



Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique¹

This standard is issued under the fixed designation C 1610/C 1610M; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This test method covers the determination of static segregation of self-consolidating concrete by measuring the coarse aggregate content in the top and bottom portions of a cylindrical specimen (or column).

1.2 This test method is not applicable to self-consolidating concrete containing lightweight aggregate.

1.3 The values stated in either inch-pounds 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 the standard.

1.4 The text of this standard 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 and health practices and determine the applicability of regulatory limitations prior to use. (Warning—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.²)*

2. Referenced Documents

2.1 ASTM Standards:³

C 125 Terminology Relating to Concrete and Concrete Aggregates

C 127 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

C 173/C 173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C 192/C 192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

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

D 1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology **C 125**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *Static Segregation, n*—settlement of coarse aggregate particles in an undisturbed mass of fresh concrete.

4. Summary of Test Method

4.1 A sample of freshly-mixed self-consolidating concrete is placed in a cylindrical mold without tamping or vibration. The mold is separated into three sections representing different levels of the cylindrical specimen (or column). Portions of concrete from the top and bottom section are washed on a 4.75 mm [No. 4] sieve, leaving the coarse aggregate on the sieve. The masses of coarse aggregate in the top and the bottom sections are determined and the percent static segregation is calculated.

5. Significance and Use

5.1 This test method provides users with a laboratory procedure to determine the potential static segregation of self-consolidating concrete.

5.2 This test method shall be used to develop self-consolidating concrete mixtures with segregation not exceeding specified limits. Self-consolidating concrete is a fluid concrete that can be prone to segregation if not proportioned to be cohesive. A cohesive self-consolidating concrete is important for all applications but is especially critical for deep-section applications such as walls or columns. Therefore, the degree of segregation can indicate if a mixture is suitable for the application.

¹ This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.47 on Self-Consolidating Concrete.

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² Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol. 04.02.

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.

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

NOTE 1—Some level of segregation is tolerable as long as the desired strength and durability performance is achieved.

6. Apparatus

6.1 *Balance*—as described in Test Method C 127.

6.2 *Column Mold*—The column portion of the mold shall be poly(vinyl chloride) (PVC) plastic pipe Schedule 40 meeting the requirements of Specification D 1785. The column shall be 8 in. [200 mm] in diameter × 26 in. [660 mm] in height and separated into 3 sections. The top section shall be 6.5 in. [165 mm] in height, the middle section 13 in. [330 mm] in height, and the bottom section 6.5 in. [165 mm] in height, as shown in Fig. 1. Each section shall have its ends flat and plane and be marked as “Top”, “Middle”, or “Bottom” relative to its location in the column. Couplers, brackets, clamps, or other equivalent fastening systems shall be used for securing the column sections together to form a mortar-tight joint and to secure the column to the base plate. The column mold shall be securely attached to a non-absorbent, rigid base plate measuring at least 12 in. [300 mm] × 12 in. [300 mm] square.

NOTE 2—Experience has shown that a base plate made from sealed or laminated plywood at least 0.75 in. [20 mm] thick is suitable for securing the column.

6.3 *Collector Plate*—The collector plate, used to obtain concrete from the top section of the column, shall be made of any nonabsorbent, rigid material measuring at least 20 in. [510 mm] × 20 in. [510 mm] square. The plate shall contain a cut out section in the center measuring 8.5 in. [215 mm] across and it shall contain a rigid lip that is at least 2 in. [50 mm] high running around three sides of the perimeter of the plate, as shown in Fig. 2.

NOTE 3—To facilitate the ease with which the test can be performed, the collector plate may contain legs or another support system so that only one person is needed to perform the concrete collection process from the top section.

6.4 *Strike-off Bar*—As described in Test Method C 173/ C 173M or Test Method C 231.

6.5 *Sieve*—A 4.75 mm [No. 4] rectangular sieve with minimum dimensions of 13 in. [330 mm] × 25 in. [630 mm].

6.6 *Sample Receptacle*—The receptacle shall be a heavy-gage metal pan, wheelbarrow, or flat, clean nonabsorbent board of sufficient capacity to allow easy remixing of the entire sample with a shovel, trowel, or scoop.

6.7 *Small Tools*—Tools and items such as shovels, plastic pails, trowels, scoops and rubber gloves shall be provided.

