Designation: A1022/A1022M – 16b

Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement[1]

This standard is issued under the fixed designation A1022/A1022M; 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 specification covers stainless steel wire and welded wire reinforcement produced from hot-rolled stainless steel rod. The stainless steel wire is cold-worked, drawn or rolled, plain (non-deformed) or deformed or a combination of deformed and plain. It is used as concrete reinforcement for applications requiring resistance to corrosion or controlled magnetic permeability, or both. Common wire sizes and dimensions are found in this specification. Actual wire sizes are not restricted to those shown in the tables.

1.2 A supplementary requirement (S1) is provided and shall apply only when specified by the purchaser. In order to obtain a corrosion tested or controlled magnetic permeability product, steel conforming to Supplementary Requirement S1 should be ordered.

1.3 The chemical composition of the steel (stainless alloy) shall be selected for suitability to the application involved by agreement between the manufacturer and the purchaser. Unless otherwise specified by the purchaser, Specification A276 shall be used for chemical requirements. The UNS designations are to be included with the type number and noted in brackets. Examples of austenitic stainless steel designations are Type 304 [S30400], 304L [S30403], 316 [S31600], 316L [S31603], 316N [S31651], 316LN [S31653] and examples of duplex stainless steel designations are Type 2205 [S32205] and 329 [S32900].

NOTE 1—Only austenitic and duplex stainless steels are usually recommended for use as reinforcement in concrete because of their high corrosion resistance. Austenitic stainless steels have good general corrosion resistance, strength characteristics which can be improved by cold working, good toughness and ductility properties at low temperatures, and low magnetic permeability. Duplex stainless steels have generally a corrosion resistance greater than that of most austenitic steels and are magnetic. Other stainless steels with different chemical compositions than the series and types mentioned above, may be used for less restrictive applications.

1.4 Wire for welded wire reinforcement is generally manufactured at 75 ksi [520 MPa] yield strength level. Other strength levels shall be by agreement between the purchaser and manufacturer.

NOTE 2—The term used to refer to yield strength levels are the same as those in ASTM Standards for welded wire reinforcement.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately 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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A276 Specification for Stainless Steel Bars and Shapes

A342/A342M Test Methods for Permeability of Weakly Magnetic Materials

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

E83 Practice for Verification and Classification of Extensometer Systems

2.2 *Military Standards:*[3]

MIL-STD-129 Marking for Shipment and Storage

2.3 *Federal Standard:*[3]

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)

2.4 *ACI Standard:*[4]

ACI 318 Building Code Requirements for Structural Concrete

2.5 *Adjuncts:*

Weld Tester Drawing [5]

[1] This specification 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.

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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.

[3] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

[4] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.aci-int.org.

[5] Available from ASTM International Headquarters. Order Adjunct No. ADJA0185. Original adjunct produced in 1967.

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *stainless steel plain wire and welded plain wire reinforcement*—as used within the scope and intent of this specification, designates a material composed of cold-worked stainless steel wire, as cold-drawn or cold-rolled from stainless steel hot-rolled rod.

3.1.1.1 *Discussion*—The welded intersections provide the bond strength for shear resistance.

3.1.2 *stainless steel deformed wire and welded deformed wire reinforcement*—as used within the scope and intent of this specification, designates a material composed of cold- worked deformed stainless steel wire as cold-drawn or cold-rolled from stainless steel hot-rolled rod.

3.1.2.1 *Discussion*—Deformations can be indented or raised rib (protrusion) types. As with plain stainless steel welded wire, the welded intersections provide bond strength for shear resistance and the deformations add to the bond strength.

3.1.3 *convoluted wire*—when wire for welded wire reinforcement is formed into a sinusoidal wave shape, it is commonly referred to as convoluted wire.

3.1.3.1 *Discussion*—The wire is used in the manufacture of cages for certain applications of concrete pipe reinforcement. Only plain wire is normally subject to convolution.

TABLE 1 Dimensional Requirements for Plain Wire—SI Units

Size Number[A]	Nominal Diameter, mm	Nominal Area, mm^2
MW 5	2.50	5
MW 10	3.60	10
MW 15	4.40	15
MW 20	5.00	20
MW 25	5.60	25
MW 30	6.20	30
MW 35	6.70	35
MW 40	7.10	40
MW 45	7.60	45
MW 50	8.00	50
MW 55	8.40	55
MW 60	8.70	60
MW 65	9.10	65
MW 70	9.40	70
MW 80	10.10	80
MW 90	10.70	90
MW 100	11.30	100
MW 120	12.40	120
MW 130	12.90	130
MW 200	15.95	200
MW 290	19.22	290

[A] This table represents a hard metrication of the most readily available sizes in the welded wire reinforcement industry. Table 1 shall be used in projects that are designed using SI units: Table 2 shall be used on projects designed using inch-pound units. Areas of wire shall be checked with the most efficient and readily available material from manufacturers. Other wire sizes are available and many manufacturers can produce them in 1-mm^2 increments.

