

**MIL-S-18729C****5 MARCH 1965****SUPERSEDING****MIL-S-18729B****3 OCTOBER 1957**

## MILITARY SPECIFICATIONS

# STEEL PLATE, SHEET, AND STRIP, ALLOY 4130, AIRCRAFT QUALITY

*This specification is mandatory for use by all Departments and agencies of the Department of Defense.*

### 1. SCOPE

**1.1 Scope.** This specification covers chrome-molybdenum alloy 4130, steel sheet, strip, and plate of thickness to and including 1.50 inches.

**1.2 Classification.** Materials shall be furnished in the following conditions, as specified (see 6.2):

Physical condition:

- (A) Annealed
- (MA) Modified annealed
- (N) Normalized or otherwise heat treated by the producer

### 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 this specification to the extent specified herein:

#### STANDARDS

##### FEDERAL

Fed. Std. No. 48—Tolerances for Steel and Iron Wrought Products

Fed. Test Method Std. No. 151—Metals; Test Methods

Fed Std. No. 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, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

**2.2 Other publications.** The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply:

##### AEROSPACE MATERIAL SPECIFICATIONS

AMS2252—Tolerances, Alloy Steel Sheet, Strip and Plate

AMS2301—Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure

AMS2640—Magnetic Particle Inspection

(Aerospace material specifications may be obtained from the Society of Automotive Engineers, 485 Lexington Avenue, New York, N.Y., 10017.)

### 3. REQUIREMENTS

**3.1 Quality.** The steel shall be of aircraft quality, suitable for the fabrication, by appropriate commercial procedures, of reliable parts which may be inspected by magnetic particle inspection methods conforming to AMS2640, with frequency/severity ratings in accordance with AMS2301 not greater than 0.80/0.67.

**3.2 Data.** Data shall be supplied as required (see 4.3 and 6.2).

**3.3 Chemical composition.** The chemical composition shall be as specified in table I.

**3.4 Transverse mechanical properties.** Transverse mechanical properties shall be as specified in table II.

**3.5 Transverse bending requirements,** materials 0.749 inch and less in thickness. Materials shall withstand bending without cracking, at room temperature with the axis of bending

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TABLE I. Chemical composition

Element	Analysis (percent)	Check analysis tolerance <sup>1</sup> (percent)
Carbon.....	0.27-0.33	± 0.02
Manganese.....	.40-0.60	± .03
Phosphorus.....	.025 max	± .005
Sulfur.....	.025 max	± .005
Silicon.....	.20-0.35	± .02
Chromium.....	.80-1.10	± .05
Molybdenum.....	.15-0.25	± .02
Nickel.....	.25 max	± .03

<sup>1</sup> Individual determinations may vary to the extent shown in the "tolerance" column, except that the several determinations of a single element in any one heat shall not vary both above and below the specified range.

transverse to the direction of rolling, through an angle as indicated in table III. Condition A material shall be bent around a diameter equal to the thickness of the sample; and condition N and MA materials, around a diameter equal to three times the thickness of the material.

**3.6 Grain size.** The grain size of the steel shall be predominately No. 5 or finer, with grains as large as No. 3 permissible.

**3.7 Response to thermal treatment.** Materials 0.250 inch or less in nominal thickness shall develop hardness of Rockwell C26 minimum when heat treated as prescribed in 4.9.2. Materials from 0.251 inch to 1.5 inch in nominal thickness shall develop the applicable minimum center hardness of table IV when heat treated as prescribed by 4.9.3.

**3.8 Surface condition.** Surfaces of materials shall be descaled and oiled. Sheet and strip materials shall receive a final cold pass to ensure smoothness.

**3.9 Decarburization.** Materials shall be free from any zone of complete decarburization as determined microscopically on prepared sections. Partial decarburization to such extent that the increase in hardness from the surface to any point below the surface of an oil-hardened specimen does not exceed two points on the Rockwell A scale is acceptable. This test is not applicable to materials less than 0.025 inch in thickness.

