



# AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.  
TWO PENNSYLVANIA PLAZA, NEW YORK, N. Y. 1000

## AMS 6438A

Superseding AMS 6438

Issued 6-30-64

Revised 11-1-68

STEEL SHEET, STRIP, AND PLATE  
1.05Cr - 0.55Ni - 1.0Mo - 0.11V (0.45 - 0.50C)  
Premium Quality, Consumable Electrode Melted

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. APPLICATION: Primarily for ultra-high strength structural applications requiring a through hardening weldable material for use at temperatures up to 600 F (316 C).

3. COMPOSITION:

∅	min	max
Carbon	0.45	0.50
Manganese	0.60	0.90
Silicon	0.15	0.30
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	0.90	1.20
Nickel	0.40	0.70
Molybdenum	0.90	1.10
Vanadium	0.08	0.15
Copper	--	0.35

- 3.1 Check Analysis: Composition variations shall meet the requirements of the latest issue of AMS 2259, paragraph titled "Low Alloy Steels" except that the variations for carbon and vanadium shall apply to "over max" only.

4. CONDITION: Unless otherwise ordered, the product shall be supplied in the following condition:

- 4.1 Sheet and Strip: Cold finished, bright or atmosphere annealed, and pickled if necessary; or hot rolled, annealed, and pickled; having hardness not higher than Rockwell C 30 or equivalent.
- 4.2 Plate: Hot rolled, annealed, and pickled having hardness not higher than Rockwell C 30 or equivalent.
- 4.3 When normalized and tempered material is specified, hardness shall be not higher than Rockwell C 30 or equivalent.

5. TECHNICAL REQUIREMENTS: When ASTM methods are specified for determining conformance to the following requirements, tests shall be conducted in accordance with the issue of the ASTM methods listed in the latest issue of AMS 2350.

5.1 Decarburization:

- 5.1.1 Material Under 0.045 In. in Thickness: The method of test and the allowance shall be as agreed upon by purchaser and vendor.

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∅ 5.1.2 Material 0.045 In. and Over in Thickness:

5.1.2.1 Specimens: Shall be the full thickness of the material except that specimens from plate over 0.250 in. thick shall be slices approximately 0.250 in. thick cut parallel to and preserving one original surface of the plate. Recommended specimen size is 1 x 4 inches.

5.1.2.2 Procedure: Specimens shall be hardened by austenitizing and quenching; preferably they shall not be tempered but, if tempered, the tempering temperature shall be not higher than 300 F (149 C). During heat treatment, specimens shall be protected by suitable atmosphere or medium or by suitable plating to prevent carburization or further decarburization. Protective plating, if used, shall then be removed from specimens of material 0.045 to 0.250 in., excl, in thickness and a portion of the specimen shall be step ground to a depth of 0.050 in. or half thickness, whichever is less. Specimens from material 0.250 in. and over in thickness shall be ground to remove from the original surface of the plate the amount of metal shown below and a portion of the specimen shall be further ground to a depth of at least 1/3 the original thickness of the specimen. At least three Rockwell hardness readings shall be taken on each prepared step and each group of readings averaged.

Nominal Original Thickness Inches	Surface Depth Removal Inch
0.250 to 0.375, incl	0.020
Over 0.375 to 0.500, incl	0.025
Over 0.500 to 0.750, incl	0.030
Over 0.750 to 1.000, incl	0.035
Over 1.000 to 2.000, incl	0.040

∅ 5.1.2.3 Allowance:

5.1.2.3.1 Material 0.045 to 0.250 In., Excl, Thick: Unless otherwise specified, the product shall be free from complete decarburization. It shall also be free from partial decarburization to the extent that the difference in hardness between the surface and the nondecarburized depth below the surface shall be not greater than 2 points on the Rockwell A scale.

5.1.2.3.2 Material 0.250 In. and Over Thick: The difference in hardness between the two prepared steps shall be not greater than 2 points on the Rockwell C scale.

5.2 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, ASTM E112, McQuaid-Ehn Test.

5.3 Properties After Heat Treatment: Test specimens, austenitized by heating in a protective atmosphere to a temperature within the range of 1600 - 1650 F (871.1 - 898.9 C), held at the selected temperature within  $\pm 10$  F ( $\pm 5.6$  C) for 1 hr, quenched in oil, stress relieved at 400 F  $\pm 10$  (204.4 C  $\pm 5.6$ ) for 1 hr, cooled in air, tempered for 4 hr at not lower than 1000 F (538 C), and cooled in air, shall conform to the following requirements:

5.3.1 Tensile Properties:

Tensile Strength, psi	224,000 min
Yield Strength at 0.2% Offset or at 0.0172 in. in 2 in. Extension Under Load (E = 29,500,000), psi	195,000 min
Elongation, % in 2 in. or 4D	7 min

5.3.1.1 For widths 9 in. and over, tensile test specimens shall be taken with the axis perpendicular to the direction of rolling. For widths less than 9 in., tensile test specimens shall be taken with the axis parallel to the direction of rolling.

5.3.2 Hardness: Not lower than Rockwell C 47 or equivalent.

6. QUALITY: Steel shall be premium quality and shall conform to the requirements of the latest issue of AMS 2300; it shall be multiple melted using vacuum consumable electrode process in the remelt cycle, unless otherwise permitted. The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.
7. TOLERANCES: Unless otherwise specified, tolerances shall conform to all applicable requirements of the latest issue of AMS 2252; for strip, tolerances for cold finished shall apply.
8. REPORTS:
  - 8.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition, grain size, and AMS 2300 frequency-severity rating of each heat in the shipment and the results of tests on each thickness from each heat to determine conformance to the tensile property and hardness requirements after heat treatment. A heat shall be the consumable electrode remelted ingots produced from steel originally melted in a single furnace charge. When permitted by purchaser, a heat may be the consumable remelted product of individual melts of similar composition produced from the same lots of controlled raw material and having the same average composition as agreed upon by purchaser and vendor. This report shall include the purchase order number, heat number, material specification number and its revision letter, thickness, size, and quantity from each heat.
  - 8.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.
9. IDENTIFICATION: Unless otherwise specified, each sheet, strip, and plate shall be marked as in 9.1 unless purchaser permits a method from 9.2.
  - 9.1 Each sheet, strip, and plate shall be marked on one face, in the respective location indicated below, with AMS 6438A, heat number, manufacturer's identification, and nominal thickness in inches. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling. The specification number, manufacturer's identification, and nominal thickness shall be continuously line marked; the heat number may be included in the line marking or may be marked at one location on each piece.
    - 9.1.1 Flat Strip 6 In. and Under in Width: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 feet.
    - 9.1.2 Flat Sheet, Flat Strip Over 6 In. in Width, and Plate: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft, the rows being spaced not more than 6 in. apart and alternately staggered.
    - 9.1.3 Coiled Sheet and Coiled Strip: Shall be marked near the outside end of