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Steel framework for chain link fence

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Acknowledgment is made for the translation of this National Standard of Canada by the Translation Bureau of Public Services and Procurement Canada.

This National Standard of Canada CAN/CGSB-138.2-2019 supersedes the 1996 edition.

Changes since the previous edition

- Added imperial units (inches/feet)
- Added a second decimal place units in metres
- Added heights and sizes of pipe (for schedule 40)

Contents		Page
1	Scope	1
2	Normative references	1
3	Terms and definitions	2
4	Classification.....	3
5	General requirements	3
6	Detailed requirements	3
7	Preparation for delivery.....	8
8	Inspection	8
9	Options.....	9

Tables

Table 1 — Dimensions and nominal weight for schedule 40 galvanized fence pipe	4
Table 2 — Chemical requirements	4
Table 3 — Yield and tensile requirements.....	4
Table 4 — Dimensions table for standard fence sizes (Dug and set).....	5
Table 5 — Allowable wind values.....	5

Steel framework for chain link fence

1 Scope

This standard applies to steel framework for chain link fence used in commercial and industrial applications.

Some quantities and dimensions used in this standard are given in SI units with imperial equivalents shown in brackets where appropriate.

All imperial measurements are industry standard nominal measurements. All metric references are closest conversions to industry standard. The imperial units are regarded as being official in the event of dispute.

The testing and evaluation of a product against this standard may require the use of materials and/or equipment that could be hazardous. This document does not purport to address all the safety aspects associated with its use. Anyone using this standard has the responsibility to consult the appropriate authorities and to establish appropriate health and safety practices in conjunction with any existing applicable regulatory requirements prior to its use.

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this National Standard of Canada. The referenced documents may be obtained from the sources noted below.

NOTE The addresses provided below were valid at the date of publication of this standard.

An undated reference is to the latest edition or revision of the reference or document in question, unless otherwise specified by the authority applying this standard. A dated reference is to the specified revision or edition of the reference or document in question.

2.1 National Research Council Canada

National Building Code (latest applicable version).

2.1.1 Source

The above may be obtained from the National Research Council of Canada, Publication Sales, Building M-23A, Ottawa, Ontario K1A 0R6. Telephone 1-800-672-7990 or 1-613-993-2463. Website https://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2015_national_building_code.html

2.2 ASTM International

ASTM A53/A53M-12 — *Standards Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.*

ASTM A121 — *Standard Specification for Metallic-Coated Carbon Steel Barbed Wire*

ASTM B6 — *Standard Specification for Zinc.*

2.2.1 Source

The above may be obtained from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, U.S.A., telephone 610-832-9585, fax 610-832-9555, Web site www.astm.org, or from IHS Markit, 200-1331 MacLeod Trail SE, Calgary, Alberta T2G 0K3, telephone 613-237-4250 or 1-800-267-8220, fax 613-237-4251, Web site www.global.ihs.com.

3 Terms and definitions

For the purposes of this National Standard of Canada, the following terms and definitions apply.

3.1

BWO

barbed wire overhang.

3.2

brace rail

tubular or fabricated steel section used for bracing terminal posts.

3.3

centre and/or bottom rails

tubular or fabricated steel sections joined at each fence post by means of fittings.

3.4

FFH

fence with fabric full height.

3.5

fence post

upright tubular or fabricated steel member for supporting fencing material.

3.6

line posts

fence posts spaced at regular intervals between terminal posts throughout each stretch of fence.

3.7

terminal posts

fence posts which include corner, end, gate and straining posts, as follows:

3.7.1

corner posts

fence posts positioned at corners and changes of direction greater than ten degrees.

3.7.2

end posts

fence posts positioned at the ends of a stretch of fence.

3.7.3

gate posts

two fence posts forming a gateway.

3.7.4**straining posts**

fence posts positioned at changes in grade greater than 30 degrees.

3.8**top rail**

tubular or fabricated steel section continuously joined by means of sleeves or couplings throughout each stretch of fence extending between terminal posts.

4 Classification

4.1 Framework¹ shall be supplied in the following types, as specified (see clause 9):

Type E — Electric resistance welded (ERW)

Type F — Continuous welded (CW)

Type S — Seamless.

