MIL-S-980B
1 July 1965
Superseding
MIL-S-980A
15 January 1952

MILITARY SPECIFICATION

STEEL, CHROMIUM ALLOY, BARS (FOR TORPEDO GYROSCOPE BEARINGS)

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope - This specification covers spheroidized chromium alloy steel bars of special metallurgical quality in sizes 1 inch and under in diameter, for use in torpedo gyroscope bearings requiring a finish of minimum surface roughness.

1.2 Classification - Chromium alloy steel bars shall be of the following classes, as specified (see 6.1):

Class I - Hot Rolled.

Class II - Ground.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

QQ-T-570 Tool Steel, Alloy

FSC 9510

STANDARDS

Federal

FED-STD-48	Tolerances for Iron and Steel Wrought Products
Fed Test Method Std. No. 151	Metals, Test Methods
FED-STD-183	Continuous Identification Marking of Iron and Steel Products

Military

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

(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.)

2.2 Other publications - The following publication, unless otherwise stated, forms a part of this specification·

AMERICAN SOCIETY FOR TESTING AND MATERIALS PUBLICATION

ASTM Standard E45	Determining the Inclusion Content of Steel

(Information as to the availability of this standard may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.)

3. REQUIREMENTS

3.1 Process - The bars shall be rolled or drawn from vacuum melted steel.

3.2 Chemical composition - The chemical composition shall conform to Table I. The contractor shall furnish a report of the ladle analysis of each heat.

3.3 Hardness (as received) - The Rockwell hardness of the bars as received shall be not more than 95 on the B scale when tested in compliance with 4.4.3.

TABLE I. Chemical Composition

Element	Ladle analysis		Permissible variations for check analyses, over the maximum limit or under the minimum limit.
	Minimum	Maximum	
	Percent	Percent	Percent
Carbon	0.95	1.10	0.03
Manganese	0.25	0.45	0.03
Silicon	0.20	0.35	0.02
Chromium	1.30	1.60	0.05
Nickel	----	0.35	0.03
Molybdenum	----	0.08	0.01
Sulphur	----	0.025	0.005
Phosphorus	----	0.025	0.005
Copper	----	0.25	----

3.4 Macrostructure - The bars shall show no pipe, porosity, abnormal segregation, or abnormal change in structure from surface to center when tested in compliance with 4.4.4. The etched sections shall be superior to the macrostructures shown for 1" Diameter on Plate No. I of QQ-T-570.

3.5 Microstructure -

3.5.1 Carbide form - The carbides shall be spheroidized and of the size and form illustrated on the acceptable photograph of figure 1, when bars are tested in compliance with 4.4.7.

3.5.2 Carbide distribution - The carbide distribution shall be as illustrated on the acceptable photograph of figure 2, when the bars are tested in compliance with 4.4.8.

3.5.3 Inclusions - The inclusion rating of bars tested in compliance with 4.4.6 shall be in conformance with Table II.

TABLE II. Inclusion content rating (see 4.4.6)

INCLUSION TYPE	DIMENSIONAL LIMITATION THICKNESS OR DIAMETER, INCH	WORST FIELD
A - Thin	0.00016 max	2.0
A - Heavy	0.00040 max	1.0
B - Thin	0.0003 to 0.0005, excl	1.5
B - Heavy	0.0005 to 0.0010, incl	1.0
C - Thin	0.00020 max	1.5
C - Heavy	0.00035 max	1.0
D - Thin	0.0002 to 0.0004, excl	1.5
D - Heavy	0.0004 to 0.0010, incl	1.0

3.5.3.1 For Types A, B, and C thin combined, there shall be not more than three fields of No. 2.0 A Type or No. 1.5 B and C Types and not more than five other lower rateable A, B, and C Type thin fields per specimen. For Type D thin, there shall be not more than three No. 1.5 fields and no more than five other lower rateable D Type thin fields per specimen. There shall be not more than one field each of No. 1.0 A, B, C, or D Type heavy per specimen.

3.6 Hardness (heat treated) - The Rockwell hardness from the center to the edge of specimens tested in compliance with 4.4.10 shall be not less than 63 on the C scale.

3.7 Grain size of the hardened fracture - The grain of specimens tested in compliance with 4.4.9 shall be fine and uniform.

3.8 Decarburization - When tested in compliance with 4.4.2, ground bars shall show no decarburization (partial plus total). Decarburization (partial plus total) of hot rolled bars 1 inch and under in diameter shall not exceed 0.012 inch in depth.

3.9 Permissible variation in diameter - The maximum permissible variation from specified diameter for ground bars shall be plus or minus 0.001 inch. The maximum permissible variation from specified diameter for hot rolled bars shall be as shown in paragraph 1a1 of Federal Standard No. 48.

