Designation: A1064/A1064M – 16a

Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete[1]

This standard is issued under the fixed designation A1064/A1064M; 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 carbon-steel wire and welded wire reinforcement produced from hot-rolled rod to be used for the reinforcement of concrete. The steel wire is cold-worked, drawn or rolled, plain (non-deformed, as-drawn or galvanized), or deformed. Welded wire reinforcement is made from plain or deformed wire, or a combination of plain and deformed wire. Common wire sizes and dimensions are given in Table 1, Table 2, Table 3, and Table 4. Actual wire sizes are not restricted to those shown in the tables.

NOTE 1—Welded wire for concrete reinforcement has historically been described by various terms: welded wire fabric, WWF, fabric, and mesh. The wire reinforcement industry has adopted the term *welded wire reinforcement* (WWR) as being more representative of the applications of the products being manufactured. Therefore, the term *welded wire fabric* has been replaced with the term *welded wire reinforcement* in this specification and in related specifications.

1.2 The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text the SI units are shown in brackets (except in Table 2 and Table 4). The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values may result in nonconformance with the specification.

1.3 *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

A641/A641M Specification for Zinc–Coated (Galvanized) Carbon Steel Wire

E83 Practice for Verification and Classification of Extensometer Systems

2.2 *U.S. Military Standard:*[3]

MIL-STD-129 Marking for Shipment and Storage

2.3 *U.S. Military Standard:*[3]

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

2.4 *American Concrete Institute (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 *convoluted wire*—when wire for welded wire reinforcement is formed into a sinusoidal wave shape, it is commonly referred to as convoluted wire. The wire is used in the manufacture of cages for certain applications of concrete pipe reinforcement. Deformed wire is not subject to convolution unless agreed upon by the purchaser and manufacturer.

3.1.2 *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 steel wire as cold-drawn or cold-rolled from hot-rolled steel rod. Deformations can be indented or raised rib (protrusion) types. The deformations and the welded intersections provide bond strength for shear resistance.

3.1.3 *plain wire and welded plain wire reinforcement*—as used within the scope and intent of this specification, designates a material composed of cold-worked steel wire, as

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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.concrete.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**

TABLE 1 Dimensional Requirements for Plain Wire—Inch-Pound Units[A]

SizeNumber[B,C,D]	Nominal Diameter in. [mm][E]	Nominal Area in.^{2} [mm^2]
W 0.5	0.080 [2.03]	0.005 [3.23]
W 1.2	0.124 [3.14]	0.012 [7.74]
W 1.4	0.134 [3.39]	0.014 [9.03]
W 2	0.160 [4.05]	0.020 [12.9]
W 2.5	0.178 [4.53]	0.025 [16.1]
W 2.9	0.192 [4.88]	0.029 [18.7]
W 3.5	0.211 [5.36]	0.035 [22.6]
W 4	0.226 [5.73]	0.040 [25.8]
W 4.5	0.239 [6.08]	0.045 [29.0]
W 5	0.252 [6.41]	0.050 [32.3]
W 5.5	0.265 [6.72]	0.055 [35.5]
W 6	0.276 [7.02]	0.060 [38.7]
W 8	0.319 [8.11]	0.080 [51.6]
W 10	0.357 [9.06]	0.100 [64.5]
W 11	0.374 [9.50]	0.110 [71.0]
W 12	0.391 [9.93]	0.120 [77.4]
W 14	0.422 [10.7]	0.140 [90.3]
W 16	0.451 [11.5]	0.160 [103]
W 18	0.479 [12.2]	0.180 [116]
W 20	0.505 [12.8]	0.200 [129]
W 22	0.529 [13.4]	0.220 [142]
W 24	0.553 [14.0]	0.240 [155]
W 26	0.575 [14.6]	0.260 [168]
W 28	0.597 [15.2]	0.280 [181]
W 30	0.618 [15.7]	0.300 [194]
W 31	0.628 [16.0]	0.310 [200]
W 45	0.757 [19.2]	0.450 [290]

[A] Table 1 should be used on projects that are designed using inch-pound units; Table 2 should be used on projects that are designed using SI units.
[B] The number following the prefix indicates the nominal cross-sectional area of the wire in square inches multiplied by 100.
[C] For sizes other than those shown above, the Size Number shall be the number of one hundredth of a square inch in the nominal area of the wire cross section, prefixed by the W.
[D] These sizes represent the most readily available sizes in the welded wire reinforcement industry. Other wire sizes are available and many manufactures can produce them in 0.0015 in.^{2} increments.
[E] The nominal diameter is based on the nominal area of the wire.

