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Superseding AMS-S-11310

Steel Bars, Carbon, Hot Rolled, for Cold Shaping, Including Cold Extrusion

NONCURRENT NOTICE

This specification has been declared “NONCURRENT” by the Aerospace Materials Division, SAE, as of February 2003. It is recommended, therefore, that this specification not be specified for new designs.

“NONCURRENT” refers to those specifications which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. Each of these “NONCURRENT” specifications is available from SAE upon request.

Similar, but not necessarily identical products, are covered by ASTM A 29, Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.

ASTM specifications are available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

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1. SCOPE:

1.1 Scope:

This specification covers hot-rolled carbon steel bars and heat treated carbon steel bars which are to be used in cold shaping, including cold extrusion, of ammunition components.

1.2 Classification:

The steel shall be furnished in the compositions listed in table I, as specified.

2. APPLICABLE DOCUMENTS:

The following publications, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 10 Brinell Hardness Testing of Metallic Materials
ASTM E 30 Chemical Analysis of Steel, Cast Iron, Open Hearth Iron, and Wrought Iron
ASTM E 340 Standard Method of Macroetching Metals and Alloys

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FED-STD-48	Tolerances for Steel and Iron Wrought Products
FED-STD-151	Metals, Test Methods
MIL-STD-163	Preparation of Steel Products for Domestic Shipment (Storage) and Overseas Shipment
MIL-STD-1459	Macrograph Standards for Steel Bars, Billets and Blooms for Ammunition Components

3. REQUIREMENTS:

3.1 Process:

The steel shall be manufactured by either the open-hearth, basic oxygen, or the electric furnace process, at the option of the steel producer, unless one of the processes is specified. Unless otherwise specified, the steel shall be fully killed with any appropriate deoxidizing agent. Aluminum, however, shall be used in the killing operation to the extent necessary to control the grain size requirements of 3.4.

3.2 Condition:

Unless otherwise specified, the steel bars shall be furnished as hot-rolled. When specified, bars shall be furnished pickled or pickled and oiled, in which case the bars shall be free from scale. When approved, descaling may be done by methods other than pickling (see 6.6).

3.3 Chemical composition:

The chemical composition of the bars, shall meet the requirements in table I, subject to the permissible variations shown in table II, provided that in a lot of steel the individual determinations for any element shall not vary both above and below the range shown in table I. Commercial steels of compositions intermediate to those in table I may be furnished if approved by the procurement activity.

3.3.1 A heat analysis of each heat or lot of steel shall be furnished by the steel producer showing the percentages of the elements (except copper, nickel, chromium, and molybdenum) shown in table I. The heat analysis shall meet the chemical requirements of table I.

3.3.1.2 High-residual-aluminum steel: When a high-residual-aluminum type of steel is required, it shall be so specified (see 6.6). The amount of aluminum used shall be greater than that necessary for the control of austenitic grain size as required by 3.4. The residual aluminum required above refers to acid soluble aluminum.

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TABLE I. Chemical requirements for ladle analysis[1]

AISI No.	Carbon, percent	Manganese, percent	Silicon[2] max percent	Phosphorus, max percent	Sulfur, max percent
1005	0.06 max	0.35 max	0.20	0.040	0.050
1006	0.08 max	0.25-0.40	0.20	0.040	0.050
1008	0.10 max	0.30-0.50	0.20	0.040	0.050
1010	0.08-0.13	0.30-0.60	0.20	0.040	0.050
1012	0.10-0.15	0.30-0.60	0.20	0.040	0.050
1017	0.15-0.20	0.30-0.60	0.20	0.040	0.050
1018	0.15-0.20	0.60-0.90	0.20	0.040	0.050
1020	0.18-0.23	0.30-0.60	0.20	0.040	0.050
1022	0.18-0.23	0.70-1.00	0.20	0.040	0.050
1025	0.22-0.28	0.30-0.60	0.20	0.040	0.050
1030	0.28-0.34	0.60-0.90	0.20	0.040	0.050
1040	0.37-0.44	0.60-0.90	0.20	0.040	0.050

[1]Unless otherwise specified, incidental elements shall not exceed the following amounts:

	Copper	Nickel	Chromium	Molybdenum
1020 and lower carbon steels	0.20	0.15	0.07	0.05
1022 and higher carbon steels	0.35	0.25	0.20	0.06

[2]When it is necessary for the silicon content to be other than provided in this table (as in the type of steel covered in paragraph 3.3.1.2) the silicon requirement shall be as approved by the Government agency directing the procurement involved.