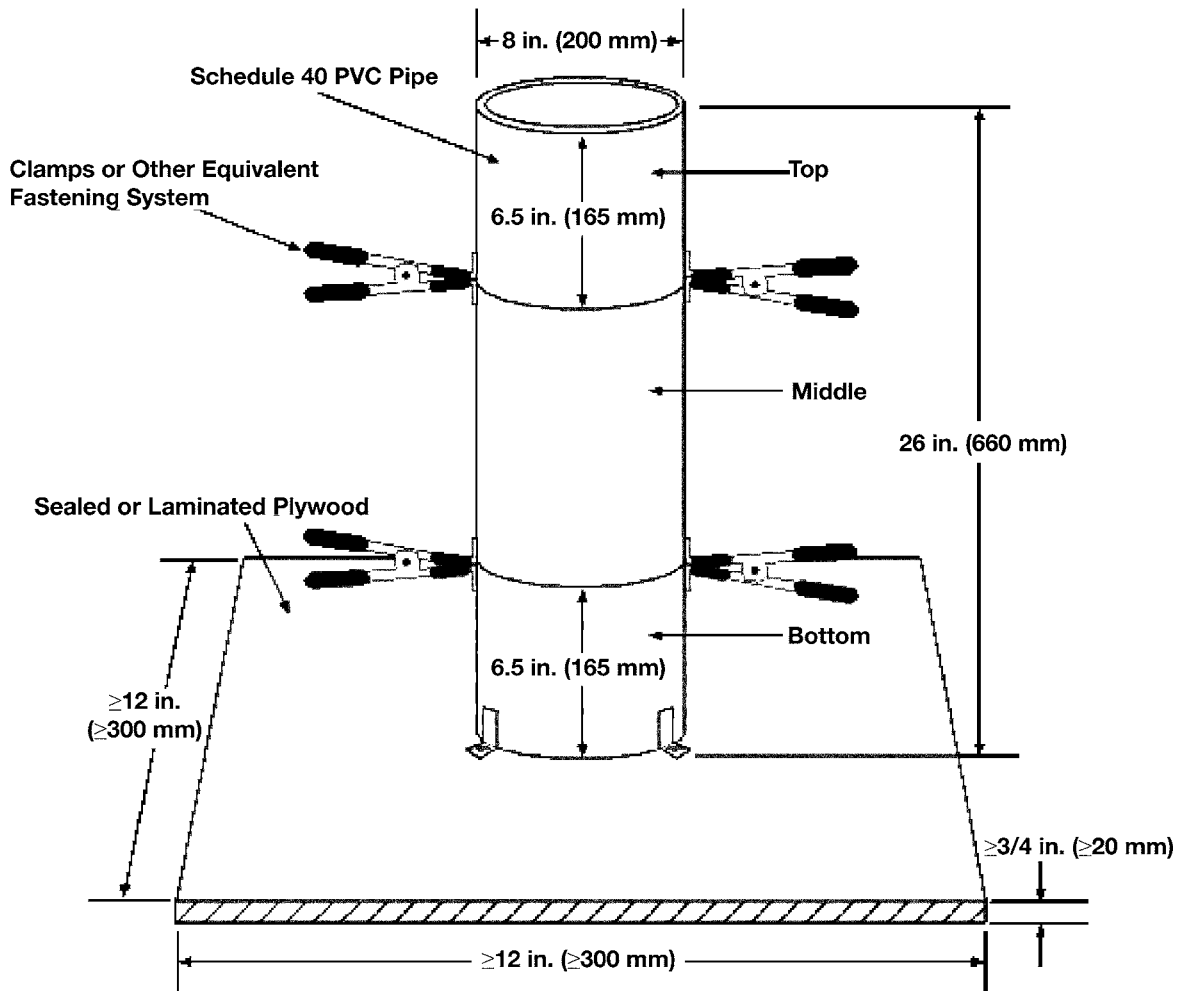


FIG. 1 Detail of Column Mold

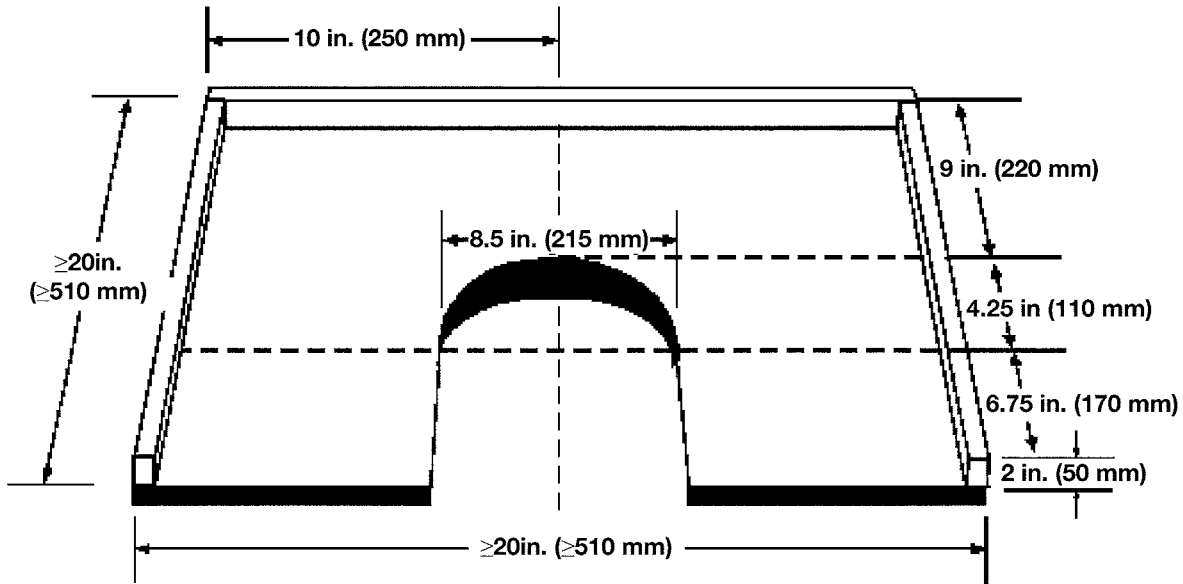


FIG. 2 Detail of Collector Plate

7. Sample

7.1 Obtain a sample of freshly-mixed self-consolidating concrete in accordance with Practice C 192/C 192M and place it in the sample receptacle.

8. Procedure

8.1 Perform the column segregation test on a flat, level surface. Do not subject the testing surface and the column mold to any vibration or disturbance.

8.2 *Remixing of Sample:* Remix the sample obtained in accordance with Section 7.1 in the sample receptacle using a shovel or scoop so that the concrete is homogeneous.

8.3 *Filling Procedure:* Using a shovel, scoop, or plastic pail, immediately fill the column mold with concrete completely and above the rim, within 2 min.

8.4 After filling the mold, strike off the top surface by sliding the strike-off bar across the top rim of the mold with a sawing motion until the concrete surface is level with the top of the mold.

8.5 Allow the concrete to stand undisturbed in the column mold for 15 ± 1 min.

8.6 Immediately following the standing period, securely hold the top section of the mold and remove the fastening system. Complete Steps 8.7 – 8.14 within 20 min thereafter.

8.7 Place the cut out section of the collector plate around the column just below the joint between the “Top” and “Middle” sections to catch and collect concrete.

8.8 Grasp the upper section of the column mold and, using a horizontal rotating motion, screed the concrete from the top section of the column on to the collector plate and then deposit it into a plastic pail.

8.9 Repeat Steps 8.6 – 8.8 to remove the concrete from the middle section of the column mold and discard the concrete.

8.10 Place the concrete sample collected from the upper section of the column onto the 4.75 mm [No. 4] sieve.

8.11 Wash the concrete on the 4.75 mm [No. 4] sieve so that only coarse aggregate remains on the sieve and then deposit the coarse aggregate into a clean plastic pail.

8.12 Repeat Steps 8.10 – 8.11 for the concrete retained in the bottom section of the mold.

