Designation: C1837 – 17

Standard Specification for Production of Dry Cast Concrete Used for Manufacturing Pipe, Box, and Precast Structures[1]

This standard is issued under the fixed designation C1837; 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 production of dry cast concrete as defined in 3.2.1. Requirements for quality of concrete shall be either as hereinafter specified or as specified by the owner. In any case where the requirements of the owner differ from those in this specification, the owner's specification shall govern. This specification does not cover the placement, consolidation, curing, or protection of the concrete.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 As used throughout this specification the manufacturer produces precast concrete products. The owner buys precast concrete products

1.4 *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:*[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

C125 Terminology Relating to Concrete and Concrete Aggregates

C150/C150M Specification for Portland Cement

C260/C260M Specification for Air-Entraining Admixtures for Concrete

C494/C494M Specification for Chemical Admixtures for Concrete

C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C822 Terminology Relating to Concrete Pipe and Related Products

C989/C989M Specification for Slag Cement for Use in Concrete and Mortars

C1064/C1064M Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

C1157/C1157M Performance Specification for Hydraulic Cement

C1240 Specification for Silica Fume Used in Cementitious Mixtures

C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

3. Terminology

3.1 *Definitions*—The terms used in this specification are defined in Terminology standards C125 and C822.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dry cast*—very low slump or zero-slump concrete that requires continuous and intense vibration, or mechanical means, or a combination of vibration and mechanical means to consolidate the concrete, enabling immediate removal of the forms from the product.

4. Materials

4.1 The aggregates shall be sized, graded, proportioned, and mixed with such proportions of cementitious material, water, and admixtures, if any, to produce a thoroughly mixed concrete of such quality that the precast product will conform to the test and design requirements of the relevant specification.

4.2 *Cementitious Materials:*

4.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification C150/C150M, or shall be Portland blast-furnace slag cement, portland-limestone cement, or portland-pozzolan cement conforming to the requirements

[1] This test method is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.05 on Special Projects.

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[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.

of Specification C595/C595M, except that the pozzolan constituent in the Type IP portland-pozzolan cement shall be fly ash.

4.2.2 *Slag Cement*—Slag cement shall conform to the requirements of Grade 100 or 120 of Specification C989/C989M.

4.2.3 *Fly Ash*—Fly ash shall conform to the requirements of Specification C618, Class F or Class C.

4.2.4 Allowable Combinations of Cementitious Materials—The combination of cementitious materials used in the concrete shall be one of the following:

4.2.4.1 Portland cement only,

4.2.4.2 Portland blast-furnace slag cement only,

4.2.4.3 Portland pozzolan cement only,

4.2.4.4 Portland-limestone cement only,

4.2.4.5 A combination of portland cement or portland-limestone cement and slag cement,

4.2.4.6 A combination of portland cement or portland-limestone cement and fly ash, or

4.2.4.7 A combination of portland cement, or portland-limestone cement, slag cement, and fly ash.

4.3 *Aggregates*—Aggregates shall conform to the requirements of Specification C33/C33M except that the requirement for gradation shall not apply.

4.4 *Admixtures and Blends*—The following admixtures and blends are allowable:

4.4.1 Air-entraining admixture conforming to Specification C260/C260M.

4.4.2 Chemical admixture conforming to Specification C494/C494M.

4.4.3 Chemical admixture or blend approved by the owner.

4.5 Water-Water used in the production of concrete shall be potable or non-potable water that meets the requirements of Specification C1602/C1602M.

5. Weigh Batching and Mixing

5.1 *Measuring Materials:*

5.1.1 Cementitious materials shall be measured by weight. For cement measured in an individual or a cumulative weigh batcher, the quantity of cement shall be within ±1 % of the required weight. Supplementing cementitious materials measured in individual or cumulative weight batchers shall be within ±5 lb, or 1 % of the required weight, whichever is greater.

5.1.2 Aggregate shall be measured by weight. The total batch weight of material shall include the required weight of dry materials plus the total weight of moisture (both absorbed and surface) contained in the aggregate. For aggregates measured in individual or cumulative weigh batchers, the quantity of each aggregate shall be within ±2 % of the required weight.

5.1.3 Mixing water shall consist of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures. The added water shall be measured by weight or volume to an accuracy of 3 % of the required total mixing water. Added ice shall be measured by weight. Total water (including any wash water) shall be measured or weighed to an accuracy of ±3 % of the specified total amount.