TABLE 2 Dimensional Requirements for Plain Wire—SI Units[A]

Size Number[B, C, D]	Nominal Diameter mm [in.][E]	Nominal Area mm^2 [in.^{2}]
MW 5	2.52 [0.099]	5 [0.008]
MW 10	3.57 [0.140]	10 [0.016]
MW 15	4.37 [0.172]	15 [0.023]
MW 20	5.05 [0.199]	20 [0.031]
MW 25	5.64 [0.222]	25 [0.039]
MW 30	6.18 [0.243]	30 [0.047]
MW 35	6.68 [0.263]	35 [0.054]
MW 40	7.14 [0.281]	40 [0.062]
MW 45	7.57 [0.298]	45 [0.070]
MW 50	7.98 [0.314]	50 [0.078]
MW 55	8.37 [0.329]	55 [0.085]
MW 60	8.74 [0.344]	60 [0.093]
MW 65	9.10 [0.358]	65 [0.101]
MW 70	9.44 [0.372]	70 [0.109]
MW 80	10.1 [0.397]	80 [0.124]
MW 90	10.7 [0.421]	90 [0.140]
MW 100	11.3 [0.444]	100 [0.155]
MW 120	12.4 [0.487]	120 [0.186]
MW 130	12.9 [0.507]	130 [0.202]
MW 200	16.0 [0.628]	200 [0.310]
MW 290	19.2 [0.757]	290 [0.450]

[A] The wire sizes in Table 1 should be used on projects that are designed using inch-pound units; the wire sizes in Table 2 should be used on projects that are designed using SI units.
[B] The number following the prefix indicates the nominal cross-sectional area of the wire in square milimetres.
[C] For sizes other than those shown above, the Size Number shall be the number of square millimetres in the nominal area of the wire cross section, prefixed by the MW.
[D] These sizes represent the most readily available sizes in the welded wire reinforcement industry. Other wire sizes are available and many manufactures can produce them in 1 mm^2 increments.
[E] The nominal diameter is based on the nominal area of the wire.

TABLE 3 Dimensional Requirements for Deformed Wire—Inch-Pound Units

Nominal Dimensions				Deformation Requirements
Deformed Wire Size[A, B, C, D]	Unit Weight, lb/ft	Diameter, in.[E]	Cross-Sectional Area, in.^{2} [F]	Minimum Average Height of Deformations, in.[G, H]
D 1	0.034	0.113	0.010	0.0045
D 2	0.068	0.160	0.020	0.0063
D 3	0.102	0.195	0.030	0.0078
D 4	0.136	0.226	0.040	0.0101
D 5	0.170	0.252	0.050	0.0113
D 6	0.204	0.276	0.060	0.0124
D 7	0.238	0.299	0.070	0.0134
D 8	0.272	0.319	0.080	0.0143
D 9	0.306	0.339	0.090	0.0152
D 10	0.340	0.357	0.100	0.0160
D 11	0.374	0.374	0.110	0.0187
D 12	0.408	0.391	0.120	0.0195
D 13	0.442	0.407	0.130	0.0203
D 14	0.476	0.422	0.140	0.0211
D 15	0.510	0.437	0.150	0.0218
D 16	0.544	0.451	0.160	0.0225
D 17	0.578	0.465	0.170	0.0232
D 18	0.612	0.479	0.180	0.0239
D 19	0.646	0.492	0.190	0.0245
D 20	0.680	0.505	0.200	0.0252
D 21	0.714	0.517	0.210	0.0259
D 22	0.748	0.529	0.220	0.0265
D 23	0.782	0.541	0.230	0.0271
D 24	0.816	0.553	0.240	0.0277
D 25	0.850	0.564	0.250	0.0282
D 26	0.884	0.575	0.260	0.0288
D 27	0.918	0.586	0.270	0.0293
D 28	0.952	0.597	0.280	0.0299
D 29	0.986	0.608	0.290	0.0304
D 30	1.02	0.618	0.300	0.0309
D 31	1.05	0.628	0.310	0.0314
D 45	1.53	0.757	0.450	0.0379