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TABLE II. Permissible variations for check analysis

Element	Maximum limit or upper limit of range, percent	Over the maximum limit, percent	Under the minimum limit, percent
Carbon	To 0.25, inclusive	0.02	0.02
	Over 0.25 to 0.55, incl.	0.03	0.03
	Over 0.55	0.04	0.04
Manganese	To 0.90, inclusive	0.03	0.03
	Over 0.90 to 1.30, incl.	0.06	0.06
Phosphorus	0.040, inclusive	0.01	--
Sulfur	To 0.050, inclusive	0.01	--
Silicon	To 0.30, inclusive	0.02	0.02

3.4 Austenitic grain size:

The steel shall have an austenitic grain size of No. 5 or finer.

3.5 Heat treatment:

Heat treatment, when required, shall be as specified (see 6.6). All heat treatment shall be performed in such a manner as to produce the specified properties throughout the lot.

3.6 Hardness (heat treated bars only):

Hardness requirements shall be as specified (see 6.6).

3.7 Decarburization:

Decarburization requirements shall apply only to 1025 and higher carbon steels, and only when specified. The maximum permissible depth of decarburization shall be as specified (see 6.6). Decarburization shall include both total and partial decarburization.

3.8 Internal Soundness:

Unless otherwise specified, the quality and cleanliness of the steel, as indicated by the macro-etch test, shall be equal to or better than standard A4, B3, C8 of MIL-STD-1459, with defects D1, D3, D4, D5, D6, D7, and D8 unacceptable.

3.9 Discard and identification of material:

3.9.1 Discard: The discard from the top and bottom of each ingot shall be sufficient to provide sound steel. There shall be no less than three marker ingots in each heat. These shall be the first and last usable ingots and an ingot approximately at the middle of the pouring of the heat. The mold practice used on marker ingots shall be similar to that used on all other ingots of the heat. All ingots shall have an original discard at least equivalent to the original discard on the marker ingots.

3.9.2 Identification: All materials shall carry the heat number and all top and bottom cuts shall be identified. All material from marker ingots shall carry the ingot number in addition to the heat number. The top end of the top cut and the bottom end of the bottom cut of all ingots shall be identified. All identification shall be retained on the pieces until the heat has satisfactorily passed the tests prescribed in Section 4.

3.10 Dimensions and tolerances:

The material shall conform to the nominal size specified in invitation for bids and in the contract or order.

3.10.1 Permissible variations for dimensions and permissible deviations from roundness and straightness shall be in accordance with the following requirements.

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3.10.1.1 The material shall meet the requirements shown in paragraph 1a1 of FED-STD-48 and table III of this specification for rounds and round-cornered squares, respectively.

3.10.2 Length:

TABLE III. Permissible variations - round-cornered squares; diagonal

Specified square size, inches	Variation from specified diagonal, inches	
	Over	Under
3 to 3-1/2, inclusive	0.066	0
Over 3-1/2 to 3-7/8, inclusive	0.088	0

3.10.2.1 Specific lengths: When specific lengths or lengths expressed as multiples of specific units are ordered, hot rolled rounds and round-cornered squares shall be furnished to length within the tolerances shown in paragraphs 1a9, 1a10, and 1a11 of FED-STD-48 for rounds and table IV of this specification for round-cornered squares (see 6.3).