5 General requirements**5.1 Materials and workmanship**

Materials used for the construction of the fence framework shall be produced by methods recognized as good commercial practice. The framework shall be of uniform quality and condition and shall be free from any defects or imperfections that might adversely affect its serviceability and appearance.

5.2 Zinc-coated components

All framework components, excluding any aluminum components normally used in fence construction, shall be zinc-coated. The galvanized coatings shall be applied by hot-dip process. All coated components shall be free from injurious defects or excessive roughness.

6 Detailed requirements**6.1 Fence posts and rails**

6.1.1 Fence posts and rails shall conform to the material requirements specified in 4.1 and in Tables 1, 2 and 3 respectively.

6.1.2 Fence posts shall be of the lengths and dimensions shown in Table 5 unless otherwise specified (see clause 9).

¹ Steel fence pipe — galvanized. Hot or cold rolled in any of those types.

Table 1 — Dimensions and nominal weight for schedule 40 galvanized fence pipe²

Outside diameter ^{a, b, c}			Nominal wall thickness (Average) ^d			Nominal weight per foot (Average)	
Metric mm	Imperial in.	Industry	Metric mm	Imperial in.	Industry	Metric kg/m	Imperial lbs/ft
33.4	1.315	1-5/16"	3.38	0.133	Schedule 40	2.50	1.68
42.2	1.660	1-11/16"	3.56	0.140	Schedule 40	3.38	2.27
48.3	1.900	1-7/8"	3.68	0.145	Schedule 40	4.05	2.72
60.3	2.375	2-3/8"	3.91	0.154	Schedule 40	5.43	3.65
73.0	2.875	2-7/8"	5.16	0.203	Schedule 40	8.62	5.79
88.9	3.500	3-1/2"	5.49	0.216	Schedule 40	11.28	7.58
114.3	4.500	4-1/2"	6.02	0.237	Schedule 40	16.06	10.79
168.3	6.625	6-5/8"	7.11	0.280	Schedule 40	28.23	18.97

^a Outside diameter industry — Some measurements have been rounded to closest metric and imperial to match industry standard.

^b Diameter — For pipe 48.3 mm (1.900 in.) and under, the outside diameter at any point shall not vary more than ± 0.40 mm (1/64 in.) from the standard specified in Table 1.

^c Diameter — For pipe 60.3 mm (2.375 in.) and over, the outside diameter shall not vary more than $\pm 1\%$ from the standard specified in Table 1.

^d Thickness — The minimum wall thickness at any point shall be not more than 12.5% under the nominal wall thickness specified in Table 1.

Table 2 — Chemical requirements

Composition — Maximum %								
Carbon	Manganese	Phosphorus	Sulphur	Copper	Nickel	Chromium	Molybdenum	Vanadium
0.300	1.200	0.050	0.045	0.400	0.400	0.400	0.150	0.080

Table 3 — Yield and tensile requirements

	Minimum	
	Metric MPa	Imperial Psi
Yield strength	206	30 000
Tensile strength	330	48 000

² Permissible variations in dimensions on the diameter and wall thickness were taken from ASTM A53/A53M – 12, Sections 10.2 and 10.3.

Table 4 — Dimensions table for standard fence sizes (Dug and set)

Height of fence m (ft)	Line post outside diameter mm	Length of line post		End, gate, corner posts outside diameter mm	Length of end & gate posts		Length of corner post		Rail outside diameter mm
		FFH m	BWO included m		FFH m	BWO included m	FFH m	BWO included m	
0.91 (3)	48.3	1.7	—	73.0	2.0	—	2.0	—	33.4
1.22 (4)	60.3	2.0	—	88.9	2.3	—	2.3	—	42.2
1.52 (5)	60.3	2.3	—	88.9	2.6	—	2.6	—	42.2
1.83 (6)	60.3	2.6	2.6	88.9	2.9	3.2	2.9	2.9	42.2
2.13 (7)	60.3	2.9	2.9	88.9	3.2	3.5	3.2	3.2	42.2
2.44 (8)	60.3	3.2	3.2	88.9	3.5	3.8	3.5	3.5	42.2
3.05 (10)	73.0	3.8	3.8	114.3	4.1	4.4	4.1	4.1	42.2
3.66 (12)	73.0	4.4	4.4	114.3	4.7	5.0	4.7	4.7	42.2
4.88 (16)	88.9	5.9	5.9	168.3	6.3	6.6	6.3	6.3	42.2