**3.10 Dimensional tolerances.** The variation between measured and ordered dimensions shall not exceed the respective tolerance limits of AMS2252, except that width tolerances for sheared and gas-cut plate shall comply with the tables titled "Alloy Steel Plates, Width and Length of Sheared Plates, One Inch and Under in Thickness, Shearing Tolerances" and "Alloy Steel Plates, Gas Cut Rectangular Plates, Width and Length Tolerances," respectively, of Federal Standard No. 48.

**3.11 Identification of product.** Plate, sheet, and strip shall be legibly marked in accordance with Federal Standard No. 183. The following marking items shall be included:

Physical condition

Heat number

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**3.11.1 Coiled sheet and strip.** The coiled sheet and strip shall be suitably tagged with

TABLE II. Transverse mechanical properties

Condition	Tensile strength (minimum)	Yield strength at 0.2 percent offset or at extension indicated (minimum)		Elongation in 2 inches (minimum)	
	psi	psi	Extension under load, inch in 2 inches	Percent	
				(A) and (MA)	(N)
(A).....	85,000 max				
(MA) and (N).....	95,000 max				
Thickness less than 0.062.....	95,000	75,000	0.0091	10.0	8.0
Thickness over 0.062 to 0.125 inch, incl.....	95,000	75,000	.0091	12.0	10.0
Thickness over 0.125 to 0.187 inch, incl.....	95,000	75,000	.0091	15.0	12.0
Thickness over 0.187 to 0.249 inch, incl.....	90,000	70,000	.0087	17.0	15.0
Thickness over 0.249 to 0.749 inch, incl.....	90,000	70,000	.0087	18.0	16.0
Thickness over 0.749 to 1.500 inch, incl.....	90,000	70,000	.0087	20.0	18.0

TABLE III. *Angle of bend*

Thickness of material	Angle of bend (min)	
	Material in condition (A)	Material in conditions (M.A.) and (N)
Inch	Degrees	Degrees
Under 0.090.....	180	180
0.090 to 0.187, incl.....	180	135
Over 0.187 to 0.249, incl.....	180	90
Over 0.249 to 0.749, incl.....	90	90

the above information, using an oilproof tag, and shall also be marked near the outer end of the coil.

**3.12 Workmanship.** Material shall be sound, of uniform quality and condition, free from scale and injurious defects such as cracks, seams, tears, grooves, laminations, pits, and blisters. Slight surface imperfections which are completely removable without reducing the section thickness below the minimum permissible dimensional tolerance limits, shall not be considered injurious defects.

#### 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 other 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 Classification of inspection.** The inspection of the steel is classified as quality conformance inspection.

**4.3 Test data.** One copy of data sheets summarizing the results of the quality conformance tests shall accompany each shipment.

#### 4.4 Examination of product.

**4.4.1 Sampling for examination of dimensions, finish, workmanship, preparation for delivery and identification marking.** Units of product shall be randomly selected in accordance with table V to represent each lot of material of one heat, the same nominal dimensions, and offered for acceptance at one time.

**4.4.2 Samples shall be examined visually or by appropriate methods for conformance with specified requirements.**

#### 4.5 Chemical analysis.

**4.5.1 Sampling.** Samples for check chemical analysis shall be selected in accordance with Method 111 or 112 of Fed. Test Method Std. No. 151, to represent each heat in the shipment.

**4.5.1.1** Samples for check chemical analysis may be waived at the discretion of the procuring activity, provided that all of the material under inspection can be identified as being made from a heat previously analyzed and found to be in conformance with the chemical composition specified herein.

