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# **Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement**

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**AASHTO Designation: M 336M/M 336-24<sup>1</sup>**

Technically Revised: 2024

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**Technical Subcommittee: 4f, Metals**

**ASTM Designation: A1064/A1064M-22**



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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 are given in Tables 9, 10, 11, and 12; actual wire sizes are not restricted to those shown in the tables.  
**Note 1**—Welded wire for concrete reinforcement has been described by various terms: welded wire fabric (WWF), fabric, and mesh. The wire reinforcement industry prefers the term “welded wire reinforcement” (WWR) as being more representative of the range of 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. This specification is applicable for orders in either SI units (MP 30M) or in inch-pound units (MP 30). The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text the inch-pound units are shown in brackets (except in Table 9 and Table 11). SI units and inch-pound units are not necessarily equivalent; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standard:*
  - T 244, Mechanical Testing of Steel Products
- 2.2. *ASTM Standard:*
  - A 641/A 641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
- 2.3. *Military Standard:*
  - MIL-STD-129, Marking for Shipment and Storage
- 2.4. *Federal Standard:*
  - Fed. Std. No. 123, Marking for Shipments (Civil Agencies)

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### 3. TERMINOLOGY

#### 3.1. *Description of Terms Specific to This Standard:*

- 3.1.1. *convoluted wire*—when wire for welded wire reinforcement is shaped 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 reinforcing. Only plain wire is normally subject to convolution.
- 3.1.2. *deformed steel wire for reinforcement*—as used within the scope and intent of this specification, shall mean any cold-worked or rolled, deformed steel wire intended for use as reinforcement in concrete construction, the wire surface having deformations that (1) inhibit longitudinal movement of the wire in such construction and (2) conform to the provisions of Section 5. It shall be permissible for the deformations to be raised or indented.
- 3.1.3. *plain steel wire for reinforcement*—as used within the scope and intent of this specification, shall mean any cold-drawn or rolled, steel wire intended for use as reinforcement in concrete construction, the wire being smooth without deformations.
- 3.1.4. *size number*—as used in this specification, refers to the numerical designation of the wire as tabulated in Tables 9, 10, 11, and 12.
- 3.1.5. *welded wire reinforcement*—as used within the scope and intent of this specification, welded wire reinforcement designates a material composed of cold-worked steel wire, fabricated into sheets or rolls by the process of electric-resistance welding. The finished material shall consist essentially of a series of longitudinal and transverse wires arranged substantially at right angles to each other and welded together at points of intersection.

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### 4. ORDERING INFORMATION

- 4.1. It shall be the responsibility of the purchaser to specify all requirements that are necessary for the manufacture and delivery of the wire under this specification. Such requirements to be considered include, but are not limited to, the following:
  - 4.1.1. Quantity (mass) [weight] 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 reinforcement);
  - 4.1.3. Wire size number (see Tables 9, 10, 11, and 12). When wire is ordered in sizes other than the common sizes shown, the nominal dimensions shall be developed from the applicable unit mass per meter of the section;
  - 4.1.4. Wire spacing, and sheet or roll width and length for welded wire reinforcement;
  - 4.1.5. Minimum yield strength or grade;
  - 4.1.6. Yield strength measurement (see Sections 6.1.1, 6.2.1, and 11.3);
  - 4.1.7. Exclusion of oversteeling, if required (see Section 6.4.5.4.2);
  - 4.1.8. Packaging (see Section 14);
  - 4.1.9. Request for outside inspection (if not requested, Section 13.1 applies);

- 4.1.10. AASHTO designation and year of issue; and
- 4.1.11. Special requirements, if any.

