INCH-POUND

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MILITARY SPECIFICATION

STEEL, CHROME-MOLYBDENUM (4130) BARS AND REFORGING STOCK (AIRCRAFT QUALITY)

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

1. SCOPE

1 1 Scope This specification covers chrome-molybdenum (4130) steel bars and forging stock of aircraft quality.

1 2 Classification. The steel bars and reforging stock shall be as follows

1.2 1 Physical condition Materials shall be furnished in one of the following physical conditions, as specified (see 6 2c)

A As forged
B As rolled
C. Annealed
D Normalized
E. Normalized and tempered
F Hardened and tempered

1 2.2 Surface conditions. Materials shall be furnished in one of the following surface conditions, as specified (see 6.2c)

1 Black, as forged or rolled
2 Pickled or blast cleaned
3 Rough turned
4. Cold finished (drawn)
5 Turned, ground and polished

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Systems Requirements Department (Code SR3), Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter

AMSC N/A FSC 9510
DISTRIBUTION STATEMENT A Approved for public release, distribution is unlimited

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 document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2e).

STANDARDS

FEDERAL

FED-STD-183	-	Continuous Identification Marking of Iron and Steel Products

MILITARY

MIL-STD-129	-	Marking for Shipment and Storage
MIL-STD-163	-	Steel Mill Products Preparation for Shipment and Storage

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from DODSSP, Subscription Services Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2e).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A255	-	End-Quench Test for Hardenability of Steel
ASTM A700	-	Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment
ASTM E8	-	Test Methods of Tension Testing of Metallic Materials
ASTM E10	-	Test Method for Brinell Hardness of Metallic Materials
ASTM E18	-	Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E112	-	Determining Average Grain Size
ASTM E350	-	Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron
ASTM E381	-	Macrotech Testing, Inspection, and Rating Steel Products Comprising Bars, Billets, Blooms, and Forgings
ASTM E1077	-	Estimating the Depth of Decarburization of Steel Specimens

(Application for copies should be addressed to the American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103-1187.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS 2251	-	Tolerances, Low-Alloy Steel Bars
AMS 2301	-	Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure.
AMS 2370	-	Quality Assurance Sampling and Testing Carbon and Low-Alloy Steel Wrought Products and Forging Stock

(Application for copies should be addressed to the Society of Automotive Engineers, Inc. 400 Commonwealth Drive, Warrendale, PA 15096.)

(Non-Government standards and other publications are normally available from the organizations that prepare or 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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Material

3.1.1 Quality. The steel shall be of aircraft quality.

3.1.1.1 Cleanliness. When inspected magnetically in accordance with the procedures of AMS 2301, material shall not exceed the size and frequency rating limits specified in AMS 2301 (see 4.5).

3.1.2 Manufacturing process. The steel may be melted by one of the commercially acceptable types of melting including open hearth, basic oxygen or electric arc furnace. The steel may be ingot cast or continuous cast into billets. When ingot casting, sufficient discard shall be made to secure freedom from piping and undue segregation.

3 1 3 Physical/surface condition Unless otherwise specified in the acquisition documents, (see 6 2c), bars 1.500 inches or less in diameter or thickness shall be furnished in conditions (C) (4), and bars over 1 500 inches in diameter or thickness shall be furnished in conditions (C) (2)

3 2 Chemical composition The chemical composition shall be within the limits specified in table I when tested in accordance with 4 6 The heat analysis shall conform to the column entitled "Analysis", and the semi-finished or finished product shall conform to the column entitled "Check analysis tolerance"

3 3 Hardenability. The hardenability for all specified physical conditions shall be J5 = 34 HRC min, and J8 = 27 HRC min when tested in accordance with 4 7

3.4 Grain size The austenitic grain size shall be predominantly No 5 or finer, with grains as large as No 3 permissible when tested in accordance with 4 8

3 5 Macrostructure. Visual examination of transverse sections of stock in sizes up to and including 36 square inches shall be equal to or better than S-2, R-1, and C-2 of ASTM E381, sizes over 36 square inches, up to and including 100 square inches, shall be equal to or better than S-2, R-2, and C-3 of ASTM E381 In addition, the transverse sections shall show no pipe or cracks, and any porosity, segregations, inclusions, and other imperfections shall be no worse than the preceeding macrographs of ASTM E 381 Macroscopic examination of finished bars is required only if manufacturers inspection of the macrostructure at an earlier stage of processing such as forged bars, blooms or billets has not been accomplished (see 4 9)

