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## MILITARY SPECIFICATION

### BAR, METAL AND BLANKS, STEEL (UNDER 2 INCHES IN DIAMETER) FOR BARRELS OF SMALL ARMS WEAPONS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers alloys steel, bars and blanks under 2 inches in diameter for use in the manufacture of barrels for small arms weapons (see 6.1 and 6.3).

#### 1.2 Classification.

1.2.1 Composition. Bars and blanks shall be furnished in the compositions listed in table I, as specified (see 6.2).

\* 1.2.2 Condition. Bars and blanks shall be furnished in the following conditions, as specified (see 6.2 and 6.3):

Bars (mill length).

Hot rolled, as rolled.

Hot rolled and annealed (see 6.6).

Quenched and tempered.

Blanks and gun barrel bar lengths.

As rolled or as forged.

Cold formed blanks (spheroidize annealed before forming.)

Quenched and tempered.

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Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Laboratory Command, Materials Technology Laboratory, ATTN: SLCMT-MEE, Watertown, MA 02172-0001 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

## STANDARDS

## FEDERAL

- FED-STD-48 - Tolerances for Steel and Iron Wrought Products, and for Centrifugally Cast Steel.
- FED-STD-66 - Steel: Chemical Composition and Hardenability.
- FED-STD-151 - Metals: Test Methods.

## MILITARY

- MIL-STD-163 - Steel Mill Products Preparation for Shipment and Storage

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

## ASTM

- ASTM A255 - End-Quench Test For Hardenability of Steel
- ASTM A751 - Chemical Analysis of Steel Products
- ASTM E10 - Brinell Hardness of Metallic Materials
- ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Material
- ASTM E23 - Notched Bar Impact Testing of Metallic Materials
- ASTM E140 - Standard Hardness Conversion Tables for Metals
- ASTM E381 - Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings

(Applications for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

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## SOCIETY OF AUTOMOTIVE ENGINEERS

AMS 2640 - Magnetic Particle Inspection.

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York City, New York 10017.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

### 3. REQUIREMENTS

3.1 Chemical composition. The chemical composition shall conform to the requirements shown in table I.

TABLE I. Chemical composition.<sup>1,2,3</sup>

Element	Composition		
	ORD 4150 Percent	ORD 4150 Resulfurized Percent	Chrome-Moly-Vanadium Percent
Carbon	0.48 - 0.55	0.47 - 0.55	0.41 - 0.49
Manganese	0.75 - 1.00	0.70 - 1.00	0.60 - 0.90
Phosphorus	0.040	0.040	0.040
Sulfur	0.040	0.05 - 0.09	0.040
Silicon	0.20 - 0.35	0.20 - 0.35	0.20 - 0.35
Chromium	0.80 - 1.10	0.80 - 1.15	0.80 - 1.15
Milybdenum	0.15 - 0.25	0.15 - 0.25	0.30 - 0.40
Vanadium			0.20 - 0.30

<sup>1</sup>Chemical ranges and limits based on ladle analysis.

<sup>2</sup>Maximum except where indicated as a range.

<sup>3</sup>Steels containing elements not designated, in excess of the following amounts, shall be subject to rejection: copper 0.35 percent and aluminum 0.040 percent.

3.1.1 Ladle analysis. A certified ladle analysis of each heat or melt of steel (see 6.3) shall be furnished by the contractor showing the percentages of the elements present.

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3.1.2 Check analysis. The chemical composition, as determined by check analysis (see 4.4.2 and 4.6.2.1), shall meet the applicable requirements specified in FED-STD-66 except that check analysis for sulfur shall be required for ORD 4150 Resulfurized steel with an allowance of 0.01 percent under or over specification limits.

3.2 Quenched and tempered condition (see 1.2.2).

\* 3.2.1 Hardness. Bars and blanks specified in the quenched and tempered condition shall have a Brinell hardness of 277 to 331 when tested as specified in 4.4.3 and 4.6.2.2.

3.2.2 Heat-treatment. Heat treatment shall consist of heating, quenching in circulating oil, and tempering to meet specified hardness and physical properties (see 6.5).

3.2.3 Stress relief. Unless otherwise specified, material which has been cold straightened after heat-treatment shall be stress relieved at a temperature not lower than 150°F below the final tempering temperature.