**4.5.1.2** The method of selecting samples as specified above is based on the assumption that the material is produced from ingots from the same heat and is essentially homogeneous in all respects. If the material is taken from stock

TABLE IV. *Hardness, as quenched*

Nominal thickness range (inches)	Rockwell C value (min)
0.250 to 0.373, incl.....	42
Over 0.373 to 0.500, incl.....	38
Over 0.500 to 0.625, incl.....	32
Over 0.625 to 0.750, incl.....	29
Over 0.750 to 0.875, incl.....	27
Over 0.875 to 1.500, incl.....	26

TABLE V. *Sampling for examination of product*

Lot size	Sample size	Acceptance number
1 to 15.....	All	0
16 to 180.....	15	0
181 to 300.....	35	0
301 to 500.....	50	1
Over 500.....	75	2

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and is not identifiable as to heat and method of manufacture, or if the identity of any portion of the shipment is obscure in any respect, additional samples shall be selected to determine conformance of all portions of the shipment to this specification. The number of additional samples required shall be determined by the procuring activity.

**4.5.2 Method.** Analysis shall be by wet chemical (Method 111), spectrochemical (Method 112 of Fed. Test Method Std. No. 151), or chemical methods except for carbon, which shall be by the combustion method.

#### 4.6 Tensile test.

**4.6.1 Sampling.** Two tensile test samples shall be selected to represent each 200 sheets or 100 plates or 10 percent of coils of product with a minimum of 4 samples from each heat, of the same thickness and condition, and submitted for acceptance at one time.

**4.6.2 Method.** Tension test specimens shall be prepared and tested in accordance with Method 211 of Fed. Test Method Std. No. 151. Round test specimens shall conform to the type R1 shown on figure 2 of Method 211. Flat test specimens shall conform to types F1 and F2 of figure 3, Method 211. All tension test specimens shall be prepared with the longitudinal axis perpendicular to the direction of rolling.

#### 4.7 Bend test.

**4.7.1 Sampling.** Three samples shall be selected from each 200 sheets or 100 plates or from each coil of product from each heat, of the same thickness and condition and submitted for acceptance at one time.

**4.7.2 Preparation of specimens.** Transverse bend specimens shall be prepared in accordance with Method 231 of Fed. Test Method Std. No. 151.

**4.7.3 Method.** Specimens shall be bent cold, Method 231 of Fed. Test Method Std. No. 151, either by pressure or by blows, except that in the event of dispute, bending shall be by pressure. The formation of cracks not over  $\frac{1}{16}$  inch in aggregate length, at the corners on the outside of the bend, shall not be cause for rejection.

#### 4.8 Grain size.

**4.8.1 Sampling.** One sample shall be selected to represent each heat of steel from which material is presented for acceptance.

**4.8.2 Method.** Specimens shall be sectioned and polished to appropriate fineness by metallographic methods and suitably etched to reveal the grain structure. The austenitic grain size shall be determined in accordance with Method 311 of Fed. Test Method Std. No. 151.

#### 4.9 Response to thermal treatment.

**4.9.1 Sampling.** Two samples shall be selected to represent each heat of alloy from which materials are submitted for acceptance. In the event the heat number is not known, one sample shall be selected from each 200 sheets or 100 plates or from each coil of product of the same thickness and presented for acceptance at one time.

**4.9.2 Method (material 0.250 inch and less in thickness).** Specimens measuring 1 by 2 inches shall be cut from the samples, quenched in oil from  $1,600^{\circ} \pm 10^{\circ}$  F, and tempered at not less than  $900^{\circ}$  F for 30 minutes at heat. Hardness tests shall be conducted in accordance with Method 243 of Fed. Test Method Std. No. 151.

**4.9.3 Method (material from 0.251 inch to 1.5 inches in nominal thickness).** Specimens 1 inch wide by 3 inches in length shall be quenched in oil from  $1,600^{\circ} \pm 10^{\circ}$  F. They shall then be sectioned at the midpoint of and normal to the longitudinal axis. Hardness tests shall be taken at the center of the section in accordance with Method 243 of Fed. Test Method Std. No. 151.

#### 4.10 Decarburization.

**4.10.1 Sampling.** Two specimens for decarburization tests shall be selected from each 200 flat plates, sheets, or strips or from each coil of material or from each 10 plates from the same heat, of the same thickness, and submitted for inspection at one time.