[A] The wire sizes in Table 3 should be used on projects that are designed using inch-pound units; the wire sizes in Table 4 should be used on projects that are designed using SI units.
[B] The number following the prefix indicates the nominal cross-sectional area of the deformed wire in square inches multiplied by 100.
[C] 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.
[D] 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.
[E] The nominal diameter of a deformed wire is equivalent to the nominal diameter of a plain wire having the same weight per foot as the deformed wire.
[F] The cross-sectional area is based on the weight of the wire. 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 lineal foot of specimen in pounds by 3.4 (weight of steel 1 in. square and 1 foot long).
[G] Measurements shall be made as described in 7.2.4.7.
[H] See 7.2.4.3 for average number of deformations per unit length.

cold-drawn or cold-rolled from hot-rolled steel rod. The welded intersections provide the bond strength for shear resistance.

4. Ordering Information

4.1 Orders for 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 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,

4.1.5 Packaging (see Section 15), and

4.1.6 ASTM designation and year of issue.

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

4.2.1 Exclusion of over-steeling (see 10.4.2 and 10.5.1),

4.2.2 Report on tests performed on the steel wire or welded wire reinforcement being furnished (see 14.1), and

4.2.3 Special requirements (if desired).

5. Materials

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

5.2 Unless otherwise specified, the wire shall be supplied uncoated. When plain wire is specified as galvanized, it shall be galvanized at finish size as described in Specification A641/A641M.

5.3 Wire used in the manufacture of welded wire reinforcement shall conform to this specification either solely or in combination of plain or deformed wire, or both.

6. Manufacture

6.1 The wire shall be cold-worked, drawn or rolled, from rods that have been hot-rolled from billets.

TABLE 4 Dimensional Requirements for Deformed Wire—SI Units

Nominal Dimensions					Deformation Requirements
Deformed Wire Size[A, B, C, D]	D [in.^{2} × 100]	Unit Mass, kg/m	Diameter, mm[E]	Cross-Sectional Area, mm^2 [F]	Minimum Average Height of Deformations, mm[G, H]
MD 25	[D 3.9]	0.196	5.64	25	0.252
MD 30	[D 4.7]	0.235	6.18	30	0.279
MD 35	[D 5.4]	0.275	6.68	35	0.302
MD 40	[D 6.2]	0.314	7.14	40	0.320
MD 45	[D 7.0]	0.353	7.57	45	0.342
MD 50	[D 7.8]	0.392	7.98	50	0.360
MD 55	[D 8.5]	0.432	8.37	55	0.378
MD 60	[D 9.3]	0.471	8.74	60	0.392
MD 65	[D 10.1]	0.510	9.10	65	0.455
MD 70	[D 10.9]	0.549	9.44	70	0.470
MD 80	[D 12.4]	0.628	10.1	80	0.505
MD 90	[D 14.0]	0.706	10.7	90	0.535
MD 100	[D 15.5]	0.785	11.3	100	0.565
MD 120	[D 18.6]	0.942	12.4	120	0.620
MD 130	[D 20.2]	1.02	12.9	130	0.645
MD 200	[D 31.0]	1.57	16.0	200	0.800
MD 290	[D 45.0]	2.28	19.2	290	0.961

[A] The wire sizes in Table 3 should be used on projects that are designed using inch-pound units; the wire sizes in Table 4 should be used on projects that are designed using SI units.
[B] The number following the prefix indicates the nominal cross-sectional area of the deformed wire in square millimetres.
[C] 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 MD.
[D] 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.
[E] The nominal diameter of a deformed wire is equivalent to the nominal diameter of a plain wire having the same weight per metre as the deformed wire.
[F] The cross-sectional area is based on the mass of the wire. 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).
[G] Measurements shall be made as described in 7.2.4.7.
[H] See 7.2.4.3 for average number of deformations per unit length.

6.2 For welded wire reinforcement, the wires shall be assembled by automatic machines or by other suitable mechanical means which will assure accurate spacing and alignment of all wires of the finished product. 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 yield strength and quality when manufactured in the manner herein required shall result in a strong, serviceable mat-type product having substantially square or rectangular openings, and shall conform to this specification.

