Designation: A 413/A 413M – 07

Standard Specification for Carbon Steel Chain[1]

This standard is issued under the fixed designation A 413/A 413M; 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.

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 Grade designation is 1/10 of the minimum breaking strength in newtons divided by two times the nominal cross-sectional area of the chain in square millimetres.

1.4 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:* [2]

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

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *breaking force, minimum*, *n*—minimum force in pounds or newtons at which the chain, during manufacture, has been found by testing to break when a constantly increasing force is applied in direct tension.

3.1.1.1 *Discussion*—This test is a manufacturer's attribute acceptance test and shall not be used as criteria for service.

3.1.2 *lot*, *n*—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*, *n*—quality control tensile test applied to chain for the purpose of verifying weld and material quality.

3.1.3.1 *Discussion*—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)*, *n*—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

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.27 on Steel Chain.

Current edition approved Nov. 1, 2007. Published November 2007. Originally approved in 1957. Last previous edition approved in 2001 as A 413/A 413M – 01.

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

***A Summary of Changes section appears at the end of this standard.**

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

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, Practices, and Terminology A 751 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 Terminology A 941.

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. Finish

8.1 The manufacturer may apply a surface treatment or finish of their own choice for identification or corrosion resistance unless the customer specifies otherwise. The surface treatment or finish shall not alter the chain in a manner that would cause the chain to not meet the other provisions of this standard.

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. All chain that is heat treated shall be in the quenched and tempered condition before the breaking force is measured.

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 The elongation test specimen shall consist of a length from the lot containing at least the number of links in Table 4.

9.3.3 A positive load not exceeding 10 % of the proof test shall be applied for determining the original gage length ($L\{0\}$).

9.3.4 The elongation shall be based on the total extension at fracture. This is expressed as a percentage of the change in length (ΔL) divided by the original gage length ($L\{0\}$). The elongation may be determined by the equation below or by autographic recorder or side scale.

$$\text{Elongation } (\%) = \{\Delta L / L\{0\}\} \times 100$$

where:

ΔL = test specimen final length at fracture – test specimen original gage length ($L\{0\}$), and

$L\{0\}$ = original gage length (sum or the inside lengths of the test chain links, not counting the fixture links, or as determined in 9.3.3).

9.3.5 The elongation shall be a minimum of 15 %.

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
⅛	4.0	0.156	4.0	400	180	800	3.6	1600	7.2	0.94	23.9	0.25	6.4
3⁄16	5.5	0.217	5.5	800	365	1600	7.2	3200	14.4	0.98	24.8	0.30	7.7
¼	7.0	0.276	7.0	1300	580	2600	11.6	5200	23.2	1.24	31.5	0.38	9.8
5⁄16	8.0	0.331	8.4	1900	860	3800	16.9	7600	33.8	1.29	32.8	0.44	11.2
⅜	10.0	0.394	10.0	2650	1200	5300	23.6	10 600	47.2	1.38	35.0	0.55	14.0
7⁄16	11.9	0.488	11.9	3700	1680	7400	32.9	14 800	65.8	1.64	41.6	0.65	16.6
½	13.0	0.512	13.0	4500	2030	9000	40.0	18 000	80.0	1.79	45.5	0.72	18.2
⅝	16.0	0.630	16.0	6900	3130	13 800	61.3	27 600	122.6	2.20	56.0	0.79	20.0
¾	20.0	0.787	20.0	10 600	4800	21 200	94.3	42 400	188.6	2.76	70.0	0.98	25.0
⅞	22.0	0.866	22.0	12 800	5810	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	8140	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).

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 2 Grade 43 High Test 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
1/4	7.0	0.276	7.0	2600	1180	3900	17.3	7800	34.6	1.24	31.5	0.38	9.8
5/16	8.7	0.343	8.7	3900	1770	5850	26.0	11 700	52.0	1.29	32.8	0.44	11.2
3/8	10.0	0.406	10.3	5400	2450	8100	36.0	16 200	72.0	1.38	35.0	0.55	14.0
7/16	11.9	0.468	11.9	7200	3270	10 800	48.0	21 600	96.0	1.64	41.6	0.65	16.6
1/2	13.0	0.531	13.5	9200	4170	13 800	61.3	27 600	122.6	1.79	45.5	0.72	18.2
5/8	16.0	0.630	16.0	13 000	5910	19 500	86.5	39 000	173.0	2.20	56.0	0.79	20.0
3/4	20.0	0.787	20.0	20 200	9180	30 300	134.7	60 600	269.4	2.76	70.0	0.98	25.0
7/8	22.0	0.866	22.0	24 500	11 140	36 750	163.3	73 500	326.6	3.03	77.0	1.08	27.5