3.3 Impact resistance.

\* 3.3.1 Quenched and tempered condition. When bars or blanks are furnished in the quenched and tempered condition, test specimens from samples taken as specified in 4.4.4.1 shall have an average longitudinal impact value at a temperature of minus 40°F of not less than 40 foot-pounds when tested as specified in 4.6.1.1 and 4.6.2.3. No individual value shall be less than 35 foot-pounds. When blanks are produced by processes which involve an upset forging operation in the cartridge chamber area, each test specimen taken from the chamber area shall have a longitudinal impact value at a temperature of minus 40°F of not less than 15 foot-pounds. Specimens taken from the non-upset area (see 4.6.1.1.3 (a)) shall meet the 40 foot-pound average and the 35 foot-pound individual requirements specified above.

\* 3.3.2 As rolled, as forged, cold formed, or annealed condition. When bars or blanks are furnished in any of the above conditions, test specimens from samples taken as specified in 4.4.4.2 and heat-treated as specified in 4.6.1.1.2 to a Rockwell hardness of C30 to C35 (or the equivalent Brinell hardness as determined using the applicable conversion table contained in ASTM E140) shall have an average longitudinal impact value at a temperature of minus 40°F of not less than 40 foot-pounds when tested as specified in 4.6.1.1 and 4.6.2.3. No individual value shall be less than 35 foot-pounds. When blanks are produced by processes which involve an upset forging operation in the cartridge chamber area, each test specimen taken from the chamber area shall have a longitudinal impact value at a temperature of minus 40°F of not less than 15 foot-pounds. Specimens taken from the non-upset area (see 4.6.1.1.3 (a)) shall meet the 40 foot-pound average and the 35 foot-pound individual requirements specified above.

3.4 Macrostructure.

3.4.1 ORD 4150 and chrome-moly-vanadium. The quality and cleanliness of the steel as indicated by the results of the macroetch test specified in 4.4.5, 4.6.1.2, and 4.6.2.4 shall be equal to or better than macrographs S-2,

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R-2, and C-2 for the electric furnace process and S-3, C-3 and R-3 for the open hearth process as shown in ASTM E381.

3.4.2 ORD 4150 resulfurized. The quality and cleanliness of the steel as indicated by the results of the macroetch test specified in 4.4.5, 4.6.1.2 and 4.6.2.4 shall be equal or better than macrographs C3-S4 contained in plate I of ASTM E381 and free of all defects shown in plate II of ASTM E381.

\* 3.5 Nonmetallic inclusions. The steel shall have a maximum average rating of 0.45 for both frequency and severity when tested as specified in 4.4.6, 4.6.1.3 and 4.6.2.5. No individual test specimen shall have a severity rating greater than 0.75.

3.6 Hardenability. The hardenability of the steel shall be not less than J52 (Rockwell C52) at 8/16 inch (one-half inch from the end of a standard Jominy or end-quench test specimen) when tested as specified in 4.4.7, 4.6.1.4 and 4.6.2.6.

\* 3.7 Forging practice. When forging operations are performed, process controls shall be subject to Government approval. Heating for forming shall be conducted using methods and equipment, including pyrometric controls, suitable for the purpose.

### 3.8 Dimensions and tolerances.

3.8.1 Blanks and forged bars. Blanks and forged bars (see 6.3) shall conform to the dimensions and tolerances specified in the contract or order (see 6.2).

\* 3.8.2 Hot rolled bars. Unless otherwise specified, hot rolled bars shall conform to the ordered dimensions and shall be within the tolerances shown in the following paragraphs of FED-STD-48 (see 6.2).

<u>Dimension</u>	<u>Paragraph</u>
Diameter	1b1
Straightness	1b5

\* 3.9 Marking. Each bar or blank shall be suitably marked to identify the heat or melt. The marking medium shall not react objectionably with the surface of the steel during heat-treatment. When specified, individual bars or blanks shall be identified as required in the invitation for bids or order (see 6.2).

3.10 Workmanship. Bars and blanks shall be sound; uniform in quality and condition; and commercially free of indications of overheating or burning, cracks, twists, seams, damaged ends, and other related defects injurious to the finished component (see 6.3).

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## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 Classification of inspection. All examination and testing in this specification is classified as quality conformance inspection and shall be to determine conformance to the requirements of the specification to serve as a basis for acceptance of the material covered by this specification.

4.3 Lot. A lot shall consist of all material submitted for inspection at the same time, of the same heat or melt, same condition, same size, and when heat-treated, shall be from the same furnace charge of a batch type furnace or shall be of the same heat-treatment in a continuous furnace. Identification of each heat or melt shall be maintained throughout manufacture and inspection.