4. Ordering Information

4.1 Orders for stainless steel wire or welded wire reinforcement under this specification shall contain the following information:

4.1.1 Quantity (weight [mass]) or square area for welded wire reinforcement,

4.1.2 Name of material (cold-drawn or rolled stainless steel wire, or welded wire reinforcement, plain or deformed, for concrete),

4.1.3 Wire size number, wire spacing, and sheet or roll width and length for welded wire reinforcement,

4.1.4 Minimum yield strength or grade, and

4.1.5 ASTM designation and year of issue.

NOTE 3—A typical ordering description is as follows: For in-lbs units: (100 000 square feet of welded wire for concrete reinforcement, 12 × 12 – W 10 × W 10 in flat sheets 96-in. wide by 15-ft long) in secured bundles for crane or forklift truck lifts. For metric units: 10 000 square metres of welded wire for concrete reinforcement, 305 × 305 – MW 65 × MW 65, in flat sheets 2438-mm wide by 4.6-mm long in secured bundles for crane or forklift truck lifts. Testing shall be in accordance with Test Methods A370.

NOTE 4—Longitudinal wires can be variably spaced. (For example, V × 12 – D 10 × D 10 or V × 305 – MD 65 × MD 65). See the Tables 1 and 2 for wire sizes.

4.2 The purchaser shall have the option to specify additional requirements, including but not limited to, the following:

4.2.1 Specified corrosion testing requirements,

4.2.2 Type of stainless steel,

4.2.3 Special heat treatment or condition,

4.2.4 Supplementary requirements,

4.2.5 Exclusion of over-steeling, if required (see 10.4),

4.2.6 Report on tests performed on the stainless steel wire or welded wire reinforcement being furnished, if desired (see 16.1), and

4.2.7 Packaging (see Section 17).

5. Materials

5.1 The stainless steel shall be made by any commercially accepted process.

5.2 Cold-worked wire or rod used in the manufacture of stainless steel welded wire reinforcement shall be in accordance with the chemical and physical requirements of Specification A276.

6. Manufacture

6.1 Stainless steel wire for welded wire reinforcement shall be cold worked, either drawn or rolled from steel rod that is rolled from properly identified heats of mold-cast or strand-cast steel.

6.2 The wire or rod shall be assembled into welded wire reinforcement by automatic machines or by other suitable mechanical means which will assure accurate spacing and alignment of all wires of the finished welded wire reinforcement. The finished welded wire reinforcement shall be furnished in flat or bent sheets or in rolls as specified by the purchaser.

6.3 Longitudinal and transverse wires shall be securely connected at every intersection by a process of electrical-resistance welding which employs the principle of fusion combined with pressure.

TABLE 2 Dimensional Requirements for Plain Wire—Inch-pound Units

Size Number[A]	Nominal Diameter, in.	Nominal Area, in^2
W 0.5	0.080	0.005
W 1.2	0.124	0.012
W 1.4	0.134	0.014
W 2	0.160	0.020
W 2.5	0.178	0.025
W 2.9	0.192	0.029
W 3.5	0.211	0.035
W 4	0.226	0.040
W 4.5	0.239	0.045
W 5	0.252	0.050
W 5.5	0.265	0.055
W 6	0.276	0.060
W 8	0.319	0.080
W 10	0.357	0.100
W 11	0.374	0.110
W 12	0.391	0.120
W 14	0.422	0.140
W 16	0.451	0.160
W 18	0.479	0.180
W 20	0.505	0.200
W 22	0.529	0.220
W 24	0.533	0.240
W 26	0.575	0.260
W 28	0.597	0.280
W 30	0.618	0.300
W 31	0.628	0.310
W 45	0.757	0.450

[A] This table represents the most readily available sizes in the welded wire reinforcement industry in sizes using inch-pound units. Areas of wire shall be checked with the most efficient and readily available material from manufacturers. Other wire sizes are available and many manufacturers can produce them in 0.0015-$in.^2$ increments.

TABLE 3 Bend Test Requirements—Plain Wire

Size Number Of Wire	Bend Test
W7 [MW 45] and smaller	Bend around a pin the diameter that is equal to the diameter of the specimen
Larger than W7 [MW 45]	Bend around a pin the diameter that is equal to twice the diameter (2d) of the specimen

6.4 Welded wire reinforcement of proper grade and quality shall result in a strong, serviceable product having substantially square or rectangular openings. It shall be fabricated and finished in a quality manner and conform to this specification.

7. Mechanical Property Requirements—Wire, Plain and Deformed

7.1 *General Requirements for Plain Wire:*

7.1.1 When plain wire is ordered by size number, the relation between size number, diameter, and area shown in Tables 1 and 2 shall apply.

7.1.2 Specimens for mechanical properties testing shall be full wire sections and shall be obtained from ends of wire coils as drawn. The specimens shall be of sufficient length to perform testing described in Test Methods A370.

7.1.3 If any test specimen exhibits obvious isolated imperfections not representative of the product, it shall be discarded and another specimen substituted.

7.1.4 *Tension Test:*

7.1.4.1 When tested as described in Test Methods and Definitions A370, the material, except as specified in 7.1.4.2 shall conform to the tensile property requirements in Table 5, based on the nominal area of the wire.

7.1.4.2 When required by the purchaser, the yield strength shall be determined as described in Test Methods and Definitions A370 at an extension of 0.5 % of gage length or by the offset method (0.2 %). For determining the yield strength use a Class B-1 extensometer as described in Practice E83.