**4.10.2 Preparation.** Specimens shall be austenitized for 30 minutes and water quenched from  $1,600^{\circ} \pm 10^{\circ}$  F.

**4.10.3 Method.** Hardness shall be deter-

TABLE VI. Random sampling

Lot size	Sample size	Acceptance number
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

mined by the Rockwell A hardness test, Method 243 of Fed. Test Method Std. No. 151. The average hardness (surface or subsurface) shall be the average of 3 tests made adjacent to each other, on the same specimen. Surface hardness tests shall be made on a clean but unground and unpolished surface. Subsurface hardness tests shall be made in a depression ground to a depth of approximately 0.020 inch or  $\frac{1}{8}$  the thickness of the specimen, whichever is less.

4.11 Quality. Heats from which sheet, strip, or plate are to be rolled shall be subjected to magnetic particle inspection tests of semi-finished mill products prior to rolling to finished size. Samples shall be taken from the product at locations representing the top and bottom of the first, middle, and last usable ingot from each heat. Specimens shall be prepared for inspection by cutting longitudinal sections through the thickness of samples at off-center locations and finish machining these sections to a roughness height rating not to exceed 40 microinches. Magnetic particle tests shall be conducted in accordance with AMS2640 and the frequency and severity ratings determined in accordance with AMS2301.

4.11.1 Plates from an uncertified heat shall be randomly sampled in accordance with table VI for longitudinal specimens cut from the sample units as specified in 4.11.

4.12 Rejection and retest. Failure of a specimen to meet the test requirements shall be cause for rejection of the lot. At the discretion of the (contractor-supplier), retest will be permitted after the lot has been screened and defectives removed. 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 with no further retesting permitted.

## 5. PREPARATION FOR DELIVERY

### 5.1 Preservation, packaging, and packing.

5.1.1 Level A. Material shall be properly separated by size and condition when prepared for delivery. Materials shall be preserved, packaged, and packed in accordance with MIL-STD-163.

5.1.2 Level C. Materials shall be prepared for delivery in accordance with the manufacturer's commercial practice.

5.2 Marking of shipments. Marking and labeling shall be in accordance with MIL-STD-163. In addition, marking shall include the following information:

STEEL PLATE, SHEET, OR STRIP (as applicable) ALLOY 4130, AIRCRAFT QUALITY

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Size and thickness

Heat No.

Quantity contained (as defined in the contract or order for each size and thickness)

Name of manufacturer

Name of contractor (if different from manufacturer)

Contract or Order No.

## 6. NOTES

6.1 Intended use. The steel is intended for applications requiring moderate mechanical properties and in which welding may be required. In thickness of 0.187 inch and less, a minimum tensile strength of 180,000 psi can be obtained by proper heat treatment, and lower strengths in greater thicknesses. The hardenability of the steel does not assure through-hardening to a uniform structure in sizes greater than 0.500 inch in thickness or diameter of equivalent round.

6.1.1 Condition (A). More time in the annealing furnace is required to attain condition (A) than condition (MA). Condition (A) material possesses more desirable forming properties.

6.1.2 Condition (MA). The modified annealed condition is intended to provide a more

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favorable base for quench-and-temper heat treatment than condition (A).

**6.2 Ordering data.** Procurement documents should specify:

- (a) Title, number, and date of this specification.
- (b) Data requirements (see 3.2 and 4.3).
- (c) Physical condition, size, and thickness to be furnished (see 1.2).
- (d) Applicable levels of packaging and packing required (see 5.1 and 5.2).

**Custodians:**

Army—MR  
Navy—WP  
Air Force—(11)

**Reviewer activities:**

Army—MI, MR  
Navy—WP  
Air Force—(11), (69)

**User activities:**

Army—  
Navy—  
Air Force—(69)

**Preparing activity:**

Navy—WP  
Project No. 9515-0051

Review/user information is current as of the date of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current Federal Supply Classification Listing of DoD Standardization Documents.



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b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR	
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		<input type="checkbox"/> OTHER (Specify): _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
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7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
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