5. MATERIALS AND MANUFACTURE

- 5.1. The steel shall be made by commercially accepted processes (typically electric arc furnace or basic oxygen).
- 5.2. The wire shall be cold drawn or rolled from rods that have been hot rolled from billets.
- 5.3. Unless otherwise specified, the wire shall be supplied uncoated. When specified as galvanized, it shall be galvanized at finish size as described in ASTM A641/A641M.
- 5.4. The wire used in the manufacture of welded wire reinforcement shall conform to this specification either solely plain or solely deformed, or a combination of both.
- 5.5. For welded wire reinforcement, the wires shall be assembled by automatic machines or by other suitable mechanical means that will assure accurate spacing and alignment of all wires of the finished welded wire reinforcement. 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.
- 5.6. Welded wire reinforcement shall be furnished either in flat sheets or in rolls, as specified by the purchaser.
- 5.7. Wire of proper grade and quality when fabricated in the manner herein required in this specification shall result in a strong, serviceable, mat-type product having substantially square or rectangular openings. It shall be fabricated and finished in a workmanlike manner, shall be free of injurious defects, 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.

6. MECHANICAL PROPERTY REQUIREMENTS

- 6.1. General Requirements for Plain Wire:
  - 6.1.1. Tension Tests:
    - 6.1.1.1. When tested as described in T 244, the material, except as specified in Section 6.1.1.3, shall conform to the tensile property requirements in Table 1, based on nominal area of wire.

Table 1—Plain Wire Tension Test Requirements

|                                 | Grade 485 [70]  | Grade 500 [72.5] | Grade 515 [75]  | Grade 533 [77.5] | Grade 550 [80]  |
|---------------------------------|-----------------|------------------|-----------------|------------------|-----------------|
| Tensile strength, min MPa [ksi] | 550 [80]        | 568 [82.5]       | 585 [85]        | 603 [87.5]       | 620 [90]        |
| Yield strength, min MPa [ksi]   | 485 [70]        | 500 [72.5]       | 515 [75]        | 533 [77.5]       | 550 [80]        |
| Reduction of area, min %        | 30 <sup>a</sup> | 30 <sup>a</sup>  | 30 <sup>a</sup> | 30 <sup>a</sup>  | 30 <sup>a</sup> |

<sup>a</sup> For material testing over 690 MPa [100 ksi] tensile strength, the reduction of area shall be a minimum of 25 percent.

- 6.1.1.2. For material to be used in the fabrication of welded wire reinforcement, the tensile and yield strength properties shall conform to the requirements given in Table 2, based on nominal area of the wire.

**Table 2**—Plain Wire Tension Test Requirements [Material for Welded Wire Reinforcement]

|                                 | Size MW 7.7 [W1.2] and Larger   |                   |                     |                   |                     |                   |
|---------------------------------|---------------------------------|-------------------|---------------------|-------------------|---------------------|-------------------|
|                                 | Grade 450<br>[65]               | Grade 485<br>[70] | Grade 500<br>[72.5] | Grade 515<br>[75] | Grade 533<br>[77.5] | Grade 550<br>[80] |
| Tensile strength, min MPa [ksi] | 515 [75]                        | 550 [80]          | 568 [82.5]          | 585 [85]          | 603 [87.5]          | 620 [90]          |
| Yield strength, min MPa [ksi]   | 450 [65]                        | 485 [70]          | 500 [72.5]          | 515 [75]          | 533 [77.5]          | 550 [80]          |
| Reduction of area, min %        | 30 <sup>a</sup>                 | 30 <sup>a</sup>   | 30 <sup>a</sup>     | 30 <sup>a</sup>   | 30 <sup>a</sup>     | 30 <sup>a</sup>   |
|                                 | Smaller than Size MW 7.7 [W1.2] |                   |                     |                   |                     |                   |
|                                 | Grade 385<br>[56]               |                   |                     |                   |                     |                   |
| Tensile strength, min MPa [ksi] | 485 [70]                        |                   |                     |                   |                     |                   |
| Yield strength, min MPa [ksi]   | 385 [56]                        |                   |                     |                   |                     |                   |
| Reduction of area, min %        | 30 <sup>a</sup>                 |                   |                     |                   |                     |                   |

<sup>a</sup> For material testing over 690 MPa [100 ksi] tensile strength, the reduction of area shall be a minimum of 25 percent.

