



Standard Test Method for Pullout Strength of Hardened Concrete¹

This standard is issued under the fixed designation C900; 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 test method covers determination of the pullout strength of hardened concrete by measuring the force required to pull an embedded metal insert and the attached concrete fragment from a concrete test specimen or structure. The insert is either cast into fresh concrete or installed in hardened concrete. This test method does not provide statistical procedures to estimate other strength properties.

1.2 The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this test method.

1.3 The text of this test method 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 this test method.

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. (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

C125 Terminology Relating to Concrete and Concrete Aggregates

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

E4 Practices for Force Verification of Testing Machines

E74 Practice of Calibration of Force-Measuring Instruments for Verifying the Force Indication of Testing Machines

¹ This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.64 on Nondestructive and In-Place Testing.

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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.

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this practice, refer to Terminology C125.

4. Summary of Test Method

4.1 A metal insert is either cast into fresh concrete or installed into hardened concrete. When a measure of the in-place pullout strength is desired, the insert is pulled by means of a jack reacting against a bearing ring. The pullout strength is determined by measuring the maximum force required to pull the insert from the concrete mass. Alternatively, the insert is loaded to a specified load to verify whether a minimum level of in-place pullout strength has been attained.

5. Significance and Use

5.1 For a given concrete and a given test apparatus, pullout strengths can be related to compressive strength test results. Such strength relationships are affected by the configuration of the embedded insert, bearing ring dimensions, depth of embedment, and the type of aggregate (lightweight or normal weight). Before use, the relationships must be established for each test system and each new concrete mixture. Such relationships are more reliable if both pullout test specimens and compressive strength test specimens are of similar size, consolidated to similar density, and cured under similar conditions.

NOTE 1—Published reports (1-17)⁴ by different researchers present their experiences in the use of pullout test equipment. Refer to ACI 228.1R (14) for guidance on establishing a strength relationship and interpreting test results. The Appendix provides a means for comparing pullout strengths obtained using different configurations.

5.2 If a strength relationship has been established experimentally and accepted by the specifier of tests, pullout tests are used to estimate the in-place strength of concrete to establish whether it has reached a specified level so that, for example:

- (1) post-tensioning may proceed;
- (2) forms and shores may be removed;
- (3) structure may be placed into service; or
- (4) winter protection and curing may be terminated.

⁴ The boldface numbers refer to the list of references at the end of this test method.