7.1.4.3 For wire to be used in the manufacture of welded wire reinforcement, the tensile and yield strength properties shall conform to the requirements given in Table 6, based on the nominal area of the wire.

7.1.4.4 Materials shall be measured at extension under load and shall not be required to exhibit a definite yield point as evidenced by a distinct arrest or halt in the load indication gauge of the testing machine prior to reaching ultimate tensile load. The purchaser shall have the option to accept this feature as sufficient evidence of compliance with the specified minimum yield strength tests covered in this specification.

7.1.5 *Bend Test*—The bend test specimen shall be bent at room temperature through 90° without cracking on the outside of the bent portion visible to a person with normal or corrected vision, as prescribed in Table 3.

7.1.6 *Reduction of Area*—Shall be determined as described in Test Methods and Definitions A370. The wire shall conform to the reduction of area requirements in Tables 5 and 6.

7.1.7 *Permissible Variation in Wire Diameter:*

7.1.7.1 The permissible variation in wire diameter shall conform to the requirements in Table 4.

7.1.7.2 The difference between the maximum and minimum diameters, as measured on any given cross section of the wire, shall not exceed the tolerances listed in Table 4 for the given wire size.

7.2 *General Requirements for Deformed Wire:*

7.2.1 When deformed wire is ordered by size number, the relation between size number, diameter, and area shown in Tables 7 and 8 shall apply.

7.2.2 Specimens for mechanical properties testing shall be full wire sections and shall be obtained from ends of wire coils as rolled. The specimens shall be of sufficient length to perform testing described in Test Methods A370.

7.2.3 If any test specimen exhibits obvious isolated imperfections not representative of the product, it shall be discarded and another specimen substituted.

7.2.4 *Deformation Criteria:*

7.2.4.1 Deformations shall be spaced along the wire at a substantially uniform distance and shall be symmetrically disposed around the perimeter. The deformations on all longitudinal lines of the wire shall be similar in size and shape. A minimum of 25 % of the total surface area shall be deformed by measurable deformations.

7.2.4.2 Deformed wire shall have two or more lines of deformations.

7.2.4.3 The average longitudinal spacing of deformations shall be not less than 3.5 nor more than 5.5 deformations per 1 in. [25 mm] in each line of deformations on the wire.

TABLE 4 Permissible Variation in Wire Diameter—Plain Wire

Size Number, in-lbs. [SI]	Nominal Diameter, in. [mm]	Permissible Variation Plus and Minus, in. [mm]	Maximum Permissible Out-of-Round, in. [mm][A]
Smaller than W 5 [MW 32]	Under 0.252 [6.4]	0.003 [0.08]	0.003 [0.08]
W 5 [MW 32] to W 12 [MW 77], incl	0.252 [6.4] to 0.391 [9.93], incl	0.004 [0.10]	0.004 [0.10]
Over W 12 [MW 77] to W 20 [MW 130], incl	Over 0.391 [9.93] to 0.505 [12.83], incl	0.006 [0.15]	0.006 [0.15]
Over W 20 [MW 130]	Over 0.505 [12.83]	0.008 [0.20]	0.008 [0.20]

[A] Out-of-round is the difference between maximum and minimum diameters of the wire, measured at the same transverse cross section.

TABLE 5 Tension Test Requirements—Plain Wire

	Grade 70 [485]	Grade 72.5 [500]	Grade 75 [515]	Grade 77.5 [533]	Grade 80[550]
Tensile strength, min, psi [MPa]	80 000 [550]	82 500 [568]	85 000 [585]	87 500 [603]	90 000 [620]
Yield strength, min, psi [MPa]	70 000 [485]	72 500 [500]	75 000 [515]	77 500 [533]	80 000 [550]
Reduction of area, min, %	30[A]	30[A]	30[A]	30[A]	30[A]

[A] For material testing over 100 000 psi [690 MPa] tensile strength, the reduction of area shall be not less than 25 %.

TABLE 6 Tension Test Requirements—Plain Wire for Welded Reinforcement

	Size W 1.2 [MW 8] and Larger					
	Grade 65 [450]	Grade 70 [485]	Grade 72.5 [500]	Grade 75 [515]	Grade 77.5 [533]	Grade 80 [550]
Tensile strength, min, psi [MPa]	75 000 [515]	80 000 [550]	82 500 [568]	85 000 [585]	87 500 [603]	90 000 [620]
Yield strength, min, psi [MPa]	65 000 [450]	70 000 [485]	72 500 [500]	75 000 [515]	77 500 [533]	80 000 [550]
Reduction of area, min, %	30[A]	30[A]	30[A]	30[A]	30[A]	30[A]
	Smaller than Size W 1.2 [MW 8]					
	Grade 56 [385]					
Tensile strength, min, psi [MPa]	70 000 [485]					
Yield strength, min, psi [MPa]	56 000 [385]					
Reduction of area, min, %	30[A]					

[A] For material testing over 100 000 psi [690 MPa] tensile strength, the reduction of area shall be not less than 25 %.

