



Designation: A981/A981M – 23

Standard Test Method for Evaluating Bond Strength for 0.600-in. [15.24-mm] Diameter Seven-Wire Steel Strand, Grade 270 [1860], Used in Prestressed Ground Anchors¹

This standard is issued under the fixed designation A981/A981M; 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 describes procedures to establish the relative bond strength of 0.600 in. [15.24 mm] diameter, Grade 270 [1860] seven-wire steel strand in cement grout as used in prestressed ground anchors for the purpose of evaluating the effects of manufacturing practices on bond strength.

1.2 The bond strength values obtained are not intended to be used to design the bond length of ground anchors that depend on field conditions.

1.3 This test method is not intended to be used as a bond test for prestressed concrete applications.

1.4 The values stated in either inch-pound or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with 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 test method is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

Current edition approved Sept. 1, 2023. Published October 2023. Originally approved in 1997. Last previous edition approved in 2016 as A981/A981M – 11 (2016). DOI: 10.1520/A0981_A0981M-23.

2. Referenced Documents

2.1 ASTM Standards:²

A416/A416M Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

A882/A882M Specification for Filled Epoxy-Coated Seven-Wire Steel Prestressing Strand

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

C150 Specification for Portland Cement

C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

E4 Practices for Force Calibration and Verification of Testing Machines

3. Terminology

3.1 Definitions of Terms Specific to This Test Method:

3.1.1 *bond strength, n*—maximum measured load in a pull test on a 0.600 in. [15.24 mm] diameter seven-wire steel strand embedded in cement grout.

3.1.2 *bonded length, n*—the length of the test strand that is in contact with the cement grout.

4. Significance and Use

4.1 Seven-wire steel strand is used in pre-tensioned and post-tensioned concrete construction.

4.2 0.600 in. [15.24 mm] diameter, Grade 270 seven-wire steel strand is used to make prestressed ground anchors which are often bonded to cement grout.

4.3 Manufacturing processes, subsequent handling, and storage conditions may influence the strand bond.

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.

4.4 The primary use of this test method is to establish the relative bond strength of 0.600 in. [15.24 mm] seven-wire steel strand.

4.5 The relative bond strength is determined by recording the pullout force at a certain displacement of the strand.

5. Apparatus

5.1 *Equipment*—A suitable tensile testing machine or load frame shall be used. The loading system shall be calibrated in accordance with Practices E4. The test system shall have sufficient capacity to prevent yielding of its various components and shall ensure that the applied tensile load remains parallel to the axis of the steel prestressing strand during testing.

5.2 *Strand Displacement Measurements*—Displacements of the free end of the seven-wire steel strand shall be measured with respect to the loaded surface of the test specimen using a dial gauge, linear variable differential transformer (LVDT), or comparable device with a smallest division of not more than 0.001 in. [25 μm].

6. Strand Bond Test Specimen

6.1 *Seven-Wire Steel Strand*—Strand shall be 0.600 in. [15.24 mm] diameter, Grade 270 [1860] and comply with either Specification A416/A416M (for uncoated strand) or Specification A882/A882M (for epoxy-coated strand) and shall be cut from standard production coils prior to packaging. The surface of the test samples shall not be wiped or cleaned in order to preserve their original condition. Minimum recommended sample length is 34 in. [860 mm].

6.2 *Test Specimen Fabrication*—The test specimen shall consist of the seven-wire steel strand embedded in cement grout and centered inside a steel pipe, 5.0 in. ± 0.125 in. [125 mm ± 3 mm] O.D. with a 0.125 in. [3 mm] thick wall, 18.0 in. ± 0.25 in. [450 mm ± 6 mm] long with a 6.0 in. by 6.0 in. by 0.25 in. [150 mm by 150 mm by 6 mm] base plate welded to one end of the steel pipe, or otherwise attached with a leakproof connection. Other mold designs, including reusable molds, shall be permitted, provided that the dimensions and confinement regarding circumferential stress provided for the grout body are the same. A 0.625 in. ± 0.125 in. [16 mm ± 3 mm] diameter hole shall be provided in the base plate to allow the strand to pass through. A 2.0 in. ± 0.08 in. [50 mm ± 2 mm] long debonding tube (Note 1) shall be positioned on the strand above the base plate and the strand shall protrude at least 2.0 in. ± 0.5 in. [50 mm ± 10 mm] from the top of the grouted steel tube. A typical test specimen is illustrated in Fig. 1.