NOTE 2—A variation of manufacturing includes the application of one or more longitudinal convoluted wires at one edge of welded wire reinforcement for concrete pipe reinforcing cages. This shape allows the cage ends to be expanded to a larger diameter to accommodate the bell-shaped ends of concrete pipe.

7. Mechanical Property Requirements—Wire, Plain and Deformed

7.1 *General Requirements for Plain Wire:*

7.1.1 The relation between size number, diameter, and area shown in Table 1 or Table 2 shall apply, whichever is applicable.

7.1.2 Specimens for mechanical properties testing shall be full wire sections and shall be obtained from ends of wire coils as drawn or rolled. The specimens shall be of sufficient length to perform testing described in Test Methods and Definitions 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 or Table 6, whichever is applicable, based on the nominal area of the wire.

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 Wire Reinforcement

	Size W1.2 [MW 7.7] 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 W1.2 [MW 7.7]
	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 Permissible Variation in Plain Wire Diameter

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 [6.40]	0.003 [0.08]	0.003 [0.08]
W 5 [MW 32] to W 12 [MW 77], incl	0.252 [6.40] to 0.391 [9.93] incl	0.004 [0.10]	0.004 [0.10]
Over W 12 [MW 77] to W 20 [MW 129], incl	over 0.391 [9.93] to 0.505 [12.83], incl	0.006 [0.15]	0.006 [0.15]
Over W 20 [MW 129]	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 8 Bend Test Requirements—Plain Wire

Size Number of Wire	Pin Diameter for Bend Tests[A]
W 7 [MW 45] and smaller	1d[B]
Larger than W 7 MW 45]	2d

[A] Bend specimen 180° unless noted otherwise.
[B] d = nominal wire diameter.

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 Reinforcement

	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]

7.1.4.2 When required by the purchaser, yield strength shall be determined as described using a Class B-l extensometer as described in Practice E83. The yield strength shall be determined as described in Test Methods and Definitions A370 at an extension under load of 0.5 % of gage length or by the offset method (0.2 %). It shall be permissible to remove the extensometer after the yield strength has been determined. The wire shall meet the requirements of Table 5 or Table 6, whichever is applicable.

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.

7.1.5 *Bend Test*—The bend test specimen shall withstand being bent at room temperature through 180° without cracking on the outside of the bent portion, as prescribed in Table 8.

7.1.6 *Reduction of Area Test*—The 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 Table 5 or Table 6, whichever is applicable.

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 7.

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 7 for the given wire size.

NOTE 3—Cold-worked wire generally does not 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.

7.2 *General Requirements for Deformed Wire:*

7.2.1 The relation between size number, diameter, and area shown in Table 3 or Table 4 shall apply, whichever is applicable.

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 and Definitions 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 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.

7.2.4.3 The average longitudinal spacing of deformations shall be not less than 3.5 nor more than 5.5 deformations per inch [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 Table 3 or Table 4 shall be as follows:

Wire Sizes	Minimum Average Height of Deformations Percent of Nominal Wire Diameter
D 3 [MD 20] and smaller	4
Larger than D 3 [MD 20] 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 (10 in. [250 mm] min) 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.

TABLE 11 Bend Test Requirements—Deformed Wire

Size Number of Wire	Pin Diameter for Bend Tests[A]
D 6 [MD 39] and smaller	2d[B]
Larger than D 6 [MD 39]	4d

[A] Bend specimen 90° unless noted otherwise.
[B] d = nominal wire diameter.

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 the 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-l extensometer as described in Practice E83. It shall be permissible to remove the extensometer after the yield strength has been determined. The wire shall meet the requirements of Table 9 or Table 10, whichever is applicable.

7.2.5.3 For material 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.

7.2.6 *Bend Test*—The bend test specimen shall be bent at room temperature through 90° without cracking on the outside of the bent portion, 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 theoretical weight [mass] shown in Table 3 or Table 4, 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 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.

7.4 *Quality, Finish, and Appearance:*

7.4.1 The wire shall be free of detrimental imperfections and shall meet the requirements of this specification.

7.4.2 Rust, surface seams, or surface irregularities shall not be a cause for rejection provided the requirements of 7.4.3 are met, and the minimum dimensions and mechanical properties of a hand wire-brushed test specimen meet the requirements of this specification.

7.4.3 Wire intended for welded wire reinforcement shall be sufficiently free of rust and drawing lubricant so as not to interfere with electric resistance welding.