3.10 Length - Unless otherwise specified by the procuring activity, bars shall be furnished in mill lengths of 6 to 16 feet except that weight of bars shorter than 10 feet shall not exceed 10 percent of the total weight.

3.11 Identification of product - Bars shall be marked in accordance with Federal Standard No. 183.

3.12 Workmanship - The bars shall be of uniform quality, smooth, free from injurious defects such as heavy scale, deep pits, pipe, laps, cracks, and seams. The bars shall be commercially straight and free from damaged ends.

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, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 Sampling -

4.2.1 Lot - For the purpose of sampling and inspection, a lot shall consist of all the bars submitted for inspection at the same time of the same melting furnace heat and of the same annealing furnace.

4.2.2 Sampling for chemical analysis - One sample for chemical analysis shall be selected from each lot.

4.2.3 Sampling for hardness (as received), macrostructure, microstructure, decarburization - One full cross-sectional slice, 1/2 ± 1/32 inch long, shall be taken from one end of each bar of the lot.

4.2.4 Sampling for hardness (heat treated), grain size - One full cross-sectional slice, 2 inches long, shall be taken from each of five bars of the lot.

4.3 Examination - Five bars from each lot shall be examined to establish compliance with identification, dimensional and workmanship requirements.

4.4 Tests -

4.4.1 Chemical analysis - The sample taken as specified in 4.2.2 shall be subjected to chemical analysis in accordance with Method 111 or 112 of Federal Test Method Standard No. 151. In case of dispute, the analysis of Method 111 shall be the basis for acceptance or rejection.

4.4.2 Decarburization - Both faces of no fewer than five of the specimens taken as specified in 4.2.3 shall be finished flat and smooth. One face of each specimen shall be polished and etched with a 5 percent nital solution (5 percent nitric acid, 1.43 sp. gr., plus 95 percent ethyl alcohol). The specimen shall be rinsed in ethyl alcohol, blown dry, and examined for decarburization, at a magnification of 100 diameters.

4.4.3 Hardness (as received) - Rockwell B hardness determinations shall be made on the unetched face of the five specimens employed for the tests of 4.4.2.

4.4.4 Macrostructure - One face of each of the remaining specimens taken as specified in 4.2.3 shall be made flat and smooth by a fine machine cut or by grinding. The smooth face of these specimens and the unetched face of the specimens employed for the tests of 4.4.2 shall be etched for 35 minutes at 160 to 175° F in dilute hydrochloric acid (50 percent hydrochloric acid, 1.19 sp. gr., plus 50 percent water). The specimens shall be scrubbed with a brush under running hot water, rinsed, and dried by an air blast. The specimens shall be examined by the unaided eye for compliance with 3.4.

4.4.5 Microstructure - Ten of the specimens employed for the tests of 4.4.4 shall be cut in the longitudinal direction, midway between the center and the surface of the specimen. The longitudinal surface of one part of each specimen shall be polished.

4.4.6 Inclusions - The inclusion content shall be determined on the polished longitudinal face of each of the ten specimens taken as specified in 4.4.5. The area to be rated shall be approximately 1/2 by 1/2 inch. When test specimens taken in conformance with 4.2.3 and 4.4.5 are smaller than 1/2 by 1/2 inch, the area to be rated shall be the entire area of the specimen. A rateable field is defined as one which has a Type A, B, C, or D inclusion rating of at least No. 1.0 thin or heavy in accordance with the dimensional limitations of 3.5.3 and the Jernkontoret chart, Plate III, ASTM E45.

4.4.7 Carbide form - The 10 specimens employed for the tests of 4.4.6 shall be etched in a 5 percent nital solution, rinsed in ethyl alcohol and dried by an air blast. The specimen shall be examined at a magnification of 1,000 diameters for compliance with 3.5.1.

4.4.8 Carbide distribution - The etched specimen employed for the tests specified in 4.4.7 shall be examined at a magnification of 100 diameters for compliance with 3.5.2.

4.4.9 Grain size - The specimens taken as specified in 4.2.4 shall be hardened by heating at 1,500 to 1,600° F for 40 minutes and quenching in oil maintained at 100 to 120° F. The specimens shall be broken transversely at a section midway between the ends and examined at the fracture for compliance with 3.7.

4.4.10 Hardness (heat treated) - The fractured face of one part of the specimen employed for the tests of 4.4.9 shall be prepared for hardness test by careful grinding, using a coolant. The Rockwell C hardness of the ground face shall be determined from the center to the edge. Hardness tests shall not be made on any decarburized zones near the edge.

4.5 Rejections - A lot shall be rejected if any specimen or bar fails to comply with this specification. At the discretion of the contractor/supplier retest will be permitted. A retest sample of five specimens shall be tested to replace each failed specimen of the original sample. If one of the retest specimens fails, the lot shall be rejected and no further retesting permitted.

