



# Standard Specification for Fence Fittings<sup>1</sup>

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## 1. Scope

1.1 This specification covers the materials, coating requirements, and inspection of fence accessories for chain-link fence for the following:

- 1.1.1 Post and line caps,
- 1.1.2 Rail and brace ends,
- 1.1.3 Top rail sleeves,
- 1.1.4 Tie wires, clips, and fasteners,
- 1.1.5 Tension and brace bands,
- 1.1.6 Tension bars,
- 1.1.7 Truss rod assembly,
- 1.1.8 Barbed wire arms,
- 1.1.9 Color coating of fittings, and
- 1.1.10 Fitting size terminology.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

- A641/A641M Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
- A809 Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire
- A817 Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
- B26/B26M Specification for Aluminum-Alloy Sand Castings
- B85 Specification for Aluminum-Alloy Die Castings
- B108 Specification for Aluminum-Alloy Permanent Mold Castings
- B117 Practice for Operating Salt Spray (Fog) Apparatus

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F14 on Fences and is the direct responsibility of Subcommittee F14.40 on Chain Link Fence and Wire Accessories.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - B209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
  - B211 Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
  - B211M Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric)
  - B221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
  - B221M Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
  - B429/B429M Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
  - B800 Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Temperatures
  - F552 Terminology Relating to Chain Link Fencing
  - F567 Practice for Installation of Chain-Link Fence
  - F668 Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric
  - F934 Specification for Colors for Polymer-Coated Chain Link Fence Materials
- 2.2 *U.S. Government Standard*:
- MIL-R-60346-C Roving, Glass, Fibrous (For Prepreg Tape and Roving, Filament Winding, and Pultrusion Applications)<sup>3</sup>

## 3. Post and Line Caps

3.1 Post and line caps shall be fabricated from pressed steel or cast iron and hot-dip galvanized with a minimum of 1.2 oz/ft<sup>2</sup> (366 g/m<sup>2</sup>) of zinc coating of surface area, or from aluminum alloy 360.0 conforming to die cast Specification B85, or sand cast or permanent mold alloy 356.0 or 713.0 conforming to Specification B26/B26M or B108.

3.2 Post and line caps shall be designed to fit snugly over posts and exclude moisture from inside when tubular posts are used.

<sup>3</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

#### 4. Rail and Brace Ends

4.1 Rail and brace ends, when required, shall be fabricated from pressed steel or cast iron, and hot-dip galvanized with a minimum of 1.2 oz/ft<sup>2</sup> (366 g/m<sup>2</sup>) of zinc coating of surface area, or from aluminum alloy 360.0 (see Specification **B85**), or alloy 356.0 or 713.0 (see Specification **B26/B26M** or Specification **B108**).

4.2 Rail and brace ends, or other approved means of connection, shall be provided when top rail or brace are required.

#### 5. Top Rail Sleeves

5.1 Top rail sleeves shall be fabricated from pressed steel or round steel tubing and hot-dip galvanized with a minimum of 1.2 oz/ft<sup>2</sup> (366 g/m<sup>2</sup>) of zinc coating of surface area, or from aluminum alloy 6063-T6 (see Specification **B221**, **B221M** or Specification **B429/B429M**).

5.2 Rail sleeve material shall be a minimum of 0.051 in. (1.3 mm) in thickness if steel, or a minimum of 0.062 in. (1.8 mm) in thickness if aluminum alloy, and a minimum of 6 in. (152.4 mm) in length.

5.3 The rail sleeve must be fabricated to prevent movement along the rail.

#### 6. Tie Wires and Clips

6.1 Ties for attaching chain-link fabric to round tubular or rectangular roll-formed horizontal rails and intermediate posts shall be one of the following systems, as selected by the purchaser:

6.1.1 *Standard Straight, Preformed Hook or Pigtail Round Wire* having a preformed hook or pigtail at one end, shall be designed of sufficient length to comply with the installation practice within Practice **F567**. Galvanized steel or aluminum round wire ties shall be “soft/bendable” so that during the installation of the tie the tie wire coating or chain link fabric coating is not damaged by cutting through to the bare steel. Specify one of the following materials.

6.1.1.1 Twelve-gage (0.106 ± 0.004-in. (2.69 ± 0.10-mm)) steel with a tensile strength range from 55 to 65 ksi and with one of the following coatings, as selected by the purchaser:

(1) A minimum of 0.80 oz/ft<sup>2</sup> (230 g/m<sup>2</sup>) of zinc in accordance with Specification A641 (A641M), Class 3 or A coating.

(2) A minimum of 0.35 oz/ft<sup>2</sup> (107 g/m<sup>2</sup>) of aluminum in accordance with Specification **A809**.

