

MIL-S-43A**31 JULY 1951****SUPERSEDING****JAN-S-43****29 April 1944****MILITARY SPECIFICATION****STEEL BARS FOR PROJECTILE STOCK**

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments.

1. SCOPE

1.1 This specification covers steel in the form of cold-drawn and stress-relieved carbon steel bars intended for the manufacture of projectiles not larger than 2 inches in diameter, by machining in screw machines.

2. APPLICABLE SPECIFICATIONS, STANDARDS, DRAWINGS, AND PUBLICATIONS

2.1 The following specifications and publication, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS**FEDERAL**

QQ-M-151—Metals; General Specification for Inspection of.

U. S. ARMY

100-2 —Standard Specification for Marking Shipments by Contractors.

NAVY DEPARTMENT

General Specifications for Inspection of Material, including Appendix II, Metals, Part A, Definitions and Tests.

PUBLICATIONS

BUREAU OF SUPPLIES AND ACCOUNTS
Navy Shipment Marking Handbook.

(Copies of specifications, standards, and drawings required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Material.—The raw materials used shall be such as to produce steel bars to comply with this specification.

3.2 Manufacture.

3.2.1 Unless otherwise specified (see 6.1), the steel shall be manufactured by the basic open hearth or electric furnace process.

3.2.2 Sufficient discard shall be taken from each ingot to remove top and bottom unsoundness.

3.2.3 Bars shall be cold drawn from hot rolled bars which may be annealed or normalized when necessary to meet specified mechanical requirements. After cold drawing, all bars shall be stress-relieved at the temperature and for the time required to produce the desired mechanical properties.

3.2.4 Bars shall be free from pipe, excessive porosity, excessive metallic inclusions, and other manufacturing defects which make the material unsuitable for the intended purpose.

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TABLE I.—Chemical requirements.

| Carbon | Manganese | Phosphorus max. | Sulphur | Silicon |
|--------------------------|-------------|--------------------|-------------|--------------------------|
| Percent | Percent | Percent | Percent | Percent |
| 0.25 - 0.40 ¹ | 1.15 - 1.55 | 0.040 | 0.08 - 0.18 | 0.10 - 0.20 ² |

¹ Carbon may be specified to any 0.10 percent range between these limits as agreed upon between the contractor and the purchasing agency.

² The range for silicon shall apply to steel for 20 mm. high explosive and incendiary bodies only.

TABLE II.—Permissible variations in chemical composition.

| Carbon | | Manganese | | Phosphorus | Sulphur | | Silicon | |
|---------|---------|-----------|---------|------------|---------|---------|---------|---------|
| Over | Under | Over | Under | Over | Over | Under | Over | Under |
| Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| 0.03 | 0.03 | 0.06 | 0.06 | 0.01 | 0.03 | 0.01 | 0.02 | 0.02 |

3.3 Chemical.

3.3.1 The ladle analysis of each heat shall meet the chemical requirements shown in table I. The chemical composition of bars, as determined by Government check analysis, shall meet the chemical requirements shown in table I within the permissible variations shown in table II, provided that in each heat of steel, the percentage of any element shall not vary both above and below the range shown in table I.

3.3.2 A ladle analysis of each heat of steel shall be furnished by the contractor showing the percentage of carbon, manganese, phosphorus, sulphur, and silicon.

3.4 Mechanical properties.—Stress relieved cold drawn bars shall meet the mechanical properties shown in table III, except that, when authorized by the purchasing agency, the maximum tensile strength may be raised or waived.

3.5 Dimensional tolerances.

3.5.1 Diameter.—Cold drawn bars shall be not larger than the ordered diameter, and

shall not be less than the ordered diameter by more than 0.004-inch for ordered diameters up to 1 inch, inclusive, and 0.006-inch for ordered diameters over 1 to 2 inches, inclusive.

3.5.2 Out-of-round.—Out-of-round of cold drawn bars shall be within the tolerance for diameter.

3.5.3 Length.—Cold drawn bars shall be furnished in lengths, tolerances in length, and with the permissible proportion of short lengths agreed upon between the purchasing agency and the contractor.

3.5.4 Allowance for machining.—The diameter of the cold drawn bar stock shall be

TABLE III.—Mechanical properties.

| Diameter | Tensile strength maximum | Yield strength minimum | Elongation in 4 X diameter minimum |
|------------------|-----------------------------|---------------------------|---|
| Inches | P.s.i. | P.s.i. | Percent |
| 1.25 and smaller | 118,000 | 75,000 | 15 |
| over 1.25 to 2 | 118,000 | 70,000 | 15 |

such as to permit the removal from the surface during the machining operation a minimum of 0.026 and 0.030 inch from bars for 20 and 40 mm. projectile bodies, respectively.

