

ASTM Welded Wire Reinforcement Test Data for Quality Assurance

Use of this guide—The left side includes test data that exists in the latest ASTM standards. The right side has referenced tables from the latest ASTM standards and data from A370-A4 and 11.4 as well as industry comments.

ASTM A82 & A496 Plain and Deformed Wire Test Data

[Note: A496 deviations are in () when different from A82]

6. Mechanical Property Requirements

5.1 (8.1) Tension Tests

5.1.1 When tested as described in Test Methods and Definitions A370, the material, except as specified in 6.1.2, shall conform to the tensile property requirements in Table 1 (Table 2 for A496) based on nominal area of wire.

5.1.2 (8.1.2) The yield strength shall be determined as described in Test Methods and Definitions A370 at an extension of 0.5% in./in. of gage length. The manufacturer is not required to test for yield strength but is responsible for supplying a product that will meet the stipulated limit when tested in conformance with the provisions of 11.3 (13.3 for A496). For determining the yield strength, use a Class B-1 extensometer as described in Practice E83. The extensometer should be removed from the specimen after the yield strength has been determined.

5.1.3 (8.1.3) For material to be used in the fabrication of welded wire reinforcement, the tensile and yield strength properties shall conform to the requirements given in Table 2 (Table 3 for A496), based on nominal area of the wire.

5.1.4 (8.1.4) The material shall not exhibit a definite yield point as evidenced by a distinct drop of the beam or halt in the gage of the testing machine prior to reaching ultimate tensile load. The purchaser may opt to accept this feature as sufficient evidence of compliance with the specified minimum yield strength tests covered in 11.3 (13.3 for A496).

5.2 (8.2) Bend Test - The bend (or wrap test - see A370, A4.7.1, 2, 3) test specimen shall stand being bent at room temperature through 180° without cracking on the outside of the bent portion as described in Table 3.

5.3 Reduction of Area Test - The reduction of area shall be determined as described in Test Methods and Definitions A370, and the wire shall conform to the reduction of area requirements in Table 1 and Table 2 (Tables 2 & 3 for A496).

10. (12) Number of Tests

One tension and one bend test shall be made from each 10 tons (9070 kg) or less of each size of wire or fraction thereof in a lot, or a total of seven samples, whichever is less. A lot shall consist of all the coils of a single size offered for delivery at the same time.

TABLE 1 - Tension Test Requirements • A82

Tensile strength, min, ksi (MPa)	80 (550)
Yield strength, min, ksi (MPa)	70 (485)
Reduction of area, min, %	30 ^A

^AFor material testing over 100 ksi (67.0 MPa) tensile strength, the reduction of area shall be not less than 25%

	psi (MPa) min
Tensile strength	85 000 (585)
Yield strength	75 000 (515)

A370, 5.1 The Tension test related to the mechanical testing of steel products subjects a machined or full-section specimen of the material under examination to a measured load sufficient to cause rupture. The resulting properties sought are defined in Terminology E6.

A370, 13.2 Yield Strength is the stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain, percent offset, total extension under load, etc. Determine method by "Extension under load."

11.3 (13.3) If the purchaser considers it desirable to determine compliance with the yield strength requirements in 5.1 (8.1.3), yield strength tests may be made in a recognized laboratory, or their representative may make the test at the mill if such tests do not interfere unnecessarily with the mill operations.

TABLE 2 - Tension Test Requirements (Material for Welded Wire Reinforcement) • A82

	Size W1.2 and Larger	Smaller than Size W1.2
Tensile strength, min, ksi, (MPa)	75 (515)	70 (485)
Yield strength, min, ksi (MPa)	65 (450)	56 (385)
Reduction of area, min, %	30	30

^AFor material testing over 100 ksi (67.0 MPa) tensile strength, the reduction of area shall be not less than 25%

TABLE 4 - Tension Test Requirements (Material for Welded Wire Reinforcement) • A496

	psi (MPa) min
Tensile strength	80 000 (550)
Yield strength	70 000 (485)

TABLE 3 - Bend Test Requirements • A82

Size Number of Wire	Bend Test
W7 and smaller	Bend around a pin the diameter that is equal to the diameter of the specimen
Coarser than W7	Bend around a pin the diameter that is equal to twice the diameter of the specimen

TABLE 5 - Bend Test Requirements • A496

Size Number of Wire	Bend Test
D-6 and smaller	Bend around a pin the diameter that is equal to twice the diameter of the specimen
Coarser than D-6	Bend around a pin the diameter that is equal to four times the diameter of the specimen

A370, A4.7.1 The wrap test is used as a means for testing the ductility of wire.

A4.7.2 The test consists of coiling the wire in a closely spaced helix tightly against a mandrel of a specified diameter for a required number of turns. (Unless other specified, the required number of turns shall be five). The wrapping may be done by hand or a power device. The wrapping rate may not exceed 15 turns per minute. The mandrel diameter shall be specified in the relevant wire product specification.