6.1.1.2 Nine-gage (0.148 ± 0.005-in. (3.76 ± 0.10-mm)) steel with a tensile strength range from 55 to 65 ksi and with one of the following coatings, as selected by the purchaser:

(1) A minimum of 0.90 oz/ft<sup>2</sup> (270 g/m<sup>2</sup>) of zinc in accordance with Specification A641 (A641M), Class 3 or A coating.

(2) A minimum of 0.40 oz/ft<sup>2</sup> (122 g/m<sup>2</sup>) of aluminum in accordance with Specification **A809**.

NOTE 1—Heavier zinc coatings than those listed in 6.1.1.1 (1) and 6.1.1.2 (1) may be specified if desired, to match the minimum zinc coating specified for the fence fabric.

6.1.1.3 Nine-gage (0.148 ± 0.005-in. (3.76 ± 0.125-mm)) or (6-gage 0.192 ± 0.005-in. (4.88 ± 0.125-mm)) aluminum Alloy 1350-H19 or approved equal.

6.1.2 *High-Security Round Wire Ties* shall be one of the following, as selected by the purchaser:

6.1.2.1 *Power-Fastened Preformed Metallic Coated Steel Round Wire Ties*, preformed to the size of the rail or post and of a sufficient length to be installed according to Practice **F567**. Power-fastened round wire ties shall be 9-gage (0.148 ± 0.005-in. (3.76 ± 0.125-mm)) or, for added security, 6-gage (0.192 ± 0.005-in. (4.88 ± 0.125-mm)) steel with a tensile strength range from 65 to 75 ksi. Specify one of the following coatings:

(1) A minimum of 2.00 oz/ft<sup>2</sup> (600 g/m<sup>2</sup>) of zinc for 6-gage or 1.80 oz/ft<sup>2</sup> (540 g/m<sup>2</sup>) of zinc for 9-gage in accordance with Specification A641 (A641M), Class B coating.

(2) A minimum of 0.40 oz/ft<sup>2</sup> (122 g/m<sup>2</sup>) of aluminum for 6-gage or 9-gage in accordance with Specification **A809**.

6.1.2.2 *Straight, Manually Fastened Coated Steel Round Wire Ties*, of sufficient length to be installed according to Practice **F567**. Wire ties shall be 9-gage (0.148 ± 0.005-in. (3.76 ± 0.125-mm)) steel, “soft/blendable,” having a tensile strength range from 55 to 65 ksi. Specify one of the following coatings:

(1) A minimum of 1.2 oz/ft<sup>2</sup> (366 g/m<sup>2</sup>) of zinc in accordance with Specification **A817**, Type 2, Class 1.

(2) A minimum of 0.40 oz/ft<sup>2</sup> (122 g/m<sup>2</sup>) of aluminum in accordance with Specification **A809**.

6.1.3 *Interlocking Preformed Flat Aluminum Band Ties*, preformed to the radius of the rail or post and configured to wrap a full 360° around the rail or post and one picket of the chain-link fabric. The ends of the tie shall be preformed in such a manner that they will interlock and flatten down into a double closed loop against the rail or post. Interlocking flat wire ties shall be fabricated from 0.0625 by 0.375-in. (1.59 by 9.53-mm) flat aluminum Alloy 5052-H32 wire with a tolerance of ±0.005 in. (±1.25 mm).

6.1.4 *Powder-Driven Fasteners*, consisting of a knurled pin of carbon steel, heat treated to a hardness of RC 52–56 and a minimum tensile strength of 240 000 psi (1655 MPa). Finish shall be zinc electroplating of 0.0003-in. (0.0076-mm) minimum thickness, evaluated for corrosion resistance for 72 consecutive hours with no signs of rust or corrosion when tested in accordance with Practice **B117**. Cap shall be Type 304 stainless steel <sup>3</sup>/<sub>32</sub> in. (2.38 mm) thick. For 9-gage or 11-gage fabric other than <sup>3</sup>/<sub>8</sub>-in. (9.53-mm) mesh, the pin shall be 1 in. (25.4 mm) long. For <sup>3</sup>/<sub>8</sub>-in. mesh and 6-gage fabric, the pin shall be 1¼ in. (31.75 mm) long.

6.2 Round wire hog rings for attaching chain-link fabric to horizontal tension wire shall be either 12-gage (0.106 ± 0.005-in. (2.69 ± 0.125-mm)) steel wire with a minimum of 0.80 oz/ft<sup>2</sup> (230 g/m<sup>2</sup>) of zinc coating in accordance with Specification A641 (A641M), Class 3 or A coating, or 9-gage (0.148 ± 0.005-in. (3.76 ± 0.125-mm)) aluminum Alloy 1350-H19 wire.

