



Standard Test Methods for Density of Unhardened and Hardened Concrete In Place By Nuclear Methods¹

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1. Scope

1.1 These test methods cover the determination of the in-place density of unhardened and hardened concrete by gamma radiation. For notes on the nuclear test see Appendix X1.

1.2 Two test methods are described, as follows:

	Section
Test Method A—Direct Transmission	7
Test Method B—Backscatter	8

1.3 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents of inch-pound units may be approximate.

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:

C 29/C 29M Test Method for Unit Weight and Voids in Aggregate²

C 138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete²

3. Significance and Use

3.1 These test methods are useful as rapid, nondestructive techniques for the in-place determination of the density of unhardened concrete. The backscatter test method is also useful for the same purpose on hardened concrete. The fundamental assumptions inherent in the test methods are that Compton scattering is the dominant interaction and that the material under test is homogeneous.

3.2 These test methods are suitable for control and for assisting in acceptance testing during construction, for evaluation of concrete quality subsequent to construction, and for research and development.

NOTE 1—Care must be taken when using these test methods in monitoring the degree of consolidation, which is the ratio of the actual density achieved to the maximum density attainable with a particular concrete. The test methods presented here are used to determine the actual density. A density measurement, by any test method, is a function of the components of the concrete and may vary, to some extent, in response to the normal, acceptable variability of those components.

3.3 Test results may be affected by reinforcing steel, by the chemical composition of concrete constituents, and by sample heterogeneity. The variations resulting from these influences are minimized by instrument design and by the user's compliance with appropriate sections of the test procedure. Results of tests by the backscatter test method may also be affected by the density of underlying material. The backscatter test method exhibits spatial bias in that the apparatus's sensitivity to the material under it decreases with distance from the surface of the concrete.

4. Apparatus

4.1 The exact details of construction of the apparatus may vary, but the apparatus as a whole shall satisfy the requirements for system precision stated in 10.1. The system shall consist of the following:

4.1.1 *Gamma Source*—An encapsulated and sealed radio-isotopic source, such as cesium-137 (see X1.2).

4.1.2 *Detector*—Any type of gamma detector, such as a Geiger-Müller tube, scintillation crystal, or proportional counter.

4.1.3 *Probe*—For direct transmission measurements, either the gamma source or the detector shall be housed in a probe for inserting in a preformed hole in the material to be tested. The probe shall be marked in increments of 2 in. (50 mm) for tests with probe depths from 2 to 12 in. (50 to 300 mm). The probe shall be so made mechanically, that when moved manually to the marked depth desired, it will be held securely in position at that depth.

4.1.4 *Readout Instrument*—A suitable scaler or direct readout meter.

4.1.5 *Gage Housing*—The source, detector, readout instrument and appropriate power supplies shall be in housings of rugged construction that are moisture and dust proof.

4.1.6 *Reference Standard*—A block of uniform, unchanging density provided for checking equipment operation, background count, and count-rate reproducibility.

4.1.7 *Guide Plate and Hole-Forming-Device*—For direct

¹ These test methods are under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and are the direct responsibility of Subcommittee C09.45 on Roller-Compacted Concrete.

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