5. PREPARATION FOR DELIVERY

5.1 Preservation - Bars shall be prepared for shipment in accordance with Levels A or C, as specified (see 6.2).

5.1.1 Level A - Preservation for shipment shall be specified for High Speed and Tool Steel, Cold Finished, in accordance with MIL-STD-163.

5.1.2 Level C - Preservation for shipment shall be in accordance with the contractor's commercial practice.

5.2 Packing - Bars shall be packed for shipment in accordance with Level A or C as specified (see 6.2).

5.2.1 Level A - Packing for shipment shall be as specified for High Speed and Tool Steel, Cold Finished, in accordance with MIL-STD-163.

5.2.2 Level C - Packing for shipment shall be in accordance with commercial practice adequate to insure carrier acceptance and safe delivery at the lowest rates.

5.3 Marking for Shipment

5.3.1 In addition to any special marking specified in the contract or order, marking for shipment shall be in accordance with MIL-STD-163.

6. NOTES

6.1 Ordering data - Invitations for bids and contracts or orders should specify the following:

(a) Title, number, and date of this specification.

(b) Class required (see 1.2).

(c) Size and quantity of material required.

(d) Level of preservation and packing required (see 5.1 and 5.2).

6.2 Identification of bars as to steel heat number should be maintained throughout processing and testing of the bars.

6.3 Commercial chemical designations - For information only, the composition covered in Table I is known commercially as AISI E 52100 or SAE 52100.

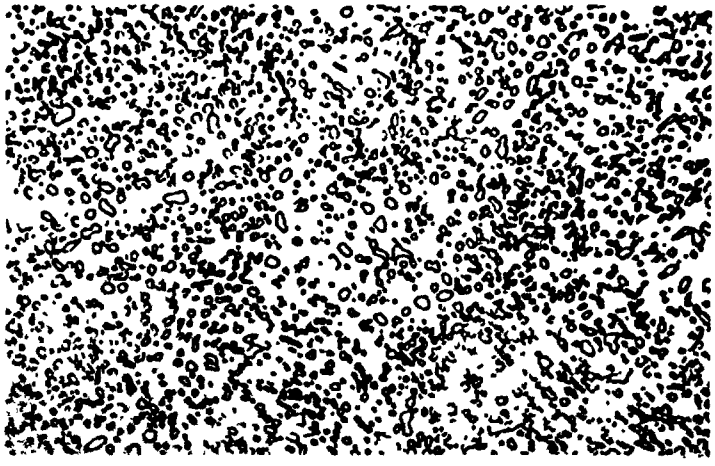
Custodians:
Army - MR
Navy - WP

Preparing activity:
Navy - WP
(Proj. No. 9510-0046)

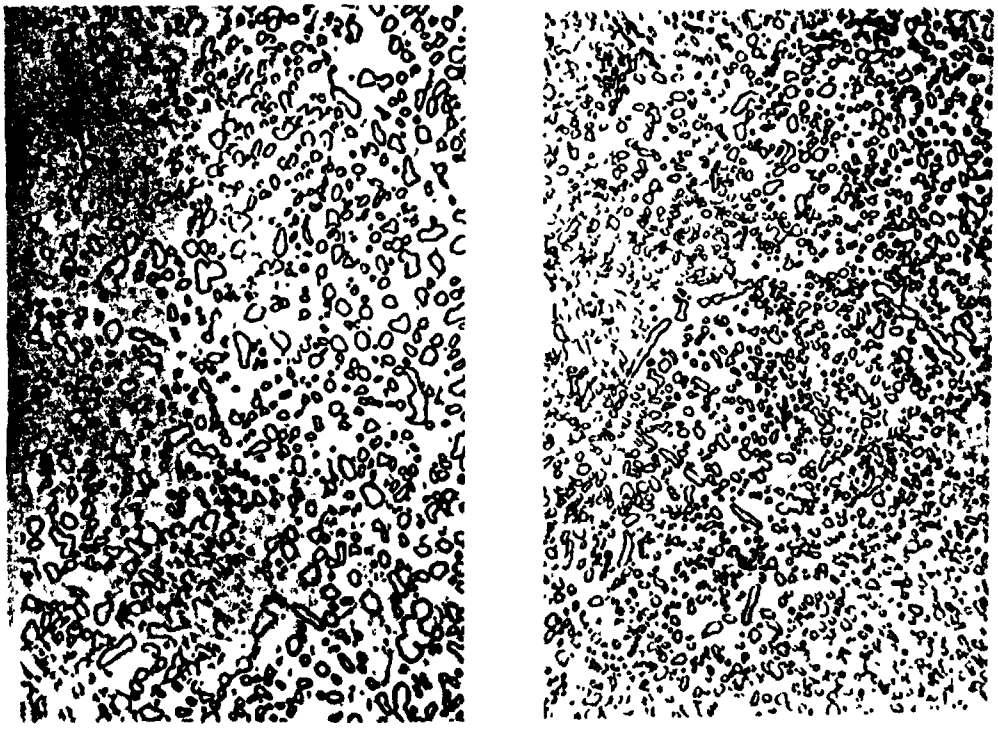
Review activities:
Army - MI, MR
Navy - WP

User activities:
Army - MO

Review/user information is current as the date of this document. For future coordination of changes to this document, draft circulation should be based on information in the current DODISS.