6.3 Round metallic-coated steel tie wires, clips, and hog rings shall withstand all forming or twisting operations, or

both, without cracking or flaking of the coating to such an extent that any zinc or aluminum can be removed by rubbing with the bare fingers.

NOTE 2—Loosening or detachment during forming or twisting operations, or both, of superficial, small particles of coating metal formed by mechanical polishing of the surface of the coating wire shall not be considered cause for rejection.

6.4 Where specified, round metallic-coated tie wires, clips, and hog rings shall be polymer coated to match the color of the chain-link fabric, as selected from Specification **F934**. The coating process and metallic-coated core wire materials shall be in accordance with Specification **F668**. The diameter of the metallic-coated core wire shall be identical to that specified for the chain-link fabric, but shall not be smaller than 11 gage ( $0.120 \pm 0.005$  in. ( $3.05 \pm 0.125$  mm)) and not larger than 9 gage ( $0.148 \pm 0.005$  in. ( $3.76 \pm 0.125$  mm)). The tensile strength of the core wire constituting the tie wires, clips, and hog rings shall be suitable to accommodate a manual or power fastening process without causing damage to the metallic or polymer coatings.

NOTE 3—Although rust formation on the cut ends or other unprotected surface areas of steel tie wires is primarily an inherent characteristic of aluminum coated steel wire, rejections of material exhibiting this condition will not be warranted irrespective of the core wire material employed unless it causes significant and noticeable staining of the tie, the chain-link fabric, the post surface, or the rail surface.

## 7. Tension and Brace Bands

7.1 Tension and brace bands shall be fabricated from pressed steel and hot-dip galvanized with a minimum of  $1.2 \text{ oz/ft}^2$  ( $366 \text{ g/m}^2$ ) of zinc coating of surface area, or from aluminum alloy 6063-T5, 6063-T6, or 8176-H19 (see Specification **B211**, **B211M**, **B221**, **B221M**, or **B800**).

7.2 Tension bands shall be a minimum of 14 gage (0.074 in. (1.88 mm)) in thickness and a minimum of  $\frac{3}{4}$  in. (19.05 mm) in width.

7.3 Brace bands shall be a minimum of 12 gage (0.105 in. (2.66 mm)) in thickness and a minimum of  $\frac{3}{4}$  in. (19.05 mm) in width.

## 8. Tension Bars

8.1 Steel tension bars shall be fabricated from merchant quality steel and hot-dip galvanized with a minimum of  $1.2 \text{ oz/ft}^2$  ( $366 \text{ g/m}^2$ ) of zinc coating of surface area.

8.2 Fiberglass tension bars shall be manufactured from unidirectional E-glass fibers in accordance with MIL-R-60346-C and processed to produce the desired shape and mechanical properties. The outer surface shall consist of a minimum average 1.5 mil (0.0015 in. (0.038 mm)) thick weather resistant plastic coating.

8.3 Aluminum alloy tension bars shall be 6061-T6 or 6063-T6 alloy (see Specification **B211M** or **B221M**).

8.4 Steel or fiberglass tension bars used to connect  $1\frac{3}{4}$  in. (44.5 mm) and 2 in. (50 mm) mesh fabric to end, gate and corner posts shall be a minimum of  $\frac{3}{16}$  in. (4.8 mm) by  $\frac{5}{8}$  in. (15.9 mm) for fabric heights up to 5 ft (1.52 m) and a minimum of  $\frac{3}{16}$  in. (4.9 mm) by  $\frac{3}{4}$  in. (19.1 mm) for fabric heights over

5 ft (1.52 m). Steel, fiberglass, or aluminum alloy tension bars used to connect 1 in. (25.4 mm) mesh fabric to end, gate and corner posts shall be a minimum of  $\frac{1}{4}$  in. (6.4 mm) by  $\frac{3}{8}$  in. (9.5 mm).

8.5 Aluminum alloy tension bars used to connect  $1\frac{3}{4}$  in. (44.5 mm) and 2 in. (50 mm) mesh fabric to end, gate and corner posts shall be a minimum of  $\frac{1}{4}$  in. (6.4 mm) by  $\frac{3}{4}$  in. (19.1 mm).

8.6 Minimum lengths of tension bar shall be 2 in. (50 mm) less than the full height of the chain link fabric.

## 9. Truss Rod Assembly

9.1 Steel truss rods shall be fabricated from  $\frac{5}{16}$  in. (7.9 mm) merchant quality rod and it and all related devices shall be hot-dip galvanized after threading with a minimum of  $1.2 \text{ oz/ft}^2$  ( $366 \text{ g/m}^2$ ) of zinc coating of surface area.