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

TABLE 3 Grade 70 Transport 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
1/4	7.0	0.281	7.0	3150	1430	6300	28.0	12 600	56.0	1.24	31.5	0.38	9.8
5/16	8.7	0.343	8.7	4700	2130	9400	41.8	18 800	83.6	1.29	32.8	0.44	11.2
3/8	10.0	0.406	10.3	6600	2990	13 200	58.7	26 400	117.4	1.38	35.0	0.55	14.0
7/16	11.9	0.468	11.9	8750	3970	17 500	77.7	35 000	155.4	1.64	41.6	0.65	16.6
1/2	13.0	0.531	13.5	11 300	5130	22 600	100.4	45 200	200.8	1.79	45.5	0.72	18.2
5/8	16.0	0.630	16.0	15 800	7170	31 600	140.4	63 200	280.8	2.20	56.0	0.79	20.0
3/4	20.0	0.787	20.0	24 700	11 200	49 400	219.6	98 800	439.2	2.76	70.0	0.98	25.0

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

TABLE 4 Mechanical Test Sample Length Requirements

Size of Chain	Minimum Number of Links in Test Specimen
7/32 in. [5.5 mm]	9
Larger than 7/32 in. [5.5 mm] but less than 3/4 in. [20.0 mm]	7
3/4 in. [20.0 mm] and larger	3

9.4 One test for breaking strength and elongation shall be made from each lot. The elongation and breaking force tests may be performed at the same time on the same test specimen.

10. Retests

10.1 If the original test specimen fails to conform to the requirements in 9.2.2, two additional test specimens from the same lot may be tested, each of which shall conform to the requirements of 9.2.2. If both additional tests are satisfactory, the chain will be considered acceptable.

11. Rework and Retreatment

11.1 Materials that fail to comply to the requirements as to dimensions and mechanical tests may be resubmitted after being reworked.

12. Inspection

12.1 When requested on the purchase order or contract, the chain shall be free of paint or other coatings which could mask surface discontinuities at the time of inspection.

12.2 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to verify that the material is being furnished in accordance with this specification. Inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All tests and inspection shall be made at the place of manufacture, unless otherwise agreed upon.

12.3 The purchaser may make the tests to govern acceptance or rejection of the material at their own laboratory or elsewhere. Tests and acceptance criteria shall conform to the requirements contained in this specification unless otherwise stated in the purchase order or contract. Tests at the purchaser's laboratory or elsewhere shall be made at the expense of the purchaser.

13. Rejection and Rehearing

13.1 Materials that fail to conform to the requirements of this specification may be rejected. Rejection shall be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of any test, the producer or supplier may make claim for a rehearing.

13.2 In the case of dissatisfaction with the results of any test in 12.3, the manufacture may make claim for a rehearing.

14. Certification and Reports

14.1 A manufacturer's certification that the chain conforms to Specification A 413/A 413M of the date of issue specified shall be furnished when requested on the purchase order or contract.

14.2 When requested on the purchase order or contract, the manufacturer shall furnish a certificate of proof test to the purchaser or his representative.

15. Product Marking

15.1 Body chain links shall not be marked with indented characters.

15.2 The 5/16 in. [8.7 mm] and 3/8 in. [10 mm] Grade 43 and 70 chain shall be embossed at intervals no greater than 1 ft [0.3 m]. All other Grade 43 and 70 chains shall be embossed at intervals no greater than 3 ft [0.9 m].

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

15.3 Grade 30 chain, sized 5/16 in. (8.4 mm) and larger, shall be marked with the manufacturer's mark or symbol and shall include 3, 30, or 300.

15.4 Grade 43 chain shall be marked with the manufacturer's mark or symbol and shall include 4, 43, or 430.

15.5 Grade 70 chain shall be marked with the manufacturer's mark or symbol and shall include 7, 70, or 700.

16. Keywords

16.1 chain; steel chain

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 413/A 413M – 01) that may impact the use of this standard. (Approved Nov. 1, 2007.)

(*1*) Added 1.3.
(*2*) Revised Section 2.
(*3*) Added new referenced standards to 5.3 and 6.2.
(*4*) Revised Section 8.
(*5*) Revised 15.3-15.5.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale