.03, the water shall be tested weekly or more often when there is reason to believe that there is a change in the water characteristics for compliance with the requirements of **Table 1**. Testing frequency is permitted to be reduced to once every month when the results of two months of consecutive tests indicate compliance with the requirements of **Table 1**.

TABLE 1 Performance Requirements for Mixing Water

	Limits
Compressive strength, min % control at 7 days ^A	90
Time of setting, deviation from control, h: min ^A	From 1:00 earlier to 1:30 later

^A Comparisons shall be based on fixed proportions for concrete or mortar mixtures. The control mixture shall be made with potable water. The test mixture shall be made with the mixing water that is being evaluated (see **Annex A1**).