



Standard Specification for Carbon Steel Chain¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers carbon steel chain for such applications as railroad cars, construction, industrial uses, load binding, and general purposes other than overhead lifting.

NOTE 1—This specification does not cover carbon steel chain for sprocket applications.

1.2 Three classes of carbon steel chain are covered:

1.2.1 *Grade 30*—Proof coil chain.

1.2.2 *Grade 43*—High test chain.

1.2.3 *Grade 70*—Transport chain.

1.3 The values stated in either acceptable metric units or in other units shall be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any way.

2. Referenced Documents

2.1 *ASTM Standards*:

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for²

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron and Wrought Iron³

E 44 Definitions of Terms Relating to Heat Treatment of Metals⁴

E 350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron and Wrought Iron⁵

E 415 Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel⁶

3. Terminology

3.1 *Definitions of Terms Specific to This Standard*:

3.1.1 *breaking force, minimum*—the minimum force in

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² *Annual Book of ASTM Standards*, Vol 01.05.

³ Discontinued. See 1995 *Annual Book of ASTM Standards*, Vol 03.05.

⁴ Discontinued. See 1993 *Annual Book of ASTM Standards*, Vol 01.02.

⁵ *Annual Book of ASTM Standards*, Vol 03.05.

⁶ *Annual Book of ASTM Standards*, Vol 03.06.

pounds or newtons at which the chain, in the condition it leaves the producer's plant, has been found by representative testing to break when a constantly increasing force was applied in direct tension to a straight length of chain on a standard testing machine. Breaking force values are a statistical attribute test and are not a guarantee that all chain segments per lot will endure these loads. Breaking force loads shall not be used as criteria for service or design purposes.

3.1.2 *lot*—for the purpose of acceptance testing, a lot shall consist of 3000 ft [1000 m], or fraction thereof, of the same grade and size chain. If a continuous length of chain exceeds 3000 ft [1000 m], it shall also be considered a lot.

3.1.3 *proof test*—a quality control tensile test applied to chain for the purpose of verifying weld and material quality. It is the minimum force in pounds or newtons which the chain has withstood at the time it left the producer, under a test in which a constantly increasing force has been applied in direct tension to a straight length of chain. Proof test loads are a manufacturing integrity test and shall not be used as criteria for service or design purposes.

3.1.4 *working load limit (WLL)*—the maximum combined static and dynamic load in pounds or kilograms that shall be applied in direct tension to an undamaged straight length of chain.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:

4.1.1 Product to conform to Specification A 413 or A 413M and date of issue,

4.1.2 Grade of chain,

4.1.3 Nominal size of chain (in. or mm),

4.1.4 Quantity of chain (ft or m),

4.1.5 Length of each piece, if required,

4.1.6 Finish, if required,

4.1.7 Certification of test(s), if required, and

4.1.8 Acceptance of inspection by purchaser, if required.

5. Material Requirements

5.1 *Heat Analysis*—The selection of the steel is left to the judgment of the individual chain manufacturer provided the steel meets the following criteria:

Carbon, max, %	0.370
Phosphorus, max, %	0.048
Sulfur, max, %	0.058

5.2 *Product Analysis*—The steel used may be analyzed by the purchaser and shall conform to the requirements of 5.1 subject to the product analysis tolerances specified in Specification A 29/A 29M. Test samples may be taken from rods, bars, or finished chain. Samples for analysis shall be so taken as to represent the full cross section of the specimen.

5.3 Test Methods E 30, E 350, or E 415 shall be used for referee purposes.

6. Manufacture

6.1 *Welding Process*—Carbon steel chain may be made by the forge welding, electric welding, or gas welding process.

6.2 *Heat Treatment*—Grades 30 and 43 do not require heat treatment, but may be heat treated at the manufacturer’s discretion. Grade 70, after welding, shall be heat treated. Heat treatment shall include quenching and tempering as described in Definitions E 44.

7. Dimensional Requirements

7.1 The chain shall conform to the dimensional requirements specified in Tables 1-3 for the appropriate grade and size chain.

7.2 *Diameter*—The diameter of the material from which the chain is manufactured shall not be smaller than the material diameter listed in Tables 1-3 within the following tolerance: -7 %. Oversized material may be used for all applications.

8. Workmanship, Finish, and Appearance

8.1 The chain at the time of shipment shall be free of discontinuities that would prevent the chain from enduring the working load limit forces.