3.6 Magnetic test for cracks and seams.—

When tested magnetically in accordance with 4.7, cold-drawn bars shall show no evidence of seams or cracks 0.020 inch or greater in depth.

3.7 Compression set and soundness for steel for 20 mm. high explosive and incendiary bodies.

3.7.1 When specified in the contract or order, stress relieved cold drawn bars for 20 mm. high explosive and incendiary bodies shall be subjected to the compression test specified in 4.5.

3.7.2 Steel intended for the manufacture of 20 mm. high explosive and incendiary bodies, while in billet form, shall be tested for soundness in accordance with 4.6.

3.8 Workmanship.—

Cold drawn bars shall have a smooth surface, and shall be straight and uniform in quality and condition within the limits of selective mill practices, and shall be free from seams, cracks, hot rolling scale, and other defects which, due to their nature, degree, or extent, prevent the use of the material for the purpose intended.

4. SAMPLING, INSPECTION, AND TEST PROCEDURE

4.1 Inspection procedure.—

For Naval purchases, the general inspection procedures shall be in accordance with General Specifications for Inspection of Material, including Appendix II, Metals Part A, Definitions and Tests.

4.2 Lot.—

Unless otherwise specified, (see 6.1), a lot shall consist of all cold drawn bars of the same diameter from the same heat

and same stress relief furnace charge; in cases where continuous type stress relief furnaces are used, a lot shall consist of all cold drawn bars of the same diameter from the same heat, stress relieved in the same run of the continuous type stress relief furnace.

4.3 Samples for chemical analysis.—

Two samples for Government chemical analysis shall be obtained by the inspector from each heat. The samples shall be taken from hot rolled material before cold drawing. One sample shall be taken from the top end of the top bloom or billet of the first usable ingot, and one sample from the bottom end of the bottom bloom or billet of the last usable ingot of the heat. Drillings shall be taken at a point midway between the center and the lateral surface of the bloom or billet by drilling parallel to the longitudinal axis. The diameter of the drill shall be $\frac{1}{2}$ inch. Each sample shall contain not less than 2 ounces of drillings.

4.4 Tension tests.

4.4.1 Tension test samples.

4.4.1.1 Stress relief charges consisting of batches.—

From each 10,000 pounds, or fraction thereof, of cold drawn bars from the same lot, the inspector shall select one bar for tension tests from each end of the stress relief furnace charge when bars are arranged side by side. A third bar shall be selected from the middle when two stacks of bars are charged end-to-end.

4.4.1.2 Continuous stress relief furnace charges.—

When continuous type stress relief furnaces are used for cold drawn bars 1 inch and under in diameter one bar for tension tests shall be taken for each 500 bars, or fraction thereof, in a lot, except that not more than 20 bars shall be selected to represent the lot. For bars over 1 inch in diameter, stress relieved in continuous-type furnaces, one bar for tension tests shall be taken for each 250 bars, or fraction thereof, in a lot,

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except that not more than 10 bars shall be selected to represent the lot.

4.4.2 Tension test specimens.—Tension test specimens shall be bars in full section, or bars machined to conform to type I, of Specification QQ-M-151.

4.4.3 Tension test methods.—Tension tests shall be conducted in accordance with Specification QQ-M-151. Yield strength shall be determined by the divider method.

4.5 Compression tests for steel intended for use in 20 mm. high explosive and incendiary bodies.

4.5.1 When specified, compression tests shall be made of the cold drawn bars, after stress relieving, one compression test being made for each tensile test specified in 4.4.1. The number of compression tests may be reduced at the discretion of the purchasing agency.

4.5.2 Compression test specimens shall be 0.8 ± 0.010 inch long and of the full cross section of the bar, or they may be turned or ground to a diameter of 0.798 inch (area of section 0.5 sq. inch). The end faces shall be ground smooth, flat, parallel, and normal to the axis of the bar. A conditioning load of 11,200 p.s.i. shall be applied to the end faces and removed. The length of the test piece shall then be measured and the measurement recorded to 0.0001 inch.

4.5.3 A proof load of 71,680 p.s.i. shall be applied and held for 10 seconds. The piece will be considered to have failed if a set greater than 0.0020 inch is found on measurement after removal of the proof load.

4.6 Internal soundness tests for steel billets intended for 20 mm. high explosive and incendiary bodies.

4.6.1 The billets from each heat intended for 20 mm. high explosive and incendiary bodies shall be provided with distinguishing markings as required for the performance of inspection specified herein.

4.6.2 The top of the top billet and the bottom of the bottom billet from the first usable ingot, middle ingot and last usable ingot of each heat intended for 20 mm. high explosive and incendiary projectile bodies shall be tested for internal soundness. In addition, the top of the top billet from every intermediate ingot shall be tested and, where necessary, cut back and tested until sound metal is reached. Top and bottom refers to the position of the metal in the ingot as poured.

4.6.3 No billet will be accepted for use in the manufacture of 20 mm. high explosive and incendiary projectile bodies unless a test made from its top end or from a billet above it in the ingot is sound. In the event of failure because of unsoundness of any of the bottom tests of 4.6.2, all bottom billets shall be tested and, where necessary, cut back and retested until sound metal is reached.

4.6.4 Soundness inspection methods.

4.6.4.1 Billets.—Specimens for macroscopic examination shall consist of transverse slices not less than $\frac{1}{4}$ inch thick representing the whole cross-section of the billet. At least one surface shall be machined or ground to a high surface finish. At the option of the contractor, an abrasive cut-off wheel may be used to remove the specimens, in which case no further surface preparation shall be required. The specimens shall be cleaned free from cutting fluid and then etched for 15 to 20 minutes in a solution of 50 parts hydrochloric acid and 50 parts water by volume, maintained at a temperature of 150 to 160° F. Billets shall be considered unsound when their representative specimens show any discontinuity in excess of standards furnished or approved by the purchasing agency.

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4.6.4.2 Bars.—In the event it is desired to manufacture 20 mm. high explosive or incendiary projectile bodies from steel not inspected or not passed as acceptable on inspection in billet form, each end of each bar shall be inspected as specified in 4.6.4.1, or by the fracture test. The fracture test shall expose a clean surface of the entire cross-sectional area of the bar. The fracture to be examined shall be approximately perpendicular to the axis of the bar, reasonably smooth and regular, free from pipe, flakes, and other internal defects which may be injurious in processing the material into shell bodies.

4.7 Magnetic tests.—Magnetic tests for revealing seams in cold drawn bars shall be made by a method approved by the purchasing agency.

4.8 Rejection and retests.

4.8.1 Rejection.—If a test specimen fails to meet any of the requirements of this specification, the lot represented by the specimen shall be rejected. If failure is due to improper heat-treatment, the contractor may re-heat and resubmit the lot for inspection. Only one such re-heat treatment shall be allowed.

4.8.2 Retests.—Retests shall be permitted in accordance with Specification QQ-M-151.

5. PREPARATION FOR DELIVERY

5.1 Preservation.—Cold-drawn steel bars shall be coated with oil, or other corrosion preventive, before shipment.

5.2 Packing.

5.2.1 All cold-drawn bars shall be separated by nominal size when loaded for shipment.

5.2.2 Cold-drawn bars shall be packed and loaded as specified.

5.2.3 Loading and packing shall be such as to insure acceptance by common or other carrier for safe transportation to the point of delivery at the lowest rate.

5.3 Marking.

5.3.1 For carload shipments, marking information shall be contained in the bills of lading and in the Government inspector's report.

5.3.2 For bars shipped boxed or bundled, shipping containers shall be marked, or tagged, with the name of the material, quantity, lot number, and the contract or order number.

5.3.3 For bars shipped loose in less than carload shipments, each bar shall be stamped or tagged with the lot number and the contract order number.

5.3.4 Shipping containers or units containing cold drawn bars for 20 mm. high explosive and incendiary bodies shall be so identified.

5.3.5 In addition to any special marking required by the contract or order, and by 5.3.2, 5.3.3, and 5.3.4, the provisions of Specification 100-2 for Army purchases, and the Navy Shipment Marking Handbook for Navy purchases, shall apply whenever applicable.

6. NOTES

6.1 Ordering data. — The purchasing agency should specify the title, number, and date of this specification, and the size and quantity of cold drawn bars; and should exercise any option contained herein (see 3.2.1, note 1 of Table I, 3.5.3, 3.7.1, 4.2, 4.5.1 and 5.2.2). Attention is invited to the fact that suitable standards for macro-etch examination of billets should be furnished (see 4.6.4.1).

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Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any

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