TABLE 7 Dimensional Requirements for Deformed Wire for Concrete Reinforcement in SI Units

	Nominal Dimensions				Deformation Requirements
Deformed Wire Size[A,B,C]	D [in^2 X 100]	Unit Mass, kg/m	Diameter, mm[D]	Cross-Sectional Area, mm^2[E]	Minimum Average Height of Deformations, mm[F,G]
MD 25	[D 3.9]	0.1962	5.60	25	0.25
MD 30	[D 4.6]	0.2355	6.20	30	0.28
MD 35	[D 5.4]	0.2747	6.70	35	0.30
MD 40	[D 6.2]	0.3140	7.10	40	0.32
MD 45	[D 7.0]	0.3532	7.60	45	0.34
MD 50	[D 7.7]	0.3925	8.00	50	0.36
MD 55	[D 8.5]	0.4317	8.40	55	0.38
MD 60	[D 9.3]	0.4709	8.70	60	0.39
MD 65	[D 10.1]	0.5102	9.10	65	0.46
MD 70	[D 10.8]	0.5494	9.40	70	0.47
MD 80	[D 12.4]	0.6279	10.10	80	0.50
MD 90	[D 13.9]	0.7065	10.70	90	0.54
MD 100	[D 15.5]	0.7849	11.30	100	0.57
MD 120	[D 18.6]	0.9419	12.40	120	0.62
MD 130	[D 20.1]	1.0204	12.90	130	0.64
MD 200	[D 31.0]	1.5700	15.95	200	0.80
MD 290	[D 45.0]	2.2700	19.22	290	0.96

[A] The number following the prefix indicates the nominal cross-sectional area of the deformed wire in square millimetres.
[B] For sizes other than those shown above, the Size Number shall be the number of square millimetres in the nominal area of the deformed wire cross section, prefixed by the letters MD.
[C] These sizes represent the most readily available sizes in the welded wire reinforcement industry. Other wire sizes are available and many manufacturers can produce them in 1 mm^2 increments.
[D] The nominal diameter of a deformed wire is equivalent to the diameter of a plain wire having the same mass per metre as the deformed wire.
[E] The cross-sectional area is based on the nominal diameter. The area in square millimetres may be calculated by dividing the unit mass in kg/mm by 7.849×10^{-6} (mass of 1 mm^3 of steel) or by dividing the unit mass in kg/m by 0.007849 (mass of steel 1 mm square and 1 m long).
[F] Measurements shall be made as described in 7.2.4.7.
[G] See 7.2.4.6 for average longitudinal number of deformations per unit length.

TABLE 8 Dimensional Requirements for Deformed Wire for Concrete Reinforcement in in.-lb Units

Nominal Dimensions				Deformation Requirements
Deformed Wire Size[A,B,C]	Unit Weight, lb/ft	Diameter, in.[D]	Cross-Sectional Area, in.[E]	Minimum Average Height of Deformations, in.[F,G]
D 1	0.034	0.113	0.01	0.0045
D 2	0.068	0.159	0.02	0.0063
D 3	0.102	0.195	0.03	0.0078
D 4	0.136	0.225	0.04	0.0101
D 5	0.170	0.252	0.05	0.0113
D 6	0.204	0.276	0.06	0.0124
D 7	0.238	0.299	0.07	0.0134
D 8	0.272	0.319	0.08	0.0143
D 9	0.306	0.338	0.09	0.0152
D 10	0.340	0.356	0.10	0.0160
D 11	0.374	0.374	0.11	0.0187
D 12	0.408	0.390	0.12	0.0195
D 13	0.442	0.406	0.13	0.0203
D 14	0.476	0.422	0.14	0.0211
D 15	0.510	0.437	0.15	0.0218
D 16	0.544	0.451	0.16	0.0225
D 17	0.578	0.465	0.17	0.0232
D 18	0.612	0.478	0.18	0.0239
D 19	0.646	0.491	0.19	0.0245
D 20	0.680	0.504	0.20	0.0252
D 21	0.714	0.517	0.21	0.0259
D 22	0.748	0.529	0.22	0.0265
D 23	0.782	0.541	0.23	0.0271
D 24	0.816	0.553	0.24	0.0277
D 25	0.850	0.564	0.25	0.0282
D 26	0.884	0.575	0.26	0.0288
D 27	0.918	0.586	0.27	0.0293
D 28	0.952	0.597	0.28	0.0299
D 29	0.986	0.608	0.29	0.0304
D 30	1.020	0.618	0.30	0.0309
D 31	1.054	0.628	0.31	0.0314
D 45	1.530	0.757	0.45	0.0379

[A] The number following the prefix indicates the nominal cross-sectional area of the deformed wire in square inches multiplied by 100.
[B] For sizes other than those shown above, the Size Number shall be the number of one hundredths of a square inch in the nominal area of the deformed wire cross section, prefixed by the D.
[C] These sizes represent the most readily available sizes in the welded wire reinforcement industry. Other wire sizes are available and many manufacturers can produce them in 0.0015-in.^{2} increments.
[D] The nominal diameter of a deformed wire is equivalent to the diameter of a plain wire having the same weight per foot as the deformed wire.
[E] The cross-sectional area is based on the nominal diameter. The area in square inches may be calculated by dividing the weight in pounds by 0.2833 (weight of 1 in.^{3} of steel) or by dividing the weight per linear foot of specimen in pounds by 3.4 (weight of steel 1 in. square and 1 foot long).
[F] Measurements shall be made as described in 7.2.4.7.
[G] See 7.2.4.6 for average longitudinal number of deformations per unit length.