8. Mechanical Property Requirements—Welded Wire Reinforcement

8.1 *Tension Test:*

8.1.1 Wire for the production of welded wire reinforcement, plain and deformed, is described in Section 7. Tensile tests shall 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 intersection located approximately at the center of the wire being tested and the transverse wire forming the welded intersection shall extend approximately 1 in. [25 mm] beyond each side of the intersection.

8.1.2 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-l extensometer as described in Practice E83. It shall be permissible to remove the extensometer from the specimen after yield strength has been determined.

8.2 *Bend Test*—The wire shall withstand the bend test as described in 7.1.5 or 7.2.6, whichever is applicable, and shall be performed on a specimen taken from between the welds.

8.3 *Weld Shear Strength:*

8.3.1 The weld shear strength between longitudinal and transverse wires shall be tested as described in Section 9. 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 [in Newtons shall not be less than 241 multiplied by the nominal area of the larger wire in square millimetres], where the smaller wire has an area of 40 % or more of the area of the larger wire. For deformed welded wire reinforcement, the smaller wire shall not be less than D 4 [MD 26].

8.3.2 Deformed welded wire reinforcement having a relationship of larger and smaller wires other than that covered in 8.3.1 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 D 4 [MD 26]. Plain welded wire reinforcement having a relationship of larger and smaller wires other than those covered in 8.3.1 shall not be subject to the weld shear requirement.

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

8.3.4 Four welds selected at random from the specimen described in 11.2 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. The longitudinal wire shall be of such length above the transverse wire that its end shall be above the center line of the upper bearing of the weld tester.

8.3.5 The material shall be deemed to conform to the requirements for weld shear strength if the average of the test results of the four specimens 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 reinforcement shall be deemed acceptable if the average of all weld shear test values across the specimen meets the prescribed minimum value.

8.4 *Number of Tests:*

8.4.1 One test for conformance to tensile strength and bend requirements shall be made for each 75 000 ft^2 [7 000 m^2] of welded wire reinforcement or remaining fraction thereof. For testing prior to fabrication, one test for each 20 tons [18 metric tonnes] of wire shall be made.

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

9. Weld Shear Test Apparatus and Methods

9.1 As the welds in welded wire reinforcement contribute to the bond and anchorage value of the wires in concrete, the weld acceptance tests shall be made in a weld tester that stresses the weld in a manner similar to which it is stressed in concrete. In order to accomplish this, the vertical wire in the weld tester shall be stressed in an axis close to its center line. Also the horizontal wire shall 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 is manufactured with different wire sizes, the larger diameter wire shall be the "vertical wire" when tested (see Fig. 1).

9.2 The weld tester shown in Fig. 1 shall be hung in a ball and socket, or similar self aligning arrangement, at the center of the machine and used with an anvil sized such that it fully supports the horizontal wire and allows the vertical wire of the test specimen to move freely in the vertical direction. 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 fits 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 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 [689 MPa/min].