Acceptable Carbide Particle Size and Form



Unacceptable Carbide Particle Size and Form

Figure 1 – Carbide particle size and form standards

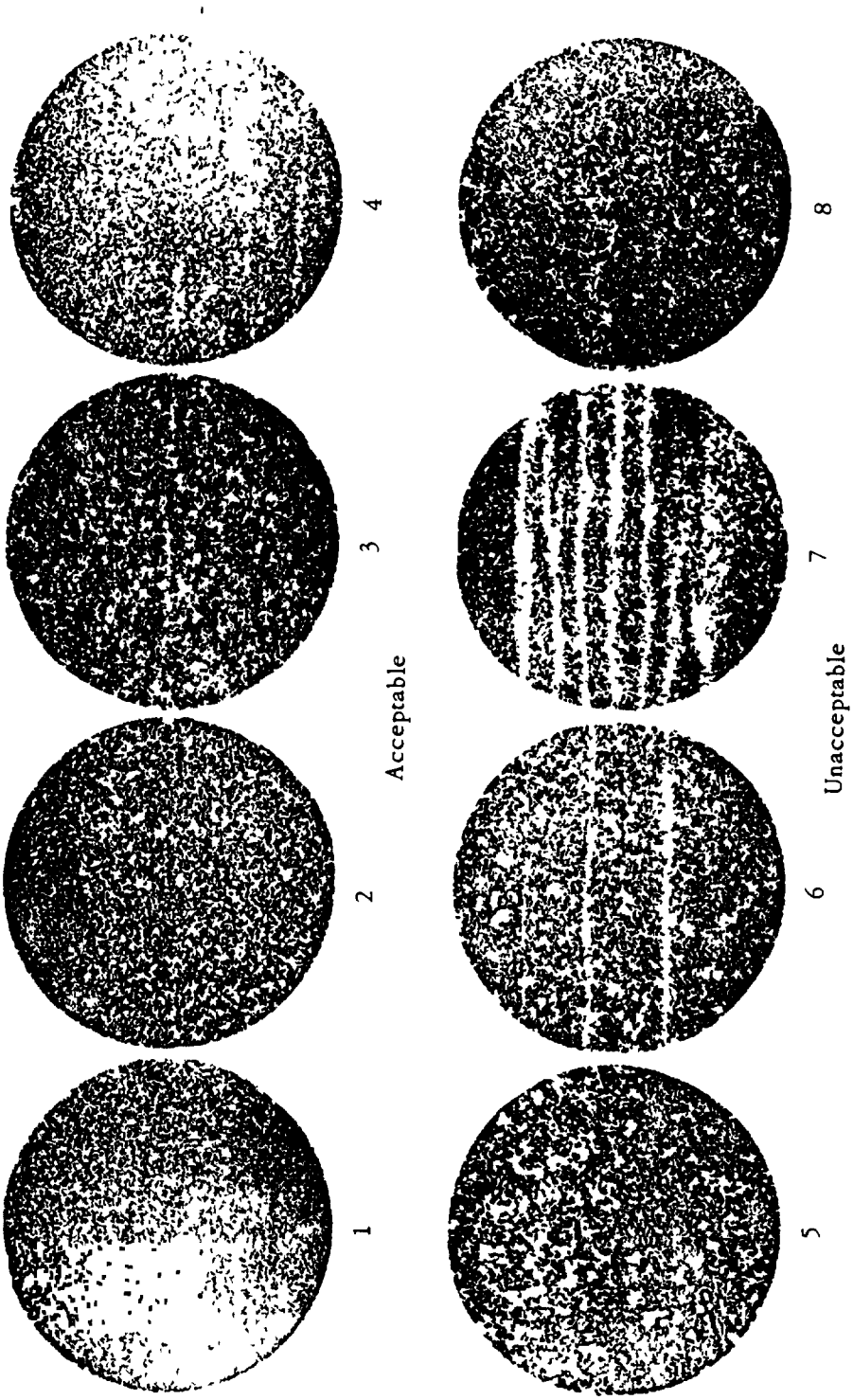


Figure 2 – Carbide distribution standards

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

MIL-S-980B STEEL, CHROMIUM ALLOY, BARS (FOR TORPEDO GYROSCOPE BEARINGS)

ORGANIZATION *(Of submitter)*	CITY AND STATE

CONTRACT NO	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

DD FORM 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE C-8279

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