7.2.4.4 The minimum average height of the center of typical deformations based on the nominal wire diameters shown in Tables 7 and 8 shall be as follows:

Wire Sizes	Minimum Average Height of Deformations, Percent of Nominal Wire Diameter
D 3 [MD 19] and smaller	4
Larger than D 3 [MD 19] through D 10 [MD 65]	4½
Larger than D 10 [MD 65]	5

7.2.4.5 The deformations shall be placed with respect to the axis of the wire so that the included angle is not less than 45°; or if deformations are curvilinear, the angle formed by the transverse axis of the deformation and the wire axis shall be not less than 45°. Where the line of deformations forms an included angle with the axis of the wire from 45° to 70° inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the included angle is over 70°, a reversal in direction is not required.

7.2.4.6 The average spacing of deformations shall be determined by dividing a measured length of the wire specimen by the number of individual deformations in any one row of deformations on any side of the wire specimens. A measured length of the wire specimen shall be considered the distance from a point on a deformation to a corresponding point on any other deformation in the same line of deformations on the wire.

7.2.4.7 The minimum average height of deformations shall be determined from measurements made on not less than two typical deformations from each line of deformations on the wire. Measurements shall be made at the center of indentations or raised ribs.

7.2.5 *Tension Test:*

7.2.5.1 When tested as described in Test Methods and Definitions A370, the material, except as specified in 7.2.5.2 shall conform to the tensile property requirements in Table 9, based on nominal area of wire.

7.2.5.2 When required by the purchaser, the yield strength shall be determined as described in Test Methods and Definitions A370 at an extension of 0.5 % of gage length or by the offset method (0.2 %). For determining the yield strength use a Class B-1 extensometer as described in Practice E83.

TABLE 9 Tension Test Requirements—Deformed Wire

	Grade 75 [515]	Grade 77.5 [533]	Grade 80 [550]
Tensile strength, min, psi [MPa]	85 000 [585]	87 500 [603]	90 000 [620]
Yield strength, min, psi [MPa]	75 000 [515]	77 500 [533]	80 000 [550]

TABLE 10 Tension Test Requirements—Deformed Wire for Welded Wire Reinforcements

	Grade 70 [485]	Grade 72.5 [500]	Grade 75 [515]	Grade 77.5 [533]	Grade 80 [550]
Tensile strength, min, psi [MPa]	80 000 [550]	82 500 [568]	85 000 [585]	87 500 [603]	90 000 [620]
Yield strength, min, psi [MPa]	70 000 [485]	72 500 [500]	75 000 [515]	77 500 [533]	80 000 [550]

TABLE 11 Bend Test Requirements—Deformed Wire

Size Number of Wire	Bend Test
D6 [MD 40] and smaller	Bend around a pin the diameter that is equal to twice (2d) the diameter of the specimen
Larger than D6 [MD 40]	Bend around a pin the diameter that is equal to four times (4d) the diameter of the specimen

7.2.5.3 For wire to be used in the manufacture of welded wire reinforcement, the tensile and yield strength properties shall conform to the requirements given in Table 10, based on the nominal area of the wire.

7.2.5.4 Materials shall be measured at extension under load and shall not be required to exhibit a definite yield point as evidenced by a distinct arrest or halt in the load indication gauge of the testing machine prior to reaching ultimate tensile load. The purchaser shall have the option to accept this feature as sufficient evidence of compliance with the specified minimum yield strength tests covered in this specification.

7.2.6 *Bend Test*—The bend test specimen shall be bent at room temperature through 90° without cracking on the outside of the bent portion visible to a person with normal or corrected vision, as prescribed in Table 11.

7.2.7 *Permissible Variation in Weight [Mass]:*

7.2.7.1 The permissible variation in weight [mass] of any deformed wire is ±6 % of its nominal weight [mass]. The nominal weights [mass] shown in Table 7 and Table 8, or similar calculations on unlisted sizes, shall be used to establish the variation.

7.3 *Number of Tests*—One tension and one bend test shall be made from each 10 tons [9000 kg] or less of each size of wire or fraction thereof.

7.4 *Quality, Finish, and Appearance:*

7.4.1 The wire shall be free of detrimental imperfections and shall have a smooth surface of 125 µin. [3.2 µm] or better. See 11.1 also.

8. Mechanical Property Requirements—Welded Wire Reinforcement

8.1 *Tensile*—Wire for the production of welded wire, deformed, is described in Section 6. Tensile tests shall be made on wire cut from the welded wire 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. [25 mm] beyond each side of the welded joint.

8.1.1 The yield strength shall be determined as described in Test Methods and Definitions A370 at an extenstion of 0.5 % of gage length or by the offset method (0.2 %). 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 14.3. For determining the yield strength use a Class B-1 extensometer as described in Practice E83. It shall be permissible to remove the extensometer after the yield strength has been determined.

8.2 *Bend Test*—The wire shall withstand the bend test as described in Table 11 and shall be performed on a specimen taken from between the welds.