4.4 Sampling.

\* 4.4.1 For visual and dimensional examination. Unless otherwise specified in the contract or order, the contractor shall use his normal commercial sampling procedures.

4.4.2 For Government product analysis. When Government product analysis is performed, at least one sample shall be taken from each heat or melt. Each sample shall be composed of approximately 2 ounces of drillings or millings taken from bars or blanks in accordance with ASTM A751. Samples shall be forwarded prepaid by the contractor to the designated testing agency (see 6.2).

4.4.3 For hardness testing. When bars or blanks are furnished in the quenched and tempered condition, the contractor shall take at random 10 samples from each 100 bars or fraction thereof. One defective sample shall cause rejection of the represented material.

4.4.4 For impact resistance testing.

\* 4.4.4.1 Quenched and tempered condition. Bars or blanks shall be taken from each heat or melt in accordance with the applicable schedule contained in table II. Sampling shall be performed in alphabetical sequence as specified in table II, and tests for each schedule must be satisfactorily completed prior to undertaking the next schedule. Sampling will revert to schedule A when any of the following occurs:

- (a) Failure of sample specimens to meet impact resistance requirements (see 3.3.1).
- (b) Modification of the heat-treat process.
- (c) Utilization of new heat-treat equipment.
- (d) Samples are taken from new heat or melt.
- (e) When continuous furnace is restarted after shutdown.

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TABLE II. Sampling for impact resistance testing.

Schedule	Batch Furnace	Continuous Furnace
A	One bar or blank from each quench lot for three consecutive quench lots from each heat-treat furnace used.	One bar or blank at start of operation. Three bars or blanks from each 1,000 bars or blanks or each 8 hours of operation, whichever occurs first. Samples shall be taken at beginning, middle and end of run. Ten consecutive satisfactory tests representing runs of 1,000 bars or blanks or 8 hours of operation shall be obtained before proceeding to schedule B.
B	One bar or blank from every 4 quench lots or each day's production, whichever occurs first, from each heat-treat furnace used for 20 consecutive samples.	One bar or blank from each 1,000 bars or blanks or each 8 hours of operation, whichever occurs first.
C	One bar or blank from each week's production from each heat-treat furnace used.	

\* 4.4.4.2 As rolled, as forged, cold formed, or annealed condition. One sample shall be taken from material representing the top and bottom of the first and last usable ingots of the heat or melt (four samples per heat or melt). Blooms or billets may be forged to bar or blank diameter for use as samples for this testing. At the option of the Government, random sampling may be used by taking at least 1 bar or blank for each 10,000 pounds of material, or fraction thereof. In any case the sample to be tested shall be of the diameter specified in the contract or order (see 6.2).

4.4.5 For macroetch testing. Full cross-section samples shall be taken, after discard, from billets representing the top and bottom of the first, middle and last usable ingots of each heat or melt. At the option of the Government, random sampling may be used by taking a full cross-section sample from at least 1 billet in each 10,000 pounds of material, or fraction thereof. In the absene of billet tests, 10 bars shall be taken from each lot.

\* 4.4.6 For nonmetallic inclusion testing. A sample shall be taken from bars and blanks representing the top and bottom of the first and last usable ingots from heats or melts having not over 10 ingots or more than 30 tons, or from portions of heats or melts within these limits; and from the top and bottom of the first, middle, and last usable ingots of heats or melts having more than 10 ingots or over 30 tons. Blooms and billets may be forged to finished bar or blank size for use as samples for this testing. At the option of the Government, random sampling may be used by taking a sample of 10 bars or blanks from each lot. When specified in the contract or order (see 6.2), the contractor shall submit to the procuring agency, prior to or not later than

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delivery of the product of the heat or melt, test samples from the same bars or blanks from which the contractor's test samples were taken. These samples shall be approximately 14 inches long.

\* 4.4.7 For hardenability testing. At least one sample shall be taken from material representing the top and bottom of the first and last usable ingots in the heat or melt (four samples per heat or melt).

#### 4.5 Examination.

\* 4.5.1 Forging practice. Periodic surveillance of forging practice shall be conducted to assure compliance with the requirements of 3.7. The Government representative shall have access to pyrometers and recording instruments and to their records. The accuracy of the pyrometers and sensing devices shall be checked by the contractor using suitable calibrating equipment whenever requested by the Government representative.