- 6.1.1.3. Yield strength shall be determined and reported according to the certification criteria in Section 13.3 and T 244 at an extension under load of 0.5 percent of gauge length or by the offset method (0.2 percent). It shall be permissible to remove the extensometer after the yield strength has been determined. The wire shall meet the requirements of Table 1 or Table 2, whichever is applicable.
- 6.1.1.4. The material shall not be required to exhibit a definite yield point as evidenced by a distinct drop of the beam or halt in the 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.
- 6.1.2. *Bend Tests*—The bend-test specimen shall withstand being bent at room temperature through 180 degrees without cracking on the outside of the bent portion, as prescribed in Table 3.

**Table 3**—Plain Wire Bend-Test Requirements

| Size Number of Wire   | Pin Diameter for Bend Test                               |
|-----------------------|----------------------------------------------------------|
| MW45 [W7] and smaller | Equal to the nominal diameter of the wire specimen       |
| Larger than MW45 [W7] | Equal to twice the nominal diameter of the wire specimen |

- 6.1.3. *Reduction of Area Test*—The reduction of area shall be determined as described in T 244, and the wire shall conform to the reduction of area requirements in Table 1 or Table 2, whichever is applicable.
- 6.1.4. *Permissible Variation in Wire Diameter:*
- 6.1.4.1. The permissible variation in the diameter of the wire shall conform to the requirements in Table 4.
- 6.1.4.2. 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.

**Table 4**—Permissible Variation in Wire Diameter

| Size Number                                 | Nominal Diameter, mm [in.] <sup>a</sup>         | Permissible Difference<br>(Max-Min)/Out-of-Round, mm [in.] |
|---------------------------------------------|-------------------------------------------------|------------------------------------------------------------|
| Smaller than MW32 [W5]                      | smaller than 6.40 [0.252]                       | 0.08 [0.003]                                               |
| MW32 [W5] to MW77 [W12], incl               | 6.40 [0.252] to 9.93 [0.391], incl              | 0.10 [0.004]                                               |
| Larger than MW77 [W12] to MW129 [W20], incl | larger than 9.93 [0.391] to 12.83 [0.505], incl | 0.15 [0.006]                                               |
| Larger than MW129 [W20]                     | larger than 12.83 [0.505]                       | 0.20 [0.008]                                               |

<sup>a</sup> Ref. Tables 9, 10, 11 and 12 for nominal diameter values.

## 6.2. General Requirements for Deformed Wire:

### 6.2.1. Tension Tests:

- 6.2.1.1. When tested as described in T 244, the material, except as specified in Section 6.2.1.4, shall conform to the tensile property requirements in Table 5 based on the nominal area of wire.

**Table 5**—Deformed Wire Tension Test Requirements

|                                 | Grade 515 [75] | Grade 533 [77.5] | Grade 550 [80] |
|---------------------------------|----------------|------------------|----------------|
| Tensile strength, min MPa [ksi] | 585 [85]       | 603 [87.5]       | 620 [90]       |
| Yield strength, min MPa [ksi]   | 515 [75]       | 533 [77.5]       | 550 [80]       |

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

**Table 6**—Deformed Wire Tension Test Requirements [Material for Welded Wire Reinforcement]

|                                 | Grade 485<br>[70] | Grade 500<br>[72.5] | Grade 515<br>[75] | Grade 533<br>[77.5] | Grade 550<br>[80] |
|---------------------------------|-------------------|---------------------|-------------------|---------------------|-------------------|
| Tensile strength, min MPa [ksi] | 550 [80]          | 568 [82.5]          | 585 [85]          | 603 [87.5]          | 620 [90]          |
| Yield strength, min MPa [ksi]   | 485 [70]          | 500 [72.5]          | 515 [75]          | 533 [77.5]          | 550 [80]          |

- 6.2.1.3. Yield strength shall be determined and reported according to the certification criteria in Section 13.3 and T 244 at an extension under load of 0.5 percent of gauge length or by the offset method (0.2 percent). It shall be permissible to remove the extensometer after the yield strength has been determined. The wire shall meet requirements of Table 5 or 6, whichever is applicable.
- 6.2.1.4. The material shall not be required to exhibit a definite yield point as evidenced by a distinct drop of the beam or halt in the 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.
- 6.2.2. *Bend Test*—The bend-test specimen shall withstand being bent at room temperature through 90 degrees without cracking on the outside of the bent portion, as prescribed in Table 7.