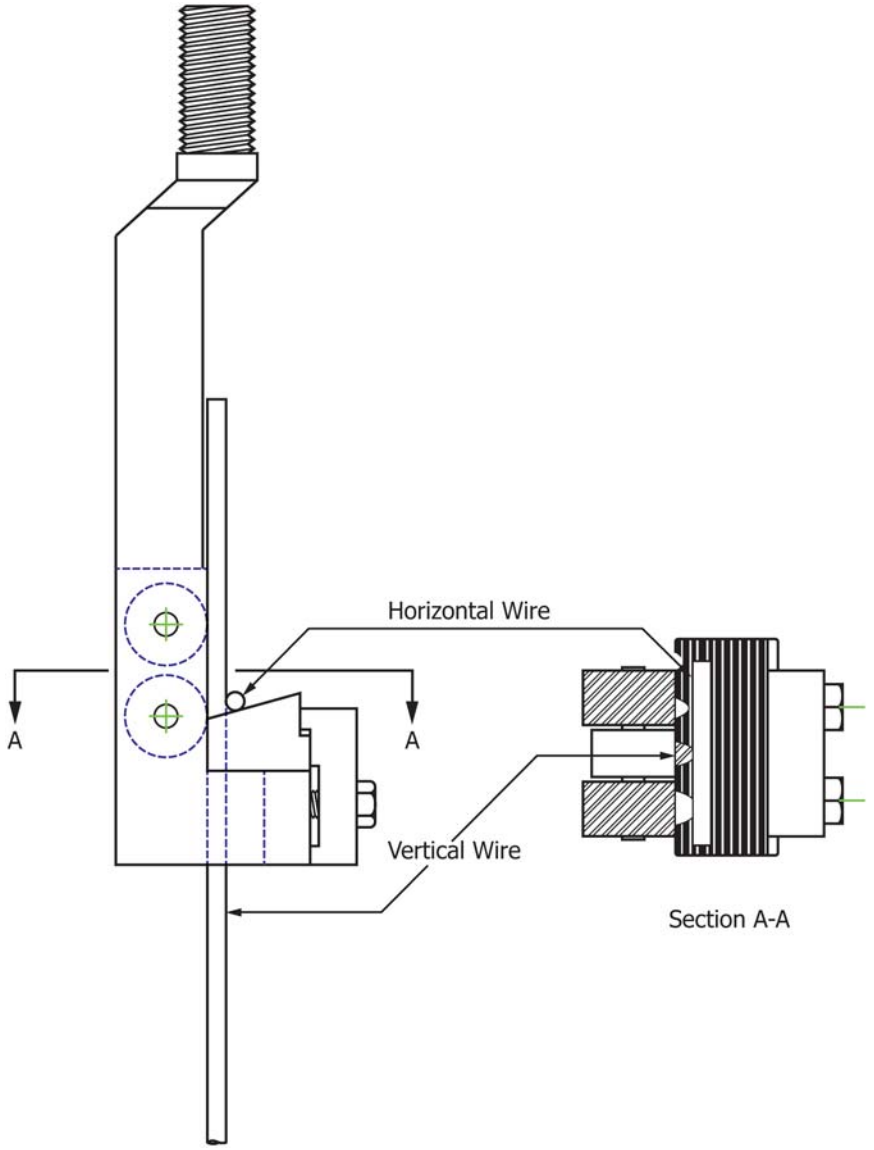
8.3 *Weld Shear Strength*—The weld shear strength between longitudinal and transverse wires shall be tested as described in Section 9. The minimum average shear value shall not be less than 35 000 pounds-force [241 newtons] multiplied by the nominal area of the larger wire in square inches [millimetres], where the smaller wire is not less than size D 4 [MD 26] and has an area of 40 % or more of the area of the larger wire.

8.3.1 Welded wire having a relationship of larger and smaller wires other than those covered in 8.3 shall meet an average weld shear strength requirement of not less than 800 lbf [3.6 kN] provided that the smaller wire is not smaller than D4 [MD 26].

8.3.2 Weld-shear tests for determination of conformance to the requirements of 8.3 shall be conducted using a fixture as described in Section 9.

8.3.3 Four welds selected at random from the specimen described in 12.2 shall be tested for weld shear strength. The transverse wire of each test specimen shall extend approximately 1 in. [25 mm] on each side of the longitudinal wire. The longitudinal wire of each test specimen shall be of such length below the transverse wire so as to be adequately engaged by the grips of the testing machine. It shall be of such length above the transverse wire that its end shall be above the center line of the upper bearing of the testing device.

8.3.4 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 8.3. If the average fails to meet the prescribed value, all the welds across the specimen shall then be tested. The welded wire shall be acceptable if the average of all weld shear test values across the specimen meets the prescribed minimum value.



NOTE 1—A detailed drawing showing complete dimensions of the weld tester may be obtained from ASTM Headquarters. (See Weld Tester Drawing, available from ASTM International Headquarters. Order Adjunct No. ADJA0185. Original adjunct produced in 1967.)

FIG. 1 Welded Wire Reinforcement Weld Tester

9. Weld Shear Test Apparatus and Methods

9.1 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 which 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 center line. 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 welded wire reinforcement has different wire sizes, the larger diameter wire is the "vertical wire" when tested (see Fig. 1).