4.5.2 Heat treatment and stress relief. Periodic process surveillance shall be conducted to assure compliance with the heat treatment (see 3.2.1) and stress relief (see 3.2.3) requirements.

4.5.3 Dimensional, marking, and workmanship. Bars and blanks shall be inspected by any suitable method acceptable to the Government to assure compliance with dimensional (see 3.8), marking (see 3.9) and workmanship (see 3.10) requirements.

4.5.4 Preparation for shipment. Examination of the preservation, packaging, packing, and marking for shipment shall be made for conformance to the requirements of section 5.

#### 4.6 Tests.

##### 4.6.1 Test specimens.

##### 4.6.1.1 Impact resistance.

\* 4.6.1.1.1 Quenched and tempered condition. At least two V-notch Charpy impact specimens shall be taken (see 4.6.1.1.3) from each sample bar or blank (see 4.4.4.1) and prepared in accordance with ASTM E23. When blanks are produced by processes which involve an upset forging operation in the chamber area, at least two additional specimens shall be taken as specified in 4.6.1.1.3(a), and prepared as specified above.

\* 4.6.1.1.2 As rolled, as forged, cold formed, or annealed condition. Heat-treatment shall be performed on each bar or blank, taken in accordance with 4.4.4.2, or on cylindrical test coupons taken from a sample bar or from the chamber area of a sample blank. Heat-treatment shall consist of austenitizing, oil quenching, and tempering, in accordance with table IV, to the hardness range specified in 3.3.2 (see 6.5). Heat-treatment should be conducted in a manner to produce a microstructure of tempered martensite in the material. Preliminary normalizing may be used. After heat-treatment, at least two V-notch Charpy impact specimens shall be taken (see 4.6.1.1.3) from each sample bar, blank or test coupon, and prepared in accordance with ASTM E23. When blanks are produced by processes which involve an upset

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forging operation in the chamber area, at least two additional specimens shall be taken as specified in 4.6.1.1.3(a), and prepared as specified above. Hardness readings to determine compliance with 3.3.2 shall be taken in accordance with ASTM E10 or ASTM E18 as applicable, on the notched face of the hardened test specimen within one-fourth inch of the center line of the notch.

\* 4.6.1.1.3 Location from which test specimens shall be taken. Unless otherwise specified, Charpy impact test specimens shall be taken from sample bars, blanks, or test coupons, as follows:

- (a) Blanks. From the chamber area, at least one major chamber diameter away from the chamber end. When blanks are produced by processes which involve an upset forging operation in the chamber area, the additional specimens shall be taken from a non-upset area beginning between 2 to 3 inches forward of the upset section.
- (b) Bars. From an area at least one bar diameter away from the bar end.
- (c) Test coupons. From an area at least one cylinder diameter away from the coupon end.

4.6.1.2 Macrostructure. Specimens shall be prepared in accordance with ASTM E381.

4.6.1.3 Nonmetallic inclusions.

\* 4.6.1.3.1 Type of specimen. Unless otherwise specified, testing for nonmetallic inclusions shall be conducted using the step-down specimen. When specified in the contract or order (see 6.2), a straight cylindrical specimen may be used in lieu of the step-down specimen.

4.6.1.3.1.1 Step-Down specimen. The step-down specimen shall be generated in equal length circumferential steps as follows:

<u>Bar or blank diameter</u>	<u>Step length</u>	<u>Step diameter</u>				
		1	2	3	4	5
Inches	Inches					
over 0.500 to 0.750 incl.	2.500	D	2/3D			
over 0.750 to 1.000 incl.	1.665	D	3/4D	1/2D		
over 1.000 to 1.500 incl.	1.250	D	4/5D	3/5D	2/5D	
over 1.500 to 1.990 incl.	1.000	D	4/5D	3/5D	2/5D	1/5D

D = original diameter minus machining stock removal (see 4.6.1.3.2).

\* 4.6.1.3.1.2 Straight cylindrical specimen. The specimen shall be machined in accordance with the machining allowance specified in 4.6.1.3.2, to a straight cylindrical specimen 5 inches  $\pm$  1/16 inch in length.

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4.6.1.3.2 Machining allowance.

<u>Diameter</u> Inches	<u>Minimum stock removal</u> <sup>1</sup> Inch (measured on radius)
over 0.500 to 0.750 incl.	0.045
over 0.750 to 1.000 incl.	0.060
over 1.000 to 1.500 incl.	0.075
over 1.500 to 1.900 incl.	0.090

<sup>1</sup>Allow 0.010 inch for finish machining after heat treatment.