Table 5 — Allowable wind values

Allowable wind values (pascals) (see 6.8.1.1) FFH ^a	Height of fence m
1271	0.91
883	1.22
565	1.52
665	1.83
489	2.13
375	2.44
457	3.05
318	3.66

^a The same wind values for the BWO (Fence height including barbed wire overhang) (see Table 4) condition are acceptable and result in a small amount of overdesign.

6.2 Fabricated sections

Material and dimensional requirements of steel sections (including shaped or formed) used as fence posts or rails shall be as specified (see clause 9).

6.3 Fittings

Fittings shall be made from zinc-coated pressed steel, galvanized steel, zinc-coated malleable iron or aluminum alloy (see clause 9). They shall be free from brittleness, porosity and defects affecting their durability, and of adequate strength for the intended purpose.

6.4 Barbed wire

Barbed wire shall be constructed from zinc- or aluminum-coated steel wire of at least 2.49 mm diameter and shall be of either single strand or 2-strand construction, as specified (see clause 9). Barbs shall be 4-point construction, formed of wire of at least 2.03 mm diameter, spaced at intervals of 150 ± 15 mm or a minimum of 61 barbs in 10 m. At the option of the producer, the barb on aluminum-coated barbed wire may be solid aluminum alloy (see clause 9). For safety reasons, barbed wire shall not be installed on fences that are less than 1.8 m in height prior to installation of the barbed wire.

6.5 Barbed tape or ribbon

When specified (see clause 9), in extreme security applications, barbed tape or ribbon may be installed on fences that have a minimum height of 3 m.

6.6 Top and bottom tension wire

Top and bottom tension wire (used wherever top and/or bottom rail is not employed) shall consist of zinc-, vinyl- or aluminum-coated steel wire of the same or larger diameter specified for the chain link fence fabric in accordance with CAN/CGSB-138.1.

Fabric should be used as top and bottom tension wire. Sufficient wire ties, clips and hog rings of adequate strength and size shall be provided for the purpose of attaching the bottom wire at 600 mm intervals.

6.7 Framework strength

6.7.1 General

6.7.1.1 All types of fence posts and rails shall exhibit wind strength characteristics conforming with or exceeding the minimum allowable wind values shown in Table 5, unless otherwise specified (see clause 9). Local conditions shall dictate the required strength of the rails.

6.7.1.2 Maximum spacing of line posts shall be 3 m unless otherwise specified (see clause 9). Excessive snow loads, particularly those resulting from snow piled mechanically against a fence, may require post spacing at less than 3 m intervals.

6.7.1.3 All fences shall have a top and bottom horizontal rail or top and bottom tension wire as specified (see clause 9).

6.7.1.4 If a top and bottom tension wire is used, a brace rail may be specified (see clause 9) for added strength.

6.7.1.5 The design of fence framework components shall be based on the National Building Code.

6.7.1.6 The importance factor, if Limit States Design is used, shall be taken as 0.7.

6.7.2 Top rail and other horizontal rails

6.7.2.1 The top rail and other horizontal rails (e.g. centre and bottom rails) shall be capable of withstanding the following loads not occurring simultaneously:

- a) A horizontally or vertically applied load at midspan of the rail of 0.86 kN.
- b) A vertically applied uniformly distributed load of 0.77 kN/m.³

6.7.2.2 The most critical of the following load patterns for the design load specified in 6.7.2.1 b shall be used for design purposes:

- a) Full load applied along the entire length.
- b) Full load applied along any one portion of the length and half load on the remainder of the length.

6.7.3 Brace rails

Brace rails shall have strength requirements as specified (see clause 9).

6.7.4 Line posts

6.7.4.1 Line posts shall be capable of withstanding the three design loads specified in 6.7.4.2, 6.7.4.3 and 6.7.4.4, not occurring simultaneously.