10. Dimensions and Permissible Variations for Welded Wire Reinforcement

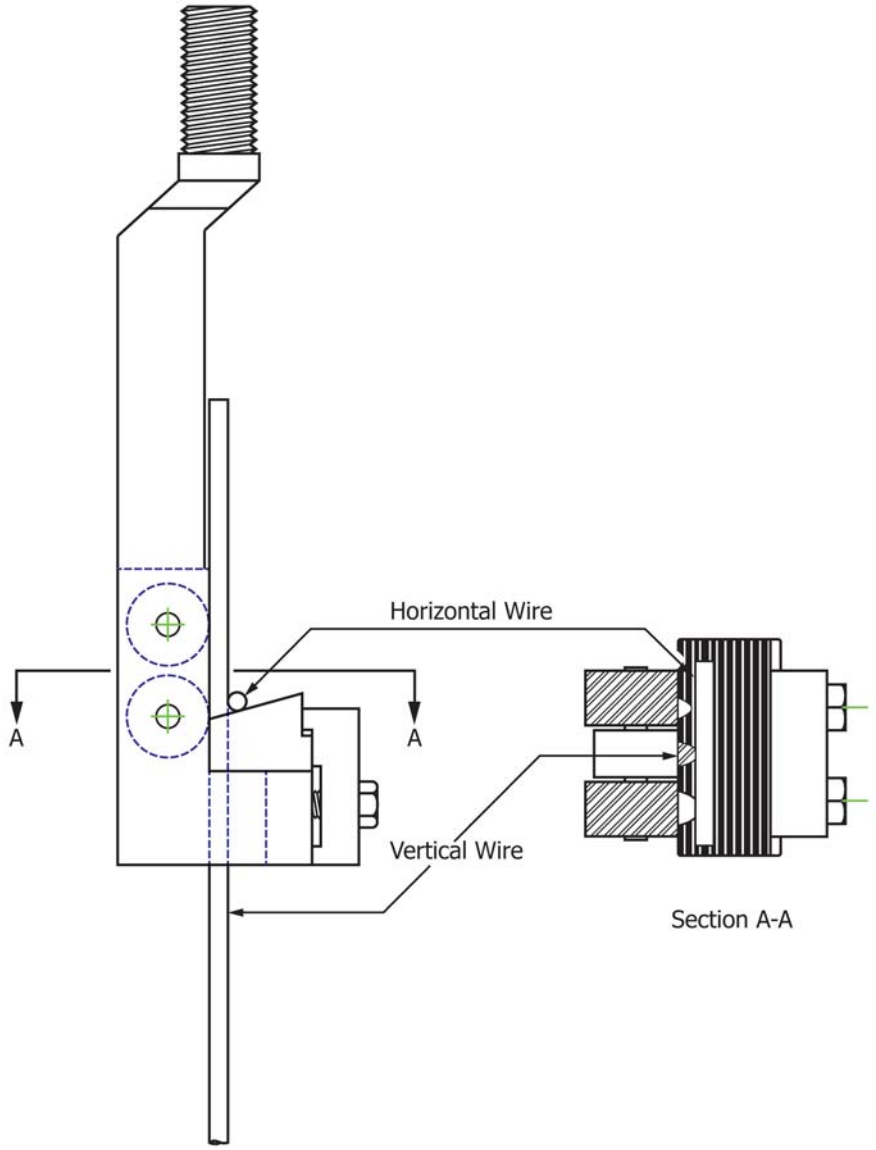
10.1 *Width*—The width of welded wire reinforcement shall be considered to be the center-to-center distance between outside longitudinal wires. The permissible variation shall not exceed 0.5 in. [13 mm] greater or less than the specified width. In case the width of flat sheets or rolls is specified as 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 0.5 in. [13 mm] greater or less than the specified length.

10.4 For plain welded wire reinforcement, the permissible variation in wire diameter of any wire in the finished product shall conform to the tolerances prescribed for the wire before welding, with the following exceptions:

10.4.1 Because of the mechanical characteristics of manufacturing welded wire reinforcement, the out-of-round requirements shall not apply.



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

10.4.2 Unless otherwise precluded by the purchaser in 4.2, the manufacturer shall be permitted to use over-sized plain wire. The size differential shall not exceed two "W" [ten "MW"] size increments on sizes W 8 [MW 52] and smaller, and four "W" [twenty "MW"] size increments on sizes larger than W 8 [MW 52]. A "W" ["MW"] size increment is a whole number increment, for example, W 5 to W 6 [MW 25 to MW 26], or W 5.4 to W 6.4 [MW 30 to MW 31]. In all cases where such over-steeling is practiced, the manufacturer shall identify the welded wire reinforcement with the style originally ordered. With the permission of the purchaser, the manufacturer shall be permitted to exceed the limits of this section.

10.5 For deformed welded wire reinforcement, the permissible variation in wire weight of any wire in the finished product shall conform to the tolerances prescribed for the wire before welding, with the following exceptions:

10.5.1 Unless otherwise precluded by the purchaser in 4.2, the manufacturer shall be permitted to apply over-sized deformed wire. The size differential shall not exceed two "D" [ten "MD"] size increments on sizes D 8 [MD 52] and smaller, and four "D" [twenty "MD"] size increments on sizes larger than D 8 [MD 52]. A "D" ["MD"] size increment is a whole number increment, for example, D 5 to D 6 [MD 25 to MD 26], or D 5.4 to D 6.4 [MD 30 to MD 31]. In all cases where such over-steeling is practiced, the manufacturer shall identify the welded wire reinforcement with the style originally ordered. With the permission of the purchaser, the manufacturer shall be permitted to exceed the limits of this section.

