



Designation: **A1022/A1022M—22 A1022/A1022M – 22a**

Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement¹

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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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 specification.

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

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.

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

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.

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

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), 38800 Country Club Dr., Farmington Hills, MI 48331-3439, <http://www.concrete.org>.

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

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-mm² increments.

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4.1.5 ASTM designation A1022 [A1022M] 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. standards.itih.ai/catalog/standards/sist/4a5e27d3-cb87-4219-bdcc-7719afa01b2b/astm-a1022-a1022m-22a

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**.

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. 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.

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:

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.

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 Yield strength 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 tensile 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](#).

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

Deformed Wire Size ^{A,B,C}	Nominal Dimensions				Deformation Requirements
	D [in ² X 100]	Unit Mass, kg/m	Diameter, mm ^D	Cross-Sectional Area, mm ^{2E}	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 mm² 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 mm³ 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.

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/dispersed 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.

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

Deformed Wire Size ^{A,B,C}	Nominal Dimensions			Deformation Requirements
	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.

7.2.4.3 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.

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.