TABLE 3 - Tension Test Requirements • A496

[Note: A497 deviations are in () when different from A185]

7. Mechanical Property Requirements

7.1 Tensile – Wire for the production of welded wire reinforcement is described in Specification A82. Tensile tests may be made on wire cut from the welded wire reinforcement and tested either across or between the welds; no less than 50% shall be across welds. Tensile tests across a weld shall have the welded joint located approximately at the center of the wire being tested and the cross wire forming the welded joint shall extend approximately 1 in. (25mm) beyond each side of the welded joint.

Note 3 – Tensile, reduction of area and bend testing are normally done at the time the wire is drawn. The manufacturer's finished product still must satisfy the mechanical properties when tested after fabrication.

7.2 Reduction of Area (A185 only)—The ruptured section of the tensile specimen is measured to determine this property. In the case of a specimen which has been tested across a weld, the measurement shall be made only when rupture has occurred at a distance from the center of a weld to permit an accurate measurement of the fractured section. The wire shall meet the minimum reduction of area requirements of Specification A82.

7.3 Bend Test – The wire shall withstand the bend test as described in Specification A82 (or A496) and shall be performed on a specimen taken from between the welds.

7.4 Weld Shear Strength – The weld shear strength between longitudinal and transverse wires shall be tested as described in Section 11. The minimum average shear value in pounds-force shall not be less than 35,000 multiplied by the nominal area of the larger wire in square inches (or in Newtons, shall not be less than 241, multiplied by the nominal area in square millimeters), where the smaller wire is less than size W1.2 (not less than a D4 for A497) and has an area of 40% or more of the area of the larger wire.

7.3.1 (A497) Reinforcement having a relationship of larger and smaller wires other than that covered in 7.3 shall meet an average weld shear strength requirement of not less than 3.6kN (800 pounds-force) provided that the smaller wire is not smaller than D4.

7.4.4 The material shall be deemed to conform to the requirements for weld shear strength if the average of the four samples complies with the value stipulated in 7.4 (or 7.3). If the average fails to meet the prescribed value, all the welds across the specimen shall then be tested. The reinforcement will be acceptable if the average of all weld shear test values across the specimen meets the prescribed minimum value.

11.(8) Weld Shear Test Apparatus and Methods

11.1 (8.1) As the welds in welded wire reinforcement contribute to the bonding and anchorage value of the wires in concrete, it is imperative that the weld acceptance tests be made in a jig that will stress the weld in a manner similar to which it is stressed in concrete. In order to accomplish this the vertical wire in the jig must be stressed in an axis close to its centerline. Also the horizontal wire must be held closely to the vertical wire, and in the same relative position, so as to prevent rotation of the horizontal wire. When the reinforcement is designed with different wire sizes, the larger diameter wire is the “vertical wire” when tested (see Fig. 1).

11.2 (8.2) Figure 1 shows the details of a typical testing jig together with two anvils which make it possible to test welds for wire up to 5/8” inch in diameter.

11.3 (8.3) Refer to the Standards of proper placement of samples in the weld tester and the maximum load for the rate of stressing. Refer to A370, 7.4 in this publication for the minimum rate of stressing.

10. (12) Number of Tests

10.1 (12.1) One test for conformance to tensile strength and bend

requirements shall be made for each 75,000 ft² (6968 m²) of reinforcement or remaining fraction thereof.

10.2 (12.2) One test for conformance to weld shear strength requirement shall be made for each 300,000 ft² (27 870 m²) or remaining fraction thereof.

A4.7.3 The wire tested shall be considered to have failed if the wire fractures or if any longitudinal or transverse cracks develop which can be seen by the unaided eye after the first complete turn. Wire which fails in the first turn shall be retested, as such fractures may be caused by bending the wire to a radius less than specified when the test starts.

A370, A4.5 Reduction of Area Test—The ends of the fractured specimen shall be carefully fitted together and the dimensions of the smallest cross section measured to the nearest 0.001 inches (0.025mm) with a pointed micrometer. The difference between the area thus found and the area of the original cross section, expressed as a percentage of the original area, is the reduction of area.

A370, 7.4 Speed of Testing—The speed of testing shall not be greater than that at which load and strain readings can be made accurately.

7.4.1 Any convenient speed of testing may be used up to 1/2 the specified yield point or yield strength. If the machine is equipped with a device to indicate the rate of loading, the speed of the machine from half the specified yield strength through the yield strength may be adjusted so that the rate of stressing does not exceed 100,000 psi (690 MPa) or a minimum of 10,000 psi (70 MPa) per-minute.

WRI Comment

Many use a rate of 40,000 psi per minute with success.

WRI Comment

All welded wire reinforcement shall pass weld-shear testing to ensure complete and quality welding.

General Comment

Since 1996, ASTM A82, A185, A496 and A497 have included a supplement. The supplement refers to high strength wire and welded wire. Building codes, for example, ACI 318, permit the use of reinforcement with a yield strength up to 550 MPa (80,000 psi).

WRI Comment

The WRI Industry and Associate members are dedicated to providing quality control and assurance that all products are tested and meet latest Codes and Standards before material leaves the plants. Institute members have a vast knowledge of manufacturing capabilities to help engineers, fabricators and contractors refine designs on an individual project basis.

