Designation: F 1043 – 03

Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework[1]

This standard is issued under the fixed designation F 1043; 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 the strength and protective coating requirements for industrial steel chain link fence framework. Maximum allowable heights of framework and post spacing are to be based on chain link fence fabric mesh size and gages, and specified wind loads. Post spacings are not to exceed 10 ft. (For additional information, see CLFMI Guide WLG2445).

1.1.1 *Caution Regarding Windload*—If additives to the fence, such as windscreen, inserts or signage, are required, it is advisable to use stronger framework and fittings, to reduce the on-center spacing of posts or to add back bracing. Factors to consider when determining windload include the type of screening material to be used, area of fence to be covered, and local wind conditions.

1.2 Posts and rails may have any cross-sectional shape meeting the requirements herein. The shapes may be formed and welded, cold formed, hot rolled, or extruded.

1.3 The values in inch-pound units are to be regarded as the standard. The values stated in SI units are for information purposes only.

NOTE 1—For aluminum-alloy extruded structural pipe and tube please refer to Specification B 429.

2. Referenced Documents

2.1 *ASTM Standards:*

A 90/A 90M Test Method for Weight [Mass] of Coating on Iron or Steel Articles with Zinc or Zinc Alloy Coatings[2]

A 123/A 123M Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron or Steel Products[2]

A 653/A 653M Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process[2]

A 875/A 875M Specification for Steel Sheet, Zinc-5 % Aluminum Alloy Metallic-Coated by the Hot-Dip Process[2]

A 1011 Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Allow with Improved Formability[3]

B 6 Specification for Zinc (Slab Zinc)[4]

B 308/B 308M Specification for Aluminum Alloy 6061 T6 Standard Structural Steel[5]

B 429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube[4]

B 750 Specification for Zinc-5 % Aluminum-Mischmetal; Alloy in Ingot Form for Hot-Dip Coatings[6]

D 1499 Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics[7]

D 3359 Test Methods for Measuring Adhesion by Tape Tests[8]

E 8 Test Methods for Tension Testing of Metallic Materials[9]

E 376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods[10]

F 552 Terminology Relating to Chain Link Fencing[2]

F 934 Specification for Standard Colors for Polymer Coated Chain Link Fence[2]

F 1083 Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized), Welded, for Fence Structures[2]

F 1553 Guide for Specifying Industrial and Commercial Chain Link Fence[2]

G 23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[11]

G 26 Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[12]

[1] 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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[2] *Annual Book of ASTM Standards*, Vol 01.06.

[3] *Annual Book of ASTM Standards*, Vol 01.03.

[4] *Annual Book of ASTM Standards*, Vol 02.03.

[5] *Annual Book of ASTM Standards*, Vol 02.02.

[6] *Annual Book of ASTM Standards*, Vol 02.04.

[7] *Annual Book of ASTM Standards*, Vol 08.01.

[8] *Annual Book of ASTM Standards*, Vol 06.01.

[9] *Annual Book of ASTM Standards*, Vol 03.01.

[10] *Annual Book of ASTM Standards*, Vol 03.03.

[11] Discontinued. See *1997 Annual Book of ASTM Standards*, Vol 14.02. Replaced by Practices G 152 and G 153.

[12] Discontinued. See *1997 Annual Book of ASTM Standards*, Vol 14.02. Replaced by Practice G 155.

2.2 *CLFMI Guide:*

WLG2445 Guide for the Selection of Line Post Spacings[13]

3. Terminology

3.1 *Definitions:*

3.1.1 *posts*—vertical members of the fence.

3.1.1.1 *Discussion*—End, corner, and pull posts are posts at which chain link fabric terminates. Gateposts are posts to which gates are either attached or latched. Line posts are posts that occur in a line of fence in which the chain link fabric passes and to which it is tied.

3.1.2 *rails*—horizontal members of the fence.

3.1.2.1 *Discussion*—May be top, bottom, intermediate or brace rails.

3.1.3 The dimensional terminology is shown in Fig. 1.

3.1.4 The relationship of measured dimension (used throughout) to trade and industry usage is shown in Table 1.

3.1.5 *open sections*—non-tubular framework sections (such as H-posts, C-posts, roll-formed top rail, and terminal posts).

3.1.6 *polymer coatings*—examples of some polymer coatings are acrylic urethane, polyurethane, polyvinyl chloride (PVC), polyester, and polyolefin elastomer.

3.1.7 See Terminology F 552 for definitions of other terms.

4. Ordering Information

4.1 Orders for steel fence framework purchased to this specification shall include the following information:

[13] Available from Chain Link Fence Manufacturers Institute, 10015 Old Columbia Road, Suite B-215, Columbia, MD 21046; or website http://www.chainlinkinfo.org/.

