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Standard Test Methods for Testing Mechanical Splices for Steel Reinforcing Bars[1]

This standard is issued under the fixed designation A1034/A1034M; 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 These test methods cover the testing of mechanical splices for reinforcing bars. The various tests herein described can be specified in total or individually.

1.2 The test methods herein described are applicable to any type of mechanical splice manufactured to join steel reinforcing bars of any grade (specified minimum yield strength), uncoated or coated.

1.3 This standard describes only the methods for testing mechanical splices for steel reinforcing bars, but does not quantify the parameters for testing nor acceptance criteria, which must be specified.

NOTE 1—Various code-writing bodies specify various parameters, such as test loads, number of cycles and test temperature, for testing.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A370 Test Methods and Definitions for Mechanical Testing of Steel Products
E4 Practices for Force Verification of Testing Machines
E8 Test Methods for Tension Testing of Metallic Materials
E9 Test Methods of Compression Testing of Metallic Materials at Room Temperature
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E83 Practice for Verification and Classification of Extensometer Systems
E466 Practice for Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bar-splice assembly*—an assembled specimen consisting of two reinforcing bars connected with a mechanical splice.

3.1.2 *clip gage*—an electrical device used to measure small displacements in test specimens whose voltage output is convertible into strain.

3.1.3 *coupler*—threaded device for joining reinforcing bars for the purpose of providing transfer of either axial compression or axial tension or both from one bar to the other.

3.1.4 *coupling sleeve*—non-threaded device for joining reinforcing bars for the purpose of providing transfer of either axial compression or axial tension or both from one bar to the other.

3.1.5 *data acquisition system*—a computer based data logging system to record the output of electrical transducers reporting load, strain or displacement.

3.1.6 *differential elongation*—the difference between the total movement measured on the splice specimen from zero load to a predetermined test load and the total movement measured on an unspliced bar specimen under the same predetermined load.

3.1.7 *linear variable differential transformer (LVDT)*—an electrical device used to measure displacements, whose voltage output is convertible into strain.

3.1.8 *mechanical splice*—the complete assembly of a coupler or a coupling sleeve and possibly additional intervening material or other components to accomplish the splicing of two reinforcing bars.

3.1.9 *slip*—the difference in extensometer readings over the gage length across the splice, measured at an initial nominal zero load and, after having loaded the bar-splice assembly to a test load and unloaded it again, at the same nominal zero load.

[1] These test methods are under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and are the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

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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.

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

3.1.10 *splice components*—all components that make up a mechanical splice for reinforcing bars, including coupler, coupling sleeve, locknuts, bolts, grout, epoxy, ferrous filler metal and/or other components.

4. Summary of Test Method

4.1 Various test methods are used to determine the performance of a mechanical splice under loading.

4.1.1 *Monotonic Tension Test*—This test measures the performance of the bar-splice assembly under an increasing tension load. The specimen is placed in the testing machine and pulled to failure.

NOTE 2—Testing of specimens in tension to failure should be approached with caution. Some types of mechanical splices may shatter while failing in tension.

4.1.2 *Monotonic Compression Test*—This test is used to ascertain the performance of the bar-splice assembly under an increasing compressive load. The specimen is placed in the testing machine and is loaded in compression until failure or a specified load is applied.

NOTE 3—Typical maximum compressive load imposed in this test is 125 % of the specified yield strength of the reinforcing bar. Testing of specimens in compression should be approached with caution. The buckling load predicted by Euler Column formula may be less than the compression load specified.

4.1.3 *Cyclic Load Test*—This test is used to ascertain how the bar-splice assembly performs when the specimen is subjected to alternating tension and compression cycles. The specimen is placed in the testing machine and is loaded in tension, then in compression until the specified number of cycles is reached. Each cycle may exceed the yield strain of the bar and is intended to simulate the demands of earthquake loading on the specimen.

4.1.4 *High-Cycle Fatigue Test*—This test is conducted with alternating tension load cycles or alternating tension to compress load cycles, with the load staying below the yield strength of the reinforcing bar. This test is conducted until failure or a specified number of cycles are reached and simulates the demands on mechanical splices placed in bridges or other structures subjected to frequent elastic load cycles.

4.1.5 *Slip Test*—This test is used to ascertain the plastic movement (slip) between reinforcing bars within the bar-slice assembly, when loaded in tension.

4.1.6 *Low-Temperature Test*—This test is run using the test methods described in 4.1.1 through 4.1.5, to ascertain the behavior of the bar-splice assembly under low temperatures.

4.1.7 *Combination Tests*—Features of one or more of the test methods described in 4.1.1 through 4.1.6 can be combined.

5. Significance and Use

5.1 *Significance*:

5.1.1 The bar-splice assembly test specimen shall closely represent the mechanical splice used in practice. The behavior of the bar-splice assembly embedded in concrete, however, may differ from its behavior during testing where it is not embedded in concrete.

5.2 *Usefulness*:

5.2.1 Testing of mechanical splices for reinforcing bars shall establish the behavior of the bar-splice assembly under the loading conditions described herein for the various test methods to determine the acceptability of the mechanical splice for use in reinforced concrete structural members under specific design criteria.

5.3 *Interpretation of Test Results*:

5.3.1 Similar or better performance of mechanical splices installed in structural members shall be expected only if materials and methods of assembly are similar to the materials and methods used in the tests.

6. Apparatus

6.1 *Equipment*:

6.1.1 A suitable testing machine or load frame shall be used. The test apparatus shall have sufficient capacity to prevent yielding of its components and shall ensure that the applied tension loads or compression loads or both remain parallel to the axis of the test specimen during testing. The equipment shall be capable of applying cyclic loads within the time periods specified herein for the individual tests.

6.2 *Load Measurements*:

6.2.1 The load in the specimen shall be measured by load cell or other external load measuring method. The load cell shall be capable of providing electronic output of load measurements and sending to a data acquisition system for later data reduction. If a data acquisition system is used, it shall be capable of recording at least one measurement per second. Strain gages or other instrumentation that may be damaged or lose accuracy when the bar yields shall not be used to measure force.

6.2.2 It shall be permissible to mark bars and couplers or coupling sleeves with punch marks, or other legible scribe or stylus markings for measuring elongation at post yield rupture.

6.2.3 The loading systems shall be calibrated in accordance with Practices E4.

6.3 *Elongation Measurements*:

6.3.1 The displacements of the reinforcing bar ends within the coupler or coupling sleeve, as well as elastic and plastic deformations in the reinforcing bar and coupler or coupling sleeve materials, shall be measured, if required, using a mechanical extensometer or an LVDT, clip gage or other electronic means. The equipment need only be capable of measuring the sum of all displacements and elongations. The elongation measuring devices shall be at least of Class C, in accordance with Practice E83.

6.3.2 The motion of the testing machine grips or cross head shall not be used for determining specimen elongation.

6.4 *Compression Test Measurements*:

6.4.1 Unless otherwise specified, it shall not be required to monitor strain in monotonic compression tests.

NOTE 4—Only the compressive strength of the test specimen is of interest for evaluating a mechanical splice in compression and not the strain.