3 6 Decarburization Unless otherwise specified (see 6 2f), when tested in accordance with 4 10, the depth of any decarburization shall be as follows.

a. Materials furnished in surface conditions (2) and (4) shall not have decarburization greater than the limits in table II

b. Bars furnished in surface conditions (3) and (5) shall be free from decarburization.

c When bars are ordered for reforging purposes, or surface condition (1), any decarburization limits are waived.

d. When determining the depth of decarburization, it is permissible to disregard local areas, provided the decarburization of such areas does not exceed the limits of table II by more than 0 005 inch and the width is 0 065 inch or less

3.7 Hardness limits for conditions (C) and (E).

a. The hardness for material in physical conditions (C) and (E) shall be no greater than Brinell 229 (or equivalent) when furnished in surface conditions (1), (2), (3), and (5), (see 4.11).

b. The hardness for material in physical conditions (C) (E) shall be no greater than Brinell 241 (or equivalent) when furnished in surface condition (4) (see 4.11).

3.8 Tensile properties of condition (F) steel. Unless otherwise specified (see 6.2.g), the mechanical properties of bar supplied in condition (F) in sizes up to and including 1.500 inches in diameter, or distance between parallel sides, shall be as specified in table III when tested in accordance with 4.12.

3.9 Identification of product. Items shall be individually marked for identification in accordance with FED-STD-183, except that bar sizes less than 0.50 inch in diameter, or distance between parallel sides, shall be marked in like manner or bundled and identified by tags marked with the same identification code, the tags to be attached to each end of each bundle with an extra tag included in the bundle. The marking items shall include this specification number and the physical condition designator (see 1.2.1 and 4.4).

3.10 Tolerances. The permissible variation in dimension of bars, produced in conformance with this specification, shall be as specified in AMS 2251 (see 4.4).

3.10 1 Mill lengths. When exact or multiple lengths are not ordered (see 6.2.h), bars will be acceptable in mill lengths of 6 to 20 feet, but not more than 10 percent of any order shall be furnished in lengths shorter than 10 feet.

3.11 Workmanship. Material shall be sound, of uniform quality and condition, free from pipes, and shall not contain laps, cracks, twists, seams, or other defects detrimental to the fabrication or performance of parts (see 4.4).

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4 2 Classification of inspection The inspection requirements specified herein are classified as follows

a. Quality conformance inspection (see 4.3)

4 3 Quality conformance inspection Quality conformance inspections shall consist of the examinations and tests specified in this specification For each requirement specified in section 3, the corresponding test method of section 4 is shown in table IV

4.3 1 Lot The lot shall consist of all bars of the same size and configuration, physical condition, from the same heat, produced under the same processing conditions, and presented for inspection at one time

4.3.2 Sampling Sampling shall be as specified in each test method

4.4 Visual examination Samples selected at random from each lot in accordance with table V shall be examined for compliance with identification of product (see 3 9), tolerances (see 3 10), and workmanship (see 3 11)

4 5 Cleanliness Specimens shall be selected, prepared, inspected, and rated in accordance with the procedures of AMS 2301 (see 3 1.1 1).

4 6 Chemical analysis.

4.6.1 Sampling For the purpose of heat analysis, one sample shall be taken immediately before, or during, the pouring of a heat When the finished or semi-finished product is a portion of a heat which was previously tested, and passed chemical analysis, then product check analysis is not required If heat analysis was not performed, or if the sample was lost, then one sample shall be taken from semi-finished or finished product representing the lot

4 6.1.1 Location Samples for check chemical analysis shall be taken parallel to the axis of the bar selected, at a point midway between the center and surface, except that material less than 1 250 inches thick shall be sampled through the entire cross section The sample shall consist of not less than 2 ounces of material

4.6.2 Test method Samples selected per 4.6.1 shall be tested in accordance with ASTM E350, by spectrochemical methods, or other analytical methods acceptable to the purchaser In the event of a dispute, the analysis shall be by wet chemical methods in accordance with ASTM E350 The analysis shall meet the limits specified in 3 2.

4.7 Hardenability.

4 7.1 Sampling. One or more samples for end-quench-hardenability tests shall be selected from each heat of steel from which material is presented for acceptance. Cast, forged, or rolled samples are acceptable

4.7.2 Test method. The end-quench-hardenability test shall be performed in accordance with ASTM A255. Test specimens shall be austenitized at 1600 ±10°F. The test results shall meet the limits specified in 3.3.