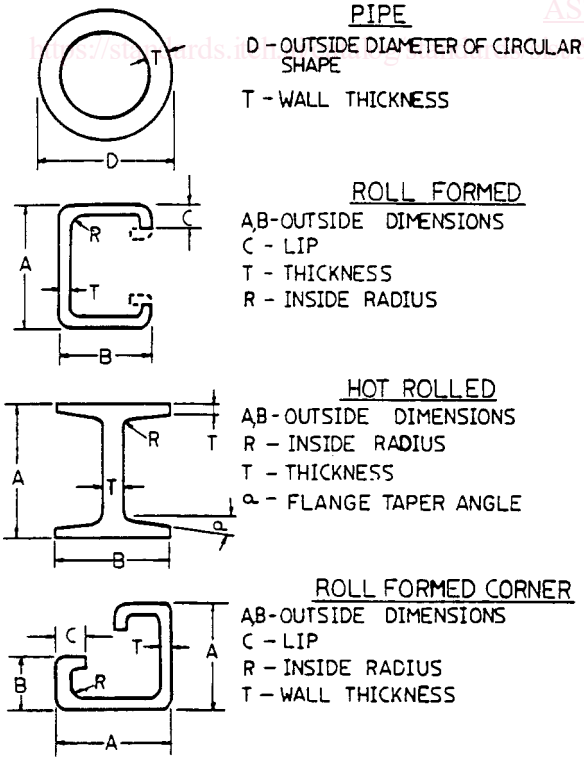

FIG. 1 Definitions of Dimensional Terms

TABLE 1 Size Terminology

Trade Size, in. [mm]	Designator, NPS [Metric]	Actual Outside Diameter	
		in.	mm
1⅜ [34.9]	1 [25]	1.315	33.4
1⅝ [41.3]	1¼ [32]	1.660	42.2
2 [50.8]	1½ [40]	1.900	48.3
2½ [63.5]	2 [50]	2.375	60.3
3 [76.2]	2½ [65]	2.875	73.0
3½ [88.9]	3 [80]	3.500	88.9
4 [101.6]	3½ [90]	4.000	101.6

4.1.1 Number of posts and rails by size and length,

4.1.2 Type of outside and inside coating (Section 7) and class of material,

4.1.3 Color, if applicable, in accordance with Specification F 934,

4.1.4 Material group (IA, IC, IC-L, II, II-L, III, III-L) (Table 2),

4.1.5 Certification, if required, and

4.1.6 Exception(s) to this specification, or special requirements, if any.

NOTE 2—These details may be covered in whole or in any part by accompanying the orders with design drawings and notations thereon.

TABLE 2 Definitions of Fence Framework Materials Design

Material	Description of Material
Group IA Round Steel Pipe	Steel pipe shall be produced to conform to Specification F 1083, standard weight (Schedule 40).
Group IB Aluminum Pipe	Aluminum pipe shall be produced of alloy Aluminum Pipe 6063 and shall conform to Specification B 429.
Group IC Round Steel Pipe (Electric Resistance Welded Pipe)	Steel pipe shall be produced in accordance with commercial standards. Minimum yield strength shall be 50 000 psi [344 MPa]. Such products shall include, without seeking to limit to, cold-formed and welded pipe. The minimum weight shall be not less than 90 % of the nominal weight.
Group IIA Roll-Formed Steel Shapes (C-Sections)	Roll formed steel shapes shall be produced to commercial standards. Minimum yield strength shall be 45 000 psi [310 MPa]. The minimum weight shall be not less than 90 % of the nominal weight. The formed lip shall be of the same thickness as the flat elements and shall project no less than ⅓ the width of the flat element being stiffened. Group II products shall be designated such that the strong axis is perpendicular to the line of fence.
Group IIB Aluminum Shapes	Aluminum shapes shall be produced of alloy 6061–T6 and shall conform to Specification B 308/B 308M.
Group III Hot-Rolled Shapes (H Beams)	Hot-rolled shapes shall meet the criteria and exhibit a minimum yield strength of 45 000 psi [310 MPa]. The minimum weight shall be not less than 90 % of the nominal weight.
Group IV Alternate Design	Any suitable design can be delivered, provided it meets the strength and stiffness criteria of Fig. 2 (Industrial) or Fig. 3 (Light Industrial/Commercial) and the producer has supplied, in a form acceptable to the purchaser, data that demonstrates conformance with the specification. At the producer's option the methods in either Section 6 or 6.4 may be used.

5. Strength Requirements

5.1 It is the intent of this specification to permit the continuance of historically proved practice in the installation of chain link fence systems, and to provide strength requirements for alternative shapes and materials. Two categories are described. Heavy industrial fence represents the most rigid and mechanically durable of the commonly installed framework. Light industrial/commercial fence, as provided herein, exhibits approximately 80 % of the load bearing capability of heavy industrial fence. The summary requirements and options for heavy industrial fence are given in Fig. 2 and those of light industrial/commercial fence in Fig. 3.

5.2 *Historical Practice*—Experience has shown that galvanized steel performs satisfactorily as fence posts and rails if furnished to the standard weight (Schedule 40) and nominal sizes listed in Specification F 1083. Therefore, fence posts and rails consisting of standard weight (Schedule 40) galvanized steel in the nominal sizes and weight per foot listed in Specification F 1083 shall be considered in compliance with this specification.