9.2 Aluminum alloy truss rods shall be fabricated from  $\frac{3}{8}$  in. (9.5 mm) alloy 6061-T6 (see Specification **B211** or **B211M** or **B221** or **B221M**). Aluminum truss rod tighteners shall be alloy 356-T6 or 713-T5 (see Specifications **B26/B26M** or **B28**) or alloy 6061-T6 (see Specification **B211** or **B221**).

9.3 Truss rod and tightener shall be capable of withstanding a tension of 2000 lb (907 kg).

## 10. Barbed Wire Arms

10.1 Barbed wire arms shall be fabricated from pressed steel or cast iron, and hot-dip galvanized with a minimum of  $1.2 \text{ oz/ft}^2$  ( $366 \text{ g/m}^2$ ) of zinc coating of surface area, or from Aluminum alloy 360 (see Specification **B85**), or 356-T6 (see Specification **B26/B26M** and **B108**). Aluminum Barb Arm Blades shall be fabricated from aluminum alloy 3003-H14, 5052-H32 or 6061-T6 extruded bar or sheet having a minimum thickness of 0.080 in. (2 mm) (see Specifications **B209**, **B209M**, **B211**, **B211M**, **B221**, and **B221M**).

10.2 Barbed wire arms shall be of the following types as specified:

10.2.1 *Type I*—Single slanted arm, for three barbed wire strands;

10.2.2 *Type II*—Single vertical arm for three barbed wire strands;

10.2.3 *Type III*—V-shaped arm, for six barbed wire strands; or

10.2.4 *Type IV*—A-shaped arm, for five barbed wire strands.

10.3 Barbed wire arms shall be fitted with clips or slots for attaching the barbed wire to the arms.

10.4 In the installed position, Type I, III and IV barbed wire arms shall project at an angle of  $45^\circ$  ( $+5^\circ$ ) from the vertical plane of the fence line.

10.5 When the base of the barbed wire arm has been securely clamped in a testing device, the arm shall be capable of supporting a vertical 250 lb (113 kg) load placed where the outer strand of barbed wire would connect to the arm, without causing any permanent deflection of the arm.

## 11. Color Coating of Fittings

11.1 The color coating of fittings shall match the color coating of the fabric when so specified. Standard colors shall be green, olive green, brown, or black as described in Munsell Units specified by Specification **F934**.

11.2 The exterior surface of the fittings shall be polymer coated with a minimum 0.006-in. (0.152-mm), maximum 0.015-in. (0.381-mm) thickness when so specified. Color coating material and thickness may be at the option of the manufacturer, when so specified by the buyer. Ferrous fittings shall be hot-dip galvanized prior to application of color coating material.

11.3 The color coating material shall be without voids on all visually exposed surfaces when viewed in the as-installed attitude, without tears or cuts that reveal the substrate and adhere to the fitting without peeling when scratched with a pick device or knife blade point.

## 12. Terminology Fitting Size Terminology

12.1 Descriptive sizes of fittings for the various shapes of posts and rail commonly used for chain-link fence shall be as listed in **Table 1**.

## 13. Illustrations

13.1 See Terminology **F552** for illustrations of various types of fittings.

## 14. Keywords

14.1 fittings; fence; high security

**TABLE 1 Fitting Sizes**

Trade Size, in.	Nominal Size, in.	Actual Size, in.	Outside Diameter, mm
<i>Pipe and Tube Sections:</i>			
1 $\frac{3}{8}$	1	1.315	33.40
1 $\frac{5}{8}$	1 $\frac{1}{4}$	1.660	42.16
2	1 $\frac{1}{2}$	1.900	48.26
2 $\frac{1}{2}$	2	2.375	60.33
3	2 $\frac{1}{2}$	2.875	73.03
3 $\frac{1}{2}$	3	3.500	88.90
4	3 $\frac{1}{2}$	4.000	101.60
4 $\frac{1}{2}$	4	4.500	114.30
6 $\frac{5}{8}$	6	6.625	168.28
8 $\frac{5}{8}$	8	8.625	219.06
<i>Formed Steel Sections:</i>			
C-Rail	1.625	1.625 by 1.250	41.28 by 31.75
Standard C	1.900	1.875 by 1.625	47.63 by 41.28
Heavy C	2.250	2.250 by 1.700	57.15 by 43.18
Terminal	3.500	3.500 by 3.500	88.90 by 88.90
<i>H Section:</i>			
2 $\frac{1}{4}$	...	2.250 by 1.700	57.15 by 43.18
<i>Square Sections:</i>			
2	...	2.000 by 2.000	50.80 by 50.80
2 $\frac{1}{2}$	...	2.500 by 2.500	63.50 by 63.50
3	...	3.000 by 3.000	76.20 by 76.20

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