4.8 Grain size

4.8 1 Sampling. One or more samples shall be selected to represent each lot of steel from which material is submitted for acceptance.

4.8 2 Test method Specimens shall be sectioned and polished to the appropriate fineness by metallographic methods and suitably etched to reveal the grain structure. The polished area need not include more than 1 square inch of surface The austenitic grain size shall be determined in accordance with ASTM E112 and shall meet the requirements specified in 3 4.

4 9 Macrostructure

4.9.1 Sampling. Samples for macrostructure rating shall be full cross-sectional specimens obtained from the billet, or rerolled product, representing the ingot or strand cast positions specified for heat qualification in AMS 2301. When ingot or strand cast billet location is not available, the lot shall be sampled on at least one end of 10 percent of the bars or billets

4 9.2 Test method. The samples shall be etched using hot hydrochloric acid (160°F) in accordance with ASTM E381 and shall meet the requirements specified in 3 5

4.10 Decarburization

4.10 1 Sampling With the exception of material specifically ordered for reforging purposes or physical-surface condition (A) (1), one sample shall be selected from each lot

4.10 2 Test method The depth of hardness shall be determined using the microscopical or microhardness methods of ASTM E1077 In case of a dispute, the microhardness method shall be used by making a microhardness traverse at not less than X 250 magnification The boundary of the decarburization shall be at the depth at which the hardness rises to 20 Knoop points (or equivalent) below the core harness. The decarburization shall meet the limits specified in 3 6

4.11 Hardness of bars in physical condition (C) and (E).

4.11.1 Sampling At least five bars from each lot shall be tested to ascertain conformance with the permissible hardness values When less than five bars are ordered, each bar shall be tested

4.11 2 Test method Hardness tests shall be conducted in accordance with ASTM E10 or ASTM E18, and shall meet the requirements specified in 3 7

4.12 Tensile properties of steel in physical condition (F)

4 12 1 Sampling For material furnished in condition (F), two tensile test samples shall be selected from bars from the same lot

4.12 2 Specimen location For bars up to 1 500 inches in diameter or thickness, the axis of the test specimen shall coincide with the central axis of the bar, for bars 1 500 inches and over, the axis shall be located midway between

the center and surface of the bar The axes of tensile test specimens shall be parallel to the direction of rolling or drawing

4 12.3 Test method The tensile test shall be conducted in accordance with ASTM E8. Yield strength shall be determined by the offset or extension-under-load methods. The mechanical properties shall meet the requirements specified in 3.8.

4 13 Inspection of packaging. The preservation, packing, and marking shall be inspected to verify conformance to the requirements of section 5.

4.14 Certified test reports Heats which have been tested and found to comply with the requirements of this specification shall be acceptable. Each shipment from these acceptable heats shall be accompanied by test reports showing the results of tests for chemistry, hardenability, tensile properties, (condition F only), grain size, macrostructure, and magnetic particle frequency/severity ratings (see 6.3).

4.15 Resampling and retesting.

4.15.1 Chemical composition, cleanliness, macrostructure, and tensile properties. If the results of chemical composition, cleanliness, macrostructure, and tensile properties do not conform to specified requirements, retest shall be permitted in accordance with the provisions specified in the resampling and retesting section of AMS 2370.

4.15.2 Visual examination Lots rejected for identification of product (3.9), tolerances (3.10), and workmanship (3.11) discrepencies may be reinspected 100 percent at the discretion of the contractor.

5. PACKAGING

5.1 Preservation and packing. Preservation and packing shall be level A or commercial, as specified (see 6.2.i).

5.1.1 Level A. Bars shall be preserved and packed in accordance with MIL-STD-163. Bars in surface conditions 2 through 5 inclusive shall be coated with a type A preservative.

5.1.2 Commercial. Bars shall be preserved and packed in accordance with ASTM A700.

5.2 Marking. The exterior and interior containers shall be marked in accordance with MIL-STD-129. The nomenclature shall include the following:

Steel, Bars 4130
Cross-sectional shape and dimensions (as applicable)
Physical condition
Surface condition
Heat number
Quantity contained (as defined in contract)
Specification MIL-S-6758B

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6 1 Intended use The material covered by this specification is intended for general use in the manufacture of parts and components hardened by heat treatment to tensile a strength of 180,000 psi or less It is weldable by fusion methods. The hardenability and weldability of this material are considered equivalent to that of MIL-S-6050

6.2 Acquisition requirements. Acquisition documents must specify the following·

a. Title, number and date of this specification, including amendments.