5.1.4 Chemical admixtures in powdered form shall be measured by weight. Liquid chemical admixtures shall be batched by weight or volume. Admixtures measured by either weight or volume, shall be batched with an accuracy of ±3 % of the total amount required or plus or minus the amount or dosage required for 100 lb of hydraulic cement, whichever is greater.

5.2 *Batching Plant:*

5.2.1 Bins with adequate separate compartments shall be provided in the batching plant for each fine and coarse aggregate. Means of control shall be provided so that, as the quantity desired in the weighing hopper is approached, the material shall be shut off within the tolerances in 5.1.2. Weighing hoppers shall be constructed so as to eliminate accumulations of batched materials and to discharge fully.

5.2.2 Indicating devices shall be in full view and near enough to be read accurately by the operator while charging the hopper. The operator shall have convenient access to all controls.

5.2.3 Scales shall be considered accurate if their accuracy is verified through the normally used capacity in accordance with

TABLE 1 Minimum Field Standard Weights and Test Loads[A]

Device Capacity	Minimum (in terms of device capacity)		Minimum Loads for Verification of Scale Accuracy
	Field Standard Weights	Test Loads[C]	
0 to 4000 lb	100 %	100 %	Field standard weights or test load to used capacity, if greater than minimum specified.
4001 to 40 000 lb	Greater of[B] 10 % or 1000 lb	50 %[D]	Strain-test loads[E] are permitted to be used above test load minimums. During initial verification, a scale shall be tested to full capacity.

[A] If the configuration and set up of the scale system prevents access or application of adequate field standard weights or if an unsafe condition is created by the verification process then the use of the scale above the verified position shall be discontinued until corrective measures have been completed.

[B] Field standard weights used in verifying accuracy of weighing devices shall comply with requirements of NIST Handbook 105-1.

[C] The term "test load" means the sum of the combination of field standard weights and any other applied load used in the conduct of a test using substitution test methods. *Substitution Test*—In the substitution test procedure, material or objects are substituted for field standard weights, or a combination of field standard weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to verify the accuracy of higher weight ranges on the scale.

[D] The scale shall be tested from zero to at least 10 % of scale capacity using field standard weights, and then to at least 50 % of scale capacity using a series of substitution load tests that utilize field standard weights equaling at least 10 % of scale capacity.

[E] A strain-load test shall be conducted to verify the accuracy from 50 % of scale capacity to the used capacity of the scale. At least one load test shall be performed in each quarter of scale capacity. *Strain-Load Test*—In the strain-load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which field standard weights or substitution test loads are added

Table 1 and load indicated relative to applied test load is within ±0.15 % of the total capacity of the scale or 0.4 % of the net applied load, whichever is greater. The minimum quantity and sequence of applied test loads used to verify material scales shall conform to Table 1 and its notes.

5.2.4 All exposed fulcrums, clevises, and similar working parts of scales shall be kept clean. Beam scales shall be equipped with a balance indicator sensitive enough to show movement when a weight equal to 0.1 % of the nominal capacity of the scale is placed in the batch hopper. Pointer travel shall be a minimum of 5 % of the net-rated capacity of the largest weigh beam for underweight and 4 % for overweight.

5.2.5 The device for the measurement of the added water shall be capable of delivering to the batch the quantity required within the accuracy required in 5.1.3. Measuring tanks shall be equipped with outside taps and valves to provide for checking their calibration unless other means are provided for readily and accurately determining the amount of water in the tank.

NOTE 1—The device for the measurement of the added water can be affected by variable pressures in the water supply line.

5.3 *Mixers:*

5.3.1 All mixers shall be capable of combining the ingredients into a thoroughly mixed and uniform mass of concrete.

5.3.2 Mixers shall be examined as frequently as necessary to detect changes in condition due to accumulations of hardened concrete or mortar and examined to detect excessive wear of blades that affects the quality of the concrete mixture.

5.4 *Mixing:*

5.4.1 Mixers shall be operated within the limits of capacity as designated by the manufacturer of the equipment.

5.4.2 Concrete shall be mixed completely in a mixer. The mixing time shall be counted from the time all the solid materials are in the mixer. Where no mixer performance tests are made, the acceptable mixing time for mixers shall be in accordance with mixer manufacturer's recommendations. Where mixers have been subjected to performance tests, mixing time may be reduced for the particular circumstances tested to a point at which satisfactory mixing shall have been accomplished.

5.4.3 Concrete produced in cold weather shall have a minimum temperature of 40°F.

5.4.4 The maximum temperature of concrete shall at no time during its mixing and placement exceed 100°F.

NOTE 2—When hot water is used rapid stiffening may occur if hot water is brought in direct contact with the cement.