8.2 The manufacturer may apply a surface treatment or coating of their own choice for identification or corrosion resistance unless the customer specifies otherwise.

9. Mechanical Requirements

9.1 *Proof Test*—All chain shall be tested to at least the proof load prescribed in Tables 1-3 for the appropriate grade and size chain. When so tested it shall withstand these loads without loss of chain integrity. Links or chain segments that do not withstand the proof test load shall be removed from the chain.

9.2 *Breaking Force*—The breaking force test specimen shall consist of a length from the lot containing at least the number of links in Table 4.

9.2.1 Fixtures for securing chain in a testing machine shall be properly designed to support securely the shoulder of the link (see Note 2). The opening in the fixture shall not be more than 125 % of the stock diameter being tested. Links engaged in the testing fixture shall not be considered part of the test specimen.

NOTE 2—“U” bolts of the same or larger diameter and the same or greater strength may be used to secure the chain to the jaws of the testing machine.

9.2.2 Test specimens shall meet or exceed the minimum breaking force values given in Tables 1-3 for the appropriate grade and size chain.

9.3 *Elongation:*

9.3.1 All chain which is heat treated (see 6.2) must be in the quenched and tempered condition before the elongation is measured.

9.3.2 Elongation is to be determined as follows:

9.3.2.1 Test samples are to consist of at least the number of links in Table 4 that constitutes the gage length. Two additional links will be required to engage the jaws of the testing machine unless this is done by half links or another method.

9.3.2.2 Place the test sample in the testing machine and load to a maximum of 10 % of the proof test force. Measure the gage length (*L*), which does not include the links engaged in the jaws of the testing machine (see Fig. 1).

9.3.2.3 The load is then gradually and smoothly increased until fracture occurs, and the maximum load applied is recorded as the breaking force. The elongation may be determined by an autographic recorder or side scale or alternatively by measuring the broken lengths on either side of the broken link as shown in Fig. 2.

9.3.3 *Calculation of Elongation:*

9.3.3.1 The mean pitch (*p'*) after seating of the links at some load not exceeding 10 % of the manufacturing test force is calculated as follows:

$$p' = (L - 2d)/n \tag{1}$$

where *n* is the actual number of links in gage length *L*.

9.3.3.2 The mean pitch (*p''*) of unbroken links after fracture is calculated as follows:

TABLE 1 Grade 30 Proof Coil Chain

Nominal Chain Size		Material Diameter		Working Load Limit, max		Proof Test, ^A min		Minimum Breaking Force ^A		Inside Length, max		Inside Width, min	
in.	mm	in.	mm	lb	kg	lb	kN	lb	kN	in.	mm	in.	mm
1/8	4.0	0.156	4.0	400	180	800	3.6	1 600	7.2	0.94	23.9	0.25	6.4
3/16	5.5	0.217	5.5	800	365	1 600	7.2	3 200	14.4	0.98	24.8	0.30	7.7
1/4	7.0	0.276	7.0	1 300	580	2 600	11.6	5 200	23.2	1.24	31.5	0.38	9.8
5/16	8.0	0.331	8.4	1 900	860	3 800	16.9	7 600	33.8	1.29	32.8	0.44	11.2
3/8	10.0	0.394	10.0	2 650	1 200	5 300	23.6	10 600	47.2	1.38	35.0	0.55	14.0
7/16	11.9	0.488	11.9	3 700	1 680	7 400	32.9	14 800	65.8	1.64	41.6	0.65	16.6
1/2	13.0	0.512	13.0	4 500	2 030	9 000	40.0	18 000	80.0	1.79	45.5	0.72	18.2
5/8	16.0	0.630	16.0	6 900	3 130	13 800	61.3	27 600	122.6	2.20	56.0	0.79	20.0
3/4	20.0	0.787	20.0	10 600	4 800	21 200	94.3	42 400	188.6	2.76	70.0	0.98	25.0
7/8	22.0	0.866	22.0	12 800	5 810	25 600	114.1	51 200	228.2	3.03	77.0	1.08	27.5
1	26.0	1.02	26.0	17 900	8 140	35 800	159.1	71 600	318.2	3.58	90.9	1.25	31.7

^A The proof test and minimum breaking force loads shall not be used as criteria for service or design purposes (see Section 4).