NOTE 1—Polyethylene, Styrofoam,³ or similar material are commonly used for this purpose.

6.3 *Test Specimen Preparation*—The untensioned strand sample shall be installed and centered inside the steel pipe as shown in Fig. 1. A sealing agent shall be applied around the hole in the base plate to prevent leakage of grout from the sample during casting.

³ Styrofoam is a registered trademark of The Dow Chemical Company.

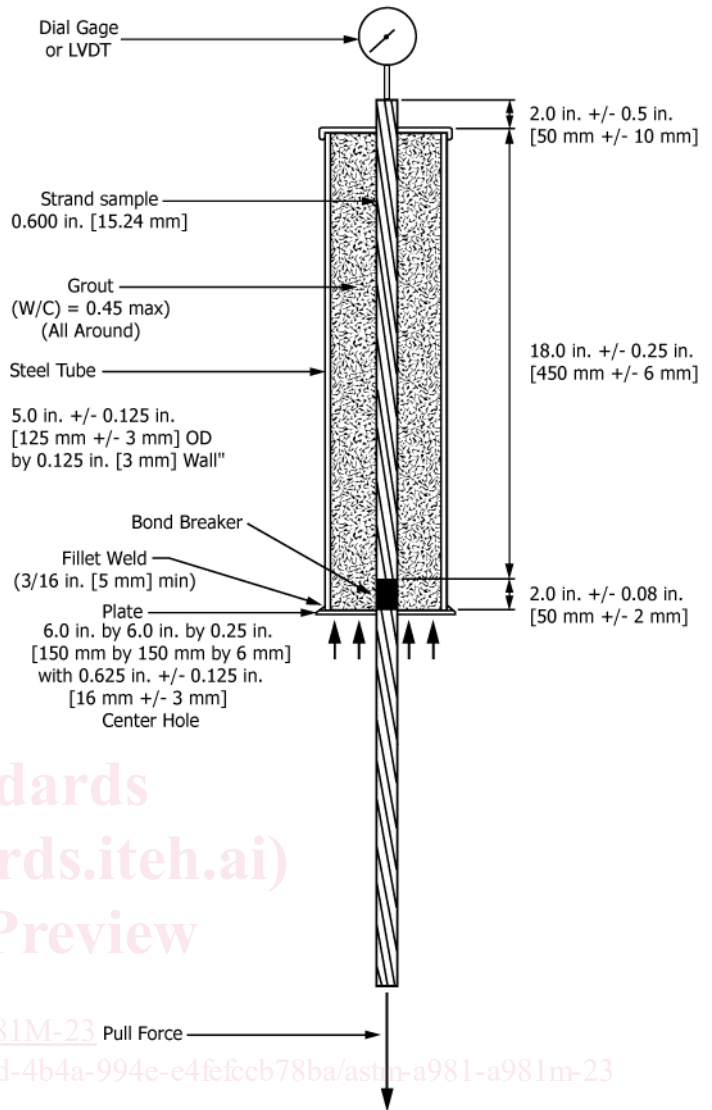


FIG. 1 Untensioned Strand Specimen

6.3.1 The grout shall be made from fresh portland cement conforming to Specification C150, Type I with a water/cement ratio of 0.45, by weight. Water shall be potable. The cement shall be added to the water. Mixing of the grout shall continue until the grout is free of lumps and undispersed cement. The grout then shall be poured into the steel tube to completely fill it. Six 2.0 in. by 2.0 in. by 2.0 in. [50 mm by 50 mm by 50 mm] test cubes shall be cast at the same time from the same batch of grout.

6.4 *Test Specimen Conditioning*—The test specimen including the grout test cubes, shall be cured according to Specification C511 at a 74 °F ± 3 °F [23 °C ± 1.7 °C] temperature and minimum 95 % relative humidity until the grout strength, as determined according to Test Method C109/C109M on at least two 2.0 in. by 2.0 in. by 2.0 in. [50 mm by 50 mm by 50 mm] test cubes, has reached a compressive strength of 3500 psi to 4000 psi [24 MPa to 28 MPa]. The seal around the hole in the base plate may be removed once the grout has set.