NOTE 3—In some situations difficulty may be encountered when concrete temperatures approach the extremes of 40°F and 100°F.

6. Volumetric Batching and Continuous Mixing

6.1 *Measuring Materials:*

6.1.1 Cement, fine and coarse aggregates, water, and admixtures shall be measured by volume. Devices such as counters, calibrated gate openings, or flowmeters shall be available for controlling and determining the quantities of the ingredients discharged. The entire measuring and dispensing mechanism shall produce the specified proportions of each ingredient within the tolerances in 6.1.6.

NOTE 4—The recommendations of the equipment manufacturer in the operation of the equipment and in calibrating and using the various gauges, revolution counters, speed indicators, or other control devices should be followed.

6.1.2 All indicating devices that bear on the accuracy of proportioning and mixing of concrete shall be in full view and near enough to be read by the operator while concrete is being produced. The operator shall have convenient access to all controls.

6.1.3 The proportioning and indicating devices shall be individually checked by following the equipment manufacturer's recommendations as related to each individual concrete batching and mixing unit. Adequate standard volume measures, scales, and weights shall be made available for the checking accuracy of the proportioning mechanism.

6.1.4 The rate of water supplied the continuous mixer shall be measured by a calibrated flowmeter coordinated with the cement and aggregate feeding mechanism, and with the mixer. The device for the measurement of water shall be capable of delivering to the batch the required quantity. The rate shall be capable of being adjusted in order to determine that the watercement (permitted or required) ratios are being met.

6.1.5 Liquid admixtures shall be dispensed through a controlled flowmeter.

6.1.6 Tolerances in proportioning the various ingredients are as follows:

Cementitious, mass % 0 to +4
Fine Aggregate, mass % ±2
Coarse Aggregate, mass % ±2
Admixtures, mass or volume % ±3
Water, mass or volume % ±3

The tolerances are based on a volume/mass relationship established by calibration of the measuring devices furnished as an integral part of the whole equipment.

NOTE 5—It is noted that to meet these tolerances, attention should be given to:
(1) Degree of compaction of the cement,
(2) Grading and other physical characteristics of the fine and coarse aggregates,
(3) Moisture content and bulking factor of the fine aggregate,
(4) Viscosity of the admixture, and
(5) Other factors of influence, for example, mechanical condition and weather.

6.2 *Mixing Mechanism:*

6.2.1 The continuous mixer shall be an auger-type mixer or any other type suitable for mixing concrete to meet the required consistency and uniformity requirements.

6.2.2 The manufacturer of the concrete shall conduct calibration and mixer efficiency tests at intervals not exceeding six months in accordance with the equipment manufacturer's recommended procedures.

6.2.3 Each batching or mixing unit, or both, shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed, and the mass-calibrated constant of the machine in terms of a revolution counter or other output indicator. The mixer shall produce a thoroughly mixed and uniform concrete.

6.3 *Mixing and Delivery:*

6.3.1 The batcher-mixer unit shall contain in separate compartments all the necessary ingredients needed for the manufacture of concrete. The unit shall be equipped with calibrated proportioning devices to vary the mix proportions and it shall produce a thoroughly mixed concrete of such quality that the precast product will conform to the test and design requirements of the relevant specification.

6.3.2 Allowable minimum and maximum concrete temperatures shall be in accordance with 5.4.3 and 5.4.4 (also see Notes 2 and 3).

7. Practices, Test Methods, and Reporting

7.1 Test dry cast concrete in accordance with the following methods:

7.1.1 *Compression Test Specimens*—Practice C497.

7.1.2 *Compression Tests*—Test Method C39/C39M.

7.1.3 *Temperature*—Test Method C1064/C1064M.

NOTE 6—Deviation from standard test methods may adversely affect test results.

NOTE 7—Deviation from standard moisture and temperature curing conditions is often a reason for low strength test results. Such deviations may invalidate the use of such test results as a basis for rejection of the concrete.

8. Strength

8.1 When strength is used as a basis for acceptance of concrete, standard specimens shall be made in accordance with Practice C497. The specimens shall be cured under standard moisture and temperature conditions in accordance with the applicable provisions of Practice C31/C31M or in a like manner as the precast concrete product.

8.2 For each strength test, two standard-size cylinders shall be made. The test result shall be the average of the strength of the two specimens except that, if any specimen shows definite evidence other than low strength, of improper sampling, molding, handling, curing, or testing, it shall be discarded and the strength of the remaining cylinder shall then be considered the test result.

9. Keywords

9.1 accuracy; blended hydraulic cement; certification; dry-cast concrete; scales; testing