8.13 Bring the coarse aggregate obtained from both the top and bottom sections of the column to a surface-dry condition by rolling it in a large absorbent cloth until all visible films of water are removed.

8.14 Determine the mass of coarse aggregate from the top and bottom sections of the column to the nearest 0.1 lb [50 g].

9. Calculation

9.1 Calculate the percent static segregation using the following equation:

$$S = 2 \left[\frac{(CA_B - CA_T)}{(CA_B + CA_T)} \right] * 100, \text{ if } CA_B > CA_T$$

$$S = 0, \text{ if } CA_B \leq CA_T$$

where:

S = static segregation, percent

CA_T = mass of coarse aggregate in the top section of the column

CA_B = mass of coarse aggregate in the bottom section of the column

10. Report

10.1 Mixture designation.

10.2 The mass of coarse aggregate obtained from the top and bottom sections of the column separately to the nearest 0.1 lb [0.05 kg].

10.3 The static segregation to the nearest 0.1 percent.

11. Precision and Bias

11.1 *Precision*—The estimate of the precision of this test method is provisional. A repeatability standard deviation of

0.2 % was obtained from a study (1) involving five replicate batches of a concrete mixture with a mean static segregation of 3.8 %.

11.2 *Bias*—The procedure used in this test method has no bias since coarse aggregate segregation of self-consolidating concrete is defined only in terms of this method.

12. Keywords

12.1 coarse aggregate; self-consolidating concrete; stability; static segregation

REFERENCES

- (1) J., Assaad, K., H., Khayat, and J., Daczko, “Evaluation of Static Stability of Self-Consolidating Concrete”, *ACI Materials Journal*, Vol. 101, No. 3, May-June, 2004, pp. 207 – 215.

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C 1610/C 1610M – 06, that may impact the use of this test method. (Approved December 15, 2006)

- (1) Revised the definition of *static segregation*.
(2) Revised 1.2.

- (3) Replaced reference to Practice C 172 with Test Method C 231.

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