\* 4.6.1.3.3 Heat treatment. Rough machined specimens shall be hardened by suitably austenitizing, quenching, and tempering to produce a hardness not lower than Brinell 250.

4.5.1.3.4 Surface finish. The finish machined surface of the test specimen shall not exceed a roughness height rating of 40 microinches. The ends shall be finished to provide good electrical contact.

4.6.1.4 Hardenability. Specimens shall be prepared in accordance with ASTM A255.

4.6.2 Test methods.

4.6.2.1 Chemical analysis. Chemical analysis of the samples taken in accordance with 4.4.2 shall be conducted in accordance with method 111 or 112 of FED-STD-151. In cases of dispute, referee analysis shall be in accordance with method 1111.

4.6.2.2 Hardness. Hardness readings shall be taken in accordance with ASTM E10 on the exterior of the test bars and blanks.

4.6.2.3 Impact resistance. Charpy impact test shall be conducted in accordance with ASTM E23. The temperature of the test specimen at the time of fracture shall be minus 40° ± 2°F.

4.6.2.4 Macrostructure. The macroetch test shall be conducted in accordance with ASTM E381.

4.6.2.5 Nonmetallic inclusions. The nonmetallic inclusion content shall be determined by the method specified below.

\* 4.6.2.5.1 Testing. Testing shall be by the wet magnetic particle method specified in AMS 2640 using circular magnetization with a magnetizing current of 900 to 1.100 amperes per inch of diameter. Direct current shall be used for magnetizing. When the step-down specimen is used, the smallest step shall be magnetized and inspected first; the next larger step shall be magnetized and inspected in succession. Inclusions one-eighth inch or less in length shall not be counted.

4.6.2.5.2 Results. The frequency and severity of nonmetallic inclusions shall be determined as shown below.

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4.6.2.5.1 Frequency.

- (a) Total the number of indications for each specimen.
- (b) Divide the total number of indications per specimen by the surface area of the specimen in square inches. This value is the frequency rating of the specimen.
- (c) Total the frequency ratings of the specimens.
- (d) Divide the total frequency ratings by the number of specimens. This value is the average frequency rating.

4.6.2.5.2.2 Severity.

- (a) The length of each indication is recorded.
- (b) Total the number of indications for each size interval shown in table III.
- (c) Multiply the total number per size interval by the severity factor of table III.
- (d) Total the products obtained in (c) for each specimen.
- (e) Divide the product total by the surface area of the specimen in square inches. This value is the severity rating for the specimen.
- (f) Total the severity ratings of the specimens.
- (g) Divide the total severity ratings by the number of specimens. This value is the average severity rating.

TABLE III. Severity of nonmetallic inclusions.

Indication length <sup>1</sup>	Severity factor
Inch	
over 1/8 to 1/4 incl.	1
over 1/4 to 1/2 incl.	2
over 1/2 to 3/4 incl.	4
over 3/4 to 1 incl.	8
over 1	16

\*1 When the step-down specimen is used, an inclusion extending the entire length of a step shall be considered to be longer than 1 inch and shall be assigned a weight of 16.

4.6.2.6 Hardenability. The hardenability test shall be conducted in accordance with ASTM A255 except that the austenitizing temperature shall be as specified in table IV.

4.7 Rejection.

4.7.1 Examination. Individual bars or blanks not meeting the requirements of this specification shall be rejected. When sampling inspection is used, the represented lot shall be rejected when the number of rejected sample units equals or exceeds the rejection number specified.

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4.7.2 Tests. Failure to comply with any of the test requirements of this specification shall be cause for rejection of the represented material.

Retest. When no sampling plan is provided for approved by the procuring agency and where there is evidence that indicates that the specimen was not representative of the lot of material, and when the detail specification does not otherwise specify, at least two specimens shall be selected to replace each test specimen which failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

\* 4.9 Calibration of impact test machines. Charpy impact test machines shall be calibrated in accordance with ASTM E23.