6.7.4.2 Minimum design load applied horizontally parallel to the direction of the fence or perpendicular to it at 1.2 m above ground level shall be 0.9 kN.

6.7.4.3 Minimum design load applied horizontally perpendicular or parallel to the fence at the level of the top rail shall be 0.68 kN.

6.7.4.4 Minimum design wind pressure (p in pascals) applied horizontally perpendicular to the direction of the fence shall be:

$$p = C_n \times q \times C_g \times C_e \times R$$

where:

p = shall be applied to the gross tributary area of the line post (post spacing \times height of fabric)

C_n = force coefficient = 1.2

q = hourly wind pressure in pascals based on probability of being exceeded in any one year of 1 in 10. (See supplement No. 1 of the National Building Code for value of q)

C_g = gust factor = 2.0

C_e = exposure factor = 1.0 for fence located at ground level

R = ratio of net and gross areas of fence⁴.

³ In some locations, experience may indicate that the design load specified in 6.7.2 is insufficient and should be increased. (Closer line post spacing for a fixed size of rail will sometimes compensate for the increased loading). In locations where ground snow loads do not exceed 2.4 kN/m² and there is no probability of snow drifting or being piled against the fence, or the height of rail is 1.5 m above the top of any anticipated snow level, the design load as specified in 6.7.2.1 b may be reduced to 0.44 kN/m.

⁴ For no ice covering on fence, "R" may be taken equal to 0.233 for fence with heavy fabric wire and equal to 0.183 for fence with medium, or light fabric. (See CAN/CGSB-138.1 for description of heavy, medium and light fabric wire).

6.7.4.5 Design wind load shall be based on no ice covering of the fence unless otherwise specified (see clause 9).

6.7.4.6 The deflection of any line post shall not exceed 1/40 of the height, due to the loading specified in 6.7.4.2, 6.7.4.3 and 6.7.4.4.

6.7.5 Terminal posts

The section modulus of terminal posts shall be at least three times that of line posts, in terms of bending resistance.

6.8 Coatings

6.8.1 Tubular steel members shall be zinc-coated inside and outside by hot-dip methods.

6.8.2 For zinc-coated tubular members, the average mass per unit area of zinc coating shall not be less than 550 g/m² (1.8 oz/ft²) of uncoated base metal surface, as determined from the average results of the two specimens and not less than 490 g/m² (1.6 oz/ft²) for either of the test specimens.

6.8.3 Zinc-coated barbed wire

It shall have a minimum coating of 244 g/m² on line wire and 183 g/m² on barbs, as determined in accordance with ASTM A121.

6.8.4 Fittings

All steel and iron fittings shall be hot dip galvanized in accordance with 6.8.1 and 6.8.2.

6.8.5 Top and bottom tension wire

Top and bottom tension wire shall be zinc-, vinyl- or aluminum-coated in accordance with CAN/CGSB-138.1 and shall have the same coating weight (or greater) as the fence fabric.

6.8.6 Slab zinc used for coating shall be of any grade in accordance with ASTM B6.

7 Preparation for delivery

7.1 Unless otherwise specified (see clause 9), normal commercial practice of packaging, labelling, packing and marking shall be acceptable.

8 Inspection

8.1 Sampling

Completed fence framework components shall be subject to inspection and testing according to requirements as specified. Sampling for this purpose shall be as specified.

9 Options

The following options shall be specified in the application of this standard:

- a) Type (see 4.1)
- b) Material and dimensional requirements of fence posts and rails (see 6.1 and 6.2)
- c) Material for fittings (see 6.3)
- d) Barbed wire material and construction (see 6.4)
- e) Requirement for solid aluminum barb (see 6.4)
- f) Requirement for barbed tape or ribbon (see 6.5)
- g) Wind strength characteristics, if other than as specified (see 6.7.1.1)
- h) Spacing of line posts, if other than as specified (see 6.7.1.2)
- i) Requirement for rails or tension wires (see 6.7.1.3)
- j) Requirement for brace rail (see 6.7.1.4)
- k) Strength of brace rails (see 6.7.3)
- l) Design wind load requirement (see 6.7.4.5)
- m) Preparation for delivery, if other than as specified (see 7.1)