b. Size and shape.

c. Physical and surface conditions, when other than condition (C) (4) is desired for bars 1.500 inches or less, and when a condition other than (C) (2) is desired for for bars over 1.500 inches.

d. Whether bars are intended for reforging purposes.

e Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 1 and 2 2).

f. Whether decarburization limits closer than those specified in 3.6 are desired.

g. The tensile strength for physical condition (F) when sizes over 1.500 inches in least dimension are ordered, or whether tensile strengths, for physical condition (F), different than those specified in table III are desired.

h. Exact lengths and length tolerances, if mill lengths are not acceptable (see 3.10.1).

i. Applicable levels of preservation, packaging, and packing (see 5.1 and 5.2)

j. Items of data required (see 6.3).

6 3 Data requirements The following Data Item Descriptions (DID's) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this specification is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.14	DI-NDTI-80809A	Test /Inspection Reports	Use contractor format

The above DID's were those cleared as of the date of this specification The current issue of DOD 5010 12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423

6 4 Subject term (key word) listing

Annealed
Decarburization
Hardened
Macrostructure
Rods
Tempered

6 5 Changes from previous issue Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes

Custodians:
Army - MR
Air Force - 20
Navy - AS

Preparing activity
Navy - AS

(Project 9510 - 0832)

Review activities
Army - MI, EA
Navy - OS
DLA - IS

Use activities:
Army - AT, ME

TABLE I. Chemical composition.

Element	Analysis (percent)	Check analysis tolerance 1/ (percent)
Carbon	0.28 - 0 33	±0 02
Manganese	0.40 - 0 60	±0 03
Phosphorus	0 025 (max)	+0 005
Sulfur	0.025 (max)	+0 005
Silicon	0 15 - 0 35	±0 02
Chromium	0 80 - 1.10	±0 05
Molybdenum	0 15 - 0 25	±0 02
Nickel	0 25 (max)	+0 03
Copper	0.35 (max)	+0 03

1/ Individual determinations may vary from the specified range to the extent shown in the check analysis column, except that the elements in any melt shall not vary both above and below the specified range The check analysis limits are not applicable for sizes over 100 square inches in cross-sectional area.

TABLE II. Decarburization limits

Nominal diameter or distance between opposite faces, inches	Maximum depth of decarburization, inches 1/
Up to 0.375 (incl)	0.010
Over 0 375 to 0 500 (incl)	0 012
Over 0.500 to 0 625 (incl)	0 014
Over 0 625 to 1 000 (incl)	0.017
Over 1 00 to 1.50 (incl)	0 020
Over 1.50 to 2 00 (incl)	0 025
Over 2.00 to 2 50 (incl)	0.030
Over 2 50 to 3.00 (incl)	0 035
Over 3 00 to 4 00 (incl)	0.045

1/ The value specified as the maximum depth of decarburization is the sum of the complete plus the partial decarburization.

TABLE III Mechanical properties of condition (F) steel

	Yield strength at 0.2 percent offset or at extension indicated in third column			
Tensile Strength psi	psi (min)	Extension under load inches per inch (in 2 inches)	Elongation in 2 inches (min) percent	Reduction of area (min) percent
125,000 (min)	100,000	0.0107	17	55

TABLE IV. Quality conformance tests.

	Requirement	Sampling and Test Method
Cleanliness	3.1.1.1	4 5
Chemical composition	3.2	4 6
Hardenability	3.3	4.7
Grain size	3.4	4 8
Macrostructure	3.5	4.9
Decarburization	3.6	4.10
Hardness	3.7	4.11
Tensile properties Condition (F) steel	3.8	4.12
Identification of product	3.9	4.4
Tolerances	3.10	4.4
Workmanship	3.11	4.4

TABLE V Sampling for examination of product.

Lot Size	Sample Size	Acceptance number (sample failures)
1 to 65	4	0
66 to 110	5	0
111 to 300	7	0
301 to 500	10	0
501 to 800	15	0
over 800	25	0

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-S-6758B	930518

3. DOCUMENT TITLE
STEEL, CHROME-MOLYBDENUM (4130) BARS AND REFORGING STOCK (AIRCRAFT QUALITY)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code)	
COMMANDING OFFICER, NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION LAKEHURST SYSTEMS REQUIREMENTS DEPARTMENT	(1) Commercial (908) 323-7488	(2) AUTOVON 624-7488
c. ADDRESS (Include Zip Code) CODE SR3 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT. Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	