10.6 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 0.25 in. [6.3 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. Sampling

11.1 Test specimens for testing mechanical properties shall be obtained by cutting from the finished welded wire reinforcement, a full width section of sufficient length to perform testing described in 7.1, 7.2, and Section 8.

11.2 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 8.3.4.

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

11.4 Any test specimen exhibiting obvious imperfections shall be discarded and another specimen substituted.

12. Inspection

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

12.2 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 operation of the manufacturer's facilities.

12.3 The purchaser shall have the option to require a yield strength measurement to determine compliance with yield strength requirements of this specification, and shall specify the method by which the yield strength is to be determined and that the measurement be performed by the manufacturer at the manufacturer's facilities, a recognized laboratory, or the purchaser's representative at the manufacturer's facilities. Such measurements shall be conducted without unnecessarily interfering with the manufacturing operations.

13. Rejection and Retest

13.1 Unless otherwise specified, any rejection shall be reported to the manufacturer within five working days from the time of selection of test specimens.

13.2 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 with respect to any prescribed tensile property, provided the average of the test results 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 with respect to bend test requirements, provided both additional specimens pass the prescribed bend test.

13.3 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 intersections in a sheet. For material furnished in rolls, not more than 1 % of the total number of intersections in 150 ft^2 [14 m^2] of welded wire reinforcement shall be broken. Not more than one-half the permissible maximum number of broken welds shall be located on any one wire.

13.4 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.

13.5 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.

13.6 Rust, surface seams, or surface irregularities shall not be cause for rejection provided the minimum welded wire reinforcement dimensions, cross-sectional area, tensile properties, and weld shear strength of a hand wire-brushed test specimen meet the requirements of this specification. The height of deformations above the minimum height requirements shall not be cause for rejection.

13.7 *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 be permitted to make claim for a rehearing and retesting.

14. Certification

14.1 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 specification number, year-date of issue, and revision letter, if any.

14.2 This conformance is predicated upon testing and acceptance of wire prior to fabrication, coupled with random shear testing during production. The purchaser shall be furnished a manufacturer's certification of conformance to this specification for each production date or production lot shipped. A production lot shall not exceed 300 000 ft^2 [28 000 m^2].

14.3 Test results for yield strength, tensile strength, and bend tests shall be reported for plain wire above Grade 70 [485], plain welded wire reinforcement above Grade 65 [450], deformed wire above Grade 75 [515], and deformed welded wire reinforcement above Grade 70 [485].

14.4 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted

document shall meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the manufacturer. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 4—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

15. Packaging and Marking

15.1 For plain and deformed wire, the size of the wire, Specification A1064/A1064M, and name or mark of the manufacturer shall be marked on a tag securely attached to each coil of wire.

15.2 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.

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

15.4 Each bundle of flat sheets, bundle of rolls, and each roll weighing over 400 lb [180 kg] shall have attached thereto a minimum of one suitable tag bearing the name of the manufacturer, description of the material, ASTM designation A1064/A1064M, and such other information as may be specified by the purchaser.

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

15.6 When specified in the contract or order, and for the 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.

16. Keywords

16.1 concrete reinforcement; deformations; deformed wire; reinforced concrete; reinforcing steels; steel wire; welded wire reinforcement

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A1064/A1064M – 16) that may impact the use of this standard. (Approved May 1, 2016.)

(1) Revised 2.1 and 15.5.
(2) Revised the footnotes of Table 3 and Table 4.
(3) Added Note 3 and removed 7.1.4.4 and 7.2.5.4.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1064/A1064M – 15a) that may impact the use of this standard. (Approved March 1, 2016.)

(1) Revised 12.1 and deleted 12.4.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1064/A1064M – 15) that may impact the use of this standard. (Approved Nov. 1, 2015.)

(1) Revised Section 4.
(2) Revised Table 7 to include a table footnote.
(3) Revised 14.4.

Committee A01 has identified the location of selected changes to this standard since the last issue (A1064/A1064M – 14) that may impact the use of this standard. (Approved March 1, 2015.)

(1) Revised 7.1.4.4 and 7.2.5.4.
(2) Revised 4.1.4, 4.2.3, 5.3, Table 5, Table 6, Table 9, and Table 10 to incorporate the information formerly set within the Supplementary Requirements section.
(3) Removed the Supplementary Requirements section.