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## Standard Specification for Grade 100 Alloy Steel Chain<sup>1</sup>

This standard is issued under the fixed designation A 973/A 973M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification covers Grade 100 heat-treated alloy steel chain for such applications as slings, lifting assemblies, and load binding.

NOTE 1—This specification does not cover alloy steel chain for pocket wheel applications.

1.2 This specification is a performance standard for Grade 100 chain used between  $-20$  and  $400^{\circ}\text{F}$  [ $-29$  and  $205^{\circ}\text{C}$ ]. The chain manufacturer should be contacted for use at temperatures outside this range.

~~1.3 The values stated in either SI 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.~~

1.3 The Grade designation is  $\frac{1}{10}$  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 SI 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:

~~A29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for<sup>2</sup>  
A919 Terminology Relating to Heat Treatment of Metals~~

~~E30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron~~

~~E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron~~

~~E415 Test Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel<sup>5</sup>~~

~~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~~

#### 2.2 SAE Standard:

~~SAE J422 Microscopic Determination of Inclusions in Steels<sup>3</sup>~~

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

~~3.1.1 *breaking force, minimum, n*—the minimum—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*—for the purpose of acceptance testing, a lot shall consist of 3000 ft [1000 m], or fraction thereof, of the same size chain. If a continuous length of chain exceeds 3000 ft [1000 m], it shall also be considered a lot. date code, n—series of letters, numbers, or both embossed on the chain which enables its manufacturing history to be traced.~~

<sup>1</sup> 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.

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<sup>2</sup> 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, Vol 01-05, volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Discontinued. See 1998 Annual Book of ASTM Standards, Vol 01.02.

<sup>5</sup> Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

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

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

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

3.1.4.1 *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.

3.1.5 *traceability code, n*—series of letters, numbers, or both embossed on the chain which enables its manufacturing history, including the identity of the steel heat, to be traced.

3.1.6 *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 include, but are not limited to, the following:

- 4.1.1 Product to conform to Specification A 973/A 973M and date of issue,
- 4.1.2 Nominal size of chain (in. or mm),
- 4.1.3 Quantity of chain (ft or m),
- 4.1.4 Length of each piece, if required,
- 4.1.5 Finish, if required,
- 4.1.6 Certification of test(s), if required,
- 4.1.7 Acceptance of inspection by purchaser, if required, and
- 4.1.8 Supplementary requirements, if required.

#### 5. Manufacturing

5.1 *Melting Process*—The alloy steel shall be fully killed and have an austenitic grain size of five or finer.

5.2 *Welding Process*—Alloy steel chain may be made by the electric welding or gas welding process.

5.3 *Heat Treatment*—After welding, alloy steel chain shall be heat treated before applying the proof test. Heat treatment shall include quenching and tempering as defined by Terminology A 919/A 941.

#### 6. Material Requirements

6.1 *Heat Analysis*—The selection and amounts of the alloying elements in the steel are left to the judgment of the individual chain manufacturer provided the steel meets the following criteria: carbon = 0.35 % max; phosphorous = 0.025 % max; sulfur = 0.025 % max. The following elements must all be present in alloying amounts, nickel (0.40% min), chromium (0.40% min), and molybdenum (0.15% min). The steel shall have oxide and silicate inclusions of 4 or less as determined by SAE J422.

6.2 *Product Analysis*—The steel used may be analyzed by the purchaser and shall conform to the requirements of 6.1 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.

6.3 *Test Methods E30, E350, or E415*

6.3 *Test Methods, Practices, and Terminology A 751* shall be used for referee purposes.

#### 7. Mechanical Requirements

7.1 *Proof Test*—All chain shall be tested to at least the proof load prescribed in Table 1 for the appropriate size chain. When so tested it shall withstand these loads without loss of chain integrity. Links or chain segments not withstanding the proof test load shall be removed from the chain.

7.2 *Breaking Force*—The breaking force test specimen shall consist of a length from the lot containing at least the number of links in Table 2. All chain shall be in the quenched and tempered condition before the breaking force is measured.

7.2.1 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.

7.2.2 Test results shall meet or exceed the minimum breaking force values given in Table 1 for the appropriate size chain.

7.3 *Elongation:*