## 5. PREPARATION FOR DELIVERY

### 5.1 Preservation and packaging.

5.1.1 Level A. Preservation and packaging of bars and blanks shall be in accordance with MIL-STD-163.

5.1.2 Level C. Preservation and packaging of bars and blanks shall be in accordance with standard commercial practice.

### 5.2 Packing.

5.2.1 Level A. Packing of bars and blanks shall be in accordance with MIL-STD-163.

5.2.2 Level C. Packing of bars and blanks shall be in accordance with standard commercial practice adequate to insure carrier acceptance and safe delivery at the lowest rate. Shipments shall comply with the requirements of the regulations applicable to the mode of transportation.

5.3 Marking. In addition to any special markings required by the contract or order, shipments shall be marked in accordance with MIL-STD-163 (see 6.2). The heat or melt identification shall be required as part of the basic marking.

## 6. NOTES

### 6.1 Intended use.

6.1.1 Steel covered by this specification is intended for use in the manufacture of gun barrels requiring deep hold drilling and rifling operations.

6.1.2 The scope of this specification does not limit the size of bars and blanks purchased in the unheat-treated condition; provided that material will be under 2 inches in diameter when heat-treatment is performed.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification
- (b) Whether bars or blanks are required.
- (c) Composition and condition required (see 1.2).

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- (d) Size required (see 3.8).
- (e) When sampling other than contractor's normal sampling procedure is specified (see 4.4.1).
- (f) Shipping instructions for Government check analysis sample (see 4.4.2).
- (g) Selection of applicable levels of preservation, packaging, and packing (see section 5).
- (h) When special marking is required (see 5.3).
- (i) Certification requirements.
- (j) Special marking on bars or blanks (see 3.9).
- (k) Whether nonmetallic inclusion test samples are required by the procuring agency (see 4.4.6).
- (l) Diameter of sample to be tested for impact resistance (see 4.4.4.2).
- (m) When straight cylindrical specimen is specified for nonmetallic inclusions testing (see 4.6.1.3.1).

\* 6.3 Definitions. Listed below are definitions of some of the special terms used in this specification:

As forged - As forged, upset, or extruded.

Blank - A partially formed gun barrel requiring machining or some other operations to produce a finished barrel.

Crack - Separation of material visually evidenced by a fine irregular line.

Forged bar - A hot rolled bar that has had any subsequent working (see "as forged").

Gun barrel bar length - Length of finished barrel plus allowance for machining.

Heat - Metallic output of one charge of an open hearth furnace (see "melt").

Melt - Metallic output of one charge of an electric furnace ("heat" and "melt" are often used interchangeably).

Mill length - Length of bar produced by steel mill. Mill length bars are usually furnished in multiple gun barrel bar lengths plus allowance for loss of material in cutting.

Seam - An unwelded lap or fold on the surface of metal usually produced during rolling or forging. May appear to be a crack.

Twist - A distortion caused by the rotation of the ends of a bar in opposite directions.

6.4 Heat-treatments indicated in table IV are for guidance.

TABLE IV. Heat-treatment procedure.

Composition	Normalizing temperature (°F)	Austenitizing temperature (°F)	Approximate tempering (°F)
Chrome-Moly Vanadium	1675 ± 25	1600 ± 25	1200
ORD 4150 and ORD 4150 Resulfurized	---	1575 ± 25	1150

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6.4.1 Minimum holding time for each heat treating operation should be 1 hour at heat for each inch of thickness at the maximum effective cross-section.

\* 6.5 For ease in cutting into barrel lengths, hot rolled mill length bars should be ordered in an annealed condition to a maximum brinell hardness of 250.

6.6 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

6.7 Metric conversion.

Metric Units and Conversion Factors

Multiply	By	To obtain
Inch	0.0254	Metre
Foot	0.3048	Metre
Foot Pound	1.3558	Joule
Pound	0.4536	Kilogram
Fahrenheit temp. = F	$C = 5/9(F - 32)$	
Celsius temp. = C		

6.8 Key words.

Steel	Hot rolled
Gun-barrels	Quenched
Small arms	Annealed
Bars	Tempered
Blanks	

Custodian:  
Army - MR

Preparing activity:  
Army - MR

Review activity  
Army - AR

Project 9510-A052

(WP# ID-0652B/DISC-0123B. FOR MTL USE ONLY.)

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-B-11595E(MR)		2. DOCUMENT TITLE BAR, METAL AND BLANKS, STEEL (UNDER 2 INCHES IN DIAMETER) FOR BARRELS OF SMALL ARMS WEAPONS	
3a. NAME OF SUBMITTING ORGANIZATION		3. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify) _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording			
b. Recommended Wording			
c. Reason/Rationale for Recommendation			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	