9.2 Fig. 1 shows the details of a typical testing jig together with two anvils, which make it possible to test welds for wire up to ¾ in. [19.05 mm] in diameter. This testing jig can be used in most tensile testing machines and should be hung in a ball and socket arrangement at the center of the tensile testing machine. This, or a similarly effective fixture designed on the same principle, shall be acceptable.

9.3 Test specimens shall be inserted through the notch in the anvil using the smallest notch available in which the vertical wire will fit loosely. The vertical wire shall be in contact with the surface of the free rotating rollers while the horizontal wire shall be supported by the anvil on each side of the slot. The bottom jaws of the tensile testing machine shall grip the lower end of the vertical wire and the load shall be applied at a rate of stressing not to exceed 100 000 psi/min [686 MPa/min].

10. Dimensions

10.1 *Width*—The width of welded wire reinforcement shall be considered to be the center-to-center distance between outside longitudinal wires. The permissible variation shall not

exceed ½ in. [13 mm] greater or less than the specified width. In case the width of flat sheets or rolls is specified as the overall width (tip-to-tip length of transverse wires), the width shall not vary more than ±1 in. [±25 mm] from the specified width. When measurements involve a convoluted wire, the measurement shall be made to the approximate center of the sinusoidal wave shape.

10.2 *Length*—The overall length of flat sheets, measured on any wire, shall not vary more than ±1 in. [±25 mm], or 1 %, whichever is greater.

10.3 Overhang of the transverse wires shall not project beyond the centerline of each longitudinal edge wire more than a distance of 1 in. [25 mm], unless otherwise specified. When transverse wires are specified to project a specific length beyond the center line of a longitudinal edge wire, the permissible variation shall not exceed ½ in. [13 mm] greater or less than the specified length.

10.4 The permissible variation in weight of any wire in the finished welded wire reinforcement shall conform to the tolerances prescribed for the wire before assembly in this specification, with the following exceptions:

10.4.1 Unless otherwise precluded by the purchaser, the manufacturer shall be permitted to apply over-sized wire (not under-sized). In all cases where such over steeling is practiced, the manufacturer shall identify the welded wire with the style originally ordered.

10.5 The average spacing of wires shall be such that the total number of wires contained in a sheet or roll is equal to or greater than that determined by the specific spacing, but the center-to-center distance between individual wires shall not vary more than ¼ in. [6 mm] from the specified spacing. Sheets of welded wire reinforcement having the specified length shall not be required to contain an identical number of transverse wires, and therefore, shall be permitted to have various lengths of longitudinal overhang.

11. Quality

11.1 When wire of the proper grade and quality is assembled into welded wire reinforcement as required by this specification, the resulting welded wire reinforcement shall be a serviceable product having substantially square or rectangular openings. If the stainless steel welded wire reinforcement is exposed to weathering, it shall not be required to have a bright or shiny appearance. Its appearance shall be permitted to be dull or grayish with areas of oxidized flash at electric resistance welded intersections. Weathered oxide films on wires with good surface finish do not affect the corrosion resistance and the low or non-magnetic properties of the reinforcement, therefore these conditions shall not be cause for rejection.

12. Sampling

12.1 Specimens for mechanical properties testing shall be obtained by cutting from the finished welded wire reinforcement a full width section, of sufficient length to perform testing described in 8.1 and 8.2.

12.2 Test specimens for determining weld-shear properties shall be obtained by cutting from the finished welded wire reinforcement, a full width section, of sufficient length to perform testing described in 8.3.3.

12.3 Measurements for conformance to dimensional characteristics shall be made on full sheets or rolls.

12.4 If any test specimen exhibits obvious imperfections, it shall be discarded and another specimen substituted.

13. Number of Tests

13.1 One test for conformance to tensile strength and bend test requirements shall be made for each 75 000 ft^2 [7000 m^2] of welded wire reinforcement or remaining fraction thereof. For testing prior to assembly, one test for each 20 tons [18 Mg] of wire shall be made.

13.2 One test for conformance to weld shear strength requirement shall be made for each 300 000 ft^2 [28 000 m^2] or remaining fraction thereof.

14. Inspection

14.1 Inspection of the stainless steel wire or welded wire reinforcement shall be agreed upon between the purchaser and the manufacturer as part of the purchase order or contract.

14.2 Except for yield strength, all tests and inspections shall be made at the manufacturer's facilities prior to shipment, unless otherwise specified. Such tests shall be so conducted as not to interfere unnecessarily with the manufacturing operations.

14.3 The manufacturer shall satisfy compliance with yield strength requirements of this specification by testing in its certified laboratory or a recognized independent laboratory, or the purchaser's representative shall have the option to perform the test at the manufacturer's facilities. Such testing shall not unnecessarily interfere with manufacturing operations.

15. Rejection and Retest

15.1 Material that does not meet the requirements of this specification shall be rejected. Unless otherwise specified, any rejection shall be reported to the manufacturer within five days from the time of selection of test specimens.