5.2.1 Experience has also shown that several additional products performed satisfactorily provided certain additional requirements are met. The nominal dimensions, minimum yield strength (Y), and nominal weight/ft are also listed in Figs. 2 and 3. These satisfactory designs are classified in accordance with products and special requirements as described in Table 2.

6. Strength Calculations

6.1 The strength of a structural member can generally be predicted from established engineering principles. The intent of this section is to provide criteria by which alternate designs can be judged to provide adequate strength without premature failure by local buckling. Accordingly, the criteria of 6.2 and 6.3 shall be satisfied even though, in general, only one will govern a particular design.

6.2 The elastic bending strength equals the yield strength times the section modulus of the entire cross section.

6.2.1 The yield strength may be considered to be either: *(1)* the minimum specified yield strength for material used to form a part, or *(2)* the value determined from tension tests performed in accordance with Test Method E 8. The specimen may be cut either from material before forming or from the part after fabrication.

6.3 Accepted engineering practice indicates that the full bending strength of a structure can be realized if the additional dimensional restrictions shown below are satisfied.

6.3.1 For circular shapes the ratio of the diameter to the thickness may not exceed 0.1 *E/Y*.

6.3.2 For cross-sectional shapes composed of flat elements, the ratio of width to thickness for elements supported along two parallel edges may not exceed 1.2 $(E/Y)^{1/2}$, and ratio of width to thickness for elements supported along one edge may not exceed 0.34 $(E/Y)^{1/2}$.

6.3.3 In these formulas, *Y* is the yield strength of the material and *E* is the modulus of elasticity of the material. A formed lip shall be considered to provide support only if the radius of gyration of the lip about the mid-thickness of the flat element from which it projects is not less than 1/5 the width of the flat element. For simple rectangular lips of the same thickness as the flat element, this requirement is satisfied when

Description	Pipe			Roll-Formed	Hot-Formed	Performance Criteria for Future Products IV	
	IA	IB	IC	II	III		
Material	Steel	Aluminum	Steel	Steel	Steel		
Reference Specification	F 1083	B 429	A 653, A924, A 569	A 570 Grade 45, Others			
Minimum Yield Strenth psi (Mpa)	30,000 (205)	25,000 (170)	50,000 (344)	45,000 (310)	45,000 (310)		
	Structural			A B C R	A B R a	Bending Strength Z x Y	Stuffness E x I
Top Rail	D = 1.660 in. (42 mm)	D = 1.660 in. (42 mm)	D = 1.660 in. (42 mm)	1 1/4 | 1 5/8 | 3/8 | 3/16		7100 lbf-in	3 x 10^6 lbf-in.^{2}
	t = 0.140 in (3.6 mm)	t = 0.140 in (3.6 mm)	t = 0.111 in (2.8 mm)	t = 0.080 in (2.0 mm)		(802 N-m)	(8.6 kPa-m^4)
	2.27 lb/ft (3.38 kg/m)	0.786 lb/ft (1.17 kg/m)	1.82 lb/ft (2.71 kg/m)	1.35 lb/ft (2.01 kg/m)		t_{min} = 0.075in. (1.9 mm)	
Line post	D = 2.375in. (60 mm)	D = 2.375in. (60 mm)	D = 2.375in. (60 mm)	2 1/4 | 1 5/8 | 3/4 | 1/4	2 1/4 | 1 49/64 | 1/4 | 10	19600 lbf-in	16 x 10^6 lbf-in.^{2}
	t = 0.154 in (3.9 mm)	t = 0.154 in (3.9 mm)	t = 0.130 in (3.3 mm)	t = 0.121 in (3.1 mm)	t=0.125 in (3.2 mm)	(2200 N-m)	(46 kPa-m^4)
	3.65 lb/ft (5.43 kg/m)	1.264 lb/ft (1.88 kg/m)	3.12 lb/ft (4.64 kg/m)	2.78 lb/ft (4.13 kg/m)	3.26 lb/ft (4.85 kg/m)	t_{min} = 0.115in. (2.9 mm)	
End corner and pull post	D = 2.875 in. (73 mm)	D = 2.875 in. (73 mm)	D = 2.875 in. (73 mm)	3 1/2 | 1 1/2 | 1 | 3/16		37200 lbf-in	35 x 10^6 lbf-in.^{2}
	t = 0.203 in (5.2 mm)	t = 0.203 in (5.2 mm)	t = 0.160 in (4.1 mm)	t = 0.135 in (3.5 mm)		(4200 N-m)	(100 kPa-m^4)
	5.79 lb/ft (8.62 kg/m)	2.004 lb/ft (2.98 kg/m)	4.64 lb/ft (6.9 kg/m)	5.10 lb/ft (7.6 kg/m)		t_{min} = 0.125in. (3.2 mm)	

A = outside dimension
B = outside dimension
C = lip

D = outside diameter
R = radius at surface (max)
a = flange taper angle
t = thickness (wall)

See Fig. 1 for drawings of shapes

Y = yield strength, min
Z = section modulus
I = moment of inertia
E = modulus of elasticity

NOTE—Engineering calculations should be used to determine post requirements for fences based on load and installation requirements.

FIG. 2 Summary of Requirements for Industrial Fence