TABLE IV - Permissible variations - round-cornered squares; length, variations from specified length

Nominal square size, inches	Lengths up to 10 ft, incl. inches		Lengths over 10 to 20 ft, incl. inches		Lengths over 20 ft, inches	
	Over	Under	Over	Under	Over	Under
3 to 3-7/8, incl.	1-1/4	0	1-3/4	0	2-1/2	0
Over 3-7/8 to 5, incl.	1-1/2	0	2	0	3	0
Over 5 to 10, incl.	2	0	3	0	4	0

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3.10.2.2 Random lengths: When hot rolled bars are ordered to a random length range which is in accord with standard ranges in paragraph 1a8 of FED-STD-48, the length of each bar shall be within the specified range.

3.10.3 Straightness:

3.10.3.1 Hot rolled bars, not heat-treated, shall conform to paragraph 1a12 of FED-STD-48.

3.10.3.2 Hot rolled bars and heat-treated bars, ordered to “special straightness,” shall not deviate from a straight line by more than 1/8 inch in any 5 foot length nor by more than 1/8 inch times one-fifth of the number of feet in the entire length.

NOTE: Because of warpage, straightness tolerances do not apply to bars if any subsequent heating operation has been performed after straightening.

3.10.3.3 In order to utilize the maximum capacity of the steel industry, it may be necessary to roll bars on mill equipment that is not capable of meeting the tolerances shown in 3.10.3.1. When approved (see 6.6), such bars shall not deviate from a straight line by more than the amounts calculated from the following formula:

$$\text{Maximum deviation in inches} = \frac{\text{Tabular value X number of feet in length}}{5}$$

The tabular value in the formula shall be as shown in table V.

TABLE V. Tabular values for straightness formula

Specified diameter, inches	Tabular values	
	For lengths not over 20 feet, inches	For lengths over 20 feet, inches
Under 4	3/4	1-1/2
4 and over	1	1-1/2

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3.11 Workmanship:

3.11.1 Bars shall be free from pipe, flakes and heat checks and shall not contain any other defect, such as seams and non-metallic inclusions, which due to their nature, degree, or extent detrimentally affect the suitability of the steel for the intended use.

3.11.2 Bars, for which no particular finish or surface preparation is specified, shall be free from flat spots within commercial tolerances, deep rolling marks, and injurious rolled-in-scale.

3.11.3 Straightening methods applied to the bars shall not produce surface defects to a detrimental degree.

3.11.4 Re-conditioning of bars by grinding for purpose of removing injurious surface defects will be permitted when approved (see 6.6).

3.11.5 Each length of bar furnished shall consist of one continuous piece cut from the full length bar as rolled. Bars joined together by welding shall not be accepted.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot:

Unless otherwise specified, a lot shall consist of all bars submitted for inspection at the same time, of the same heat, the same condition, the same diameter or thickness, and, when heat-treated, from the same furnace charge of a batch-type heat-treating furnace or subjected to continuous treatment under the same conditions in a continuous-type furnace.

4.3 Check Analysis:

4.3.1 Chemical analyses may be made by the purchaser representing each heat of steel. The chemical composition thus determined shall meet the requirements of paragraph 3.3.

4.3.2 Samples for check analysis shall be taken at a point midway between the center and the surface of the bloom, billet, or bar by drilling parallel to the longitudinal axis. For pieces having a cross-sectional area up to 16 square inches inclusive, the nominal diameter of the drill shall be 1/2 inch; for material over 16 square inches in cross-sectional area, the nominal diameter of the drill shall be one inch. Each sample shall consist of not less than two ounces of drillings.

4.3.3 When specified, two samples for check analysis shall be furnished by the steel supplier to the purchaser. One sample shall be taken from the top end of the top bloom, billet, or bar of the first usable ingot and one sample from the bottom end of the bottom bloom, billet, or bar of the last usable ingot of the heat. The samples shall be taken in accordance with paragraph 4.3.2.

4.3.4 In case a referee analysis is required and agreed upon to resolve a dispute concerning the results of a check analysis, a referee analysis shall be performed in accordance with ASTM Methods E 30, Chemical Analysis of Steel, Cast Iron, Open Hearth Iron and Wrought Iron.

4.4 Austenitic grain size tests:

At least one grain size determination shall be made for each heat.

4.4.1 Austenitic grain size shall be determined in accordance with an applicable method described in FED-STD-151.

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