15.2 In case a specimen fails to meet the tension or bend test, the material shall not be rejected until two additional specimens taken from other wires in the same sheet or roll have been tested. The material shall be considered as meeting the specification in respect to any prescribed tensile property, provided the tested average for the three specimens, including the specimen originally tested, is equal to or exceeds the required minimum for the particular property in question and provided further that none of the three specimens develops less than 80 % of the required minimum for the tensile property in question. The material shall be considered as meeting this specification in respect to bend test requirements, provided both additional specimens satisfactorily pass the prescribed bend test.

15.3 Welded intersections shall withstand normal shipping and handling without becoming broken, but the presence of broken welds, regardless of cause, shall not constitute cause for rejection unless the number of broken welds per sheet exceeds

1 % of the total number of joints in a sheet, or if the material is furnished in rolls, 1 % of the total number of joints in 150 ft^2 [14 m^2] of welded wire and, furthermore, provided not more than one half the permissible maximum number of broken welds are located on any one wire.

15.4 In the event of rejection because of failure to meet the weld shear requirements, four additional specimens shall be taken from four different sheets or rolls and tested in accordance with Section 9. If the average of all the weld shear tests performed does not meet the requirement, the material shall be rejected.

15.5 In the event of rejection because of failure to meet the requirements for dimensions, the amount of material rejected shall be limited to those individual sheets or rolls which fail to meet this specification.

15.6 Dull gray surface, surface seams, or surface irregularities such as outlined in Section 11 shall not be cause for rejection provided the minimum welded wire dimensions, cross-sectional area, tensile properties, and weld shear strength of a hand wire-brushed test specimen are not less than the requirements of this specification. The height of deformations above the minimum height requirements shall not be cause for rejection.

15.7 *Rehearing*—Rejected materials shall be preserved for a period of at least two weeks from the date of inspection, during which time the manufacturer shall have the option to make claim for a rehearing and retesting.

16. Certification

16.1 If outside inspection is waived, a manufacturer's certification that the material has been manufactured in accordance with and meets the requirements of this specification shall be the basis of acceptance of the material. The certification shall include the designation, year-date of issue, and revision letter, if any.

16.2 This conformance is predicated upon testing and acceptance of wire prior to assembly, coupled with random shear testing during production. Because of warehousing and stocking problems, no efforts are normally taken to supply actual test data on material shipped. If this is deemed essential, outside inspection should be utilized.

16.3 Test results for yield strength, tensile strength, reduction of area (for plain wire), and bend tests shall be reported for plain wire above Grade 70, plain welded wire reinforcement above Grade 65, deformed wire above Grade 75, and deformed welded wire reinforcement above Grade 70.

17. Packaging and Package Marking

17.1 The size of the wire, ASTM designation, and name or mark of the manufacturer shall be marked on a tag securely attached to each coil of wire.

17.2 Packaging, marking and loading for shipment shall be agreed upon between the purchaser and manufacturer.

17.3 When welded wire reinforcement is furnished in flat sheets, it shall be assembled in bundles of convenient size containing not more than 150 sheets and securely fastened together.

17.4 When welded wire reinforcement is furnished in rolls, each roll shall be secured so as to prevent unwinding during shipping and handling.

17.5 Each bundle of flat sheets and each roll shall have attached thereto a suitable tag bearing the name of the manufacturer, description of the material and such other information as specified by the purchaser.

17.6 When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. government, marking for shipment, in addition to requirements specified in the contract or order, shall be in accordance with MIL-STD-129 for U.S. military agencies and in accordance with Fed. Std. No. 123 for U.S. government civil agencies.

18. Keywords

18.1 concrete reinforcement; corrosion resistance; deformations; magnetic properties; reinforced concrete; reinforcing steels; stainless steel welded wire reinforcement; stainless wire; steel wire; welded wire reinforcement

SUPPLEMENTARY REQUIREMENTS

S1. Magnetic Permeability Testing

S1.1 Supplementary requirement (S1) shall apply only when specified by the purchaser. When material of controlled magnetic permeability is desired, the material shall be tested in accordance with Test Methods A342/A342M. The specific limits of magnetic permeability shall be established by agreement between the manufacturer and the purchaser.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A1022/A1022M – 16a) that may impact the use of this standard. (Approved Sept. 1, 2016.)

(1) Revised 1.3 and 4.2.2.
(2) Deleted 4.1.6 and 4.2.2 and renumbered subsequent sections accordingly.
(3) Moved 4.2.4, 4.2.5, 4.2.6, and 4.2.7 from 4.1 to 4.2.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1022/A1022M – 16) that may impact the use of this standard. (Approved May 1, 2016.)

(1) Revised 2.1 and 17.2.
(2) Revised the footnotes of Table 7 and Table 8.
(3) Revised 7.1.5 and 7.2.6.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1022/A1022M – 15a) that may impact the use of this standard. (Approved March 1, 2016.)

(1) Revised Section 14.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1022/A1022M – 15) that may impact the use of this standard. (Approved Dec. 1, 2015.)

(1) Revised 1.3.
(2) Revised Section 4.
(3) Revised S1.1.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1022/A1022M – 14a) that may impact the use of this standard. (Approved June 1, 2015.)

(1) Revised 1.2, 4.1.4, 8.1.1, and 16.3.
(2) Revised Table 5, Table 6, Table 9, and Table 10.
(3) Revised Sections 5, 6, and 7.
(4) Deleted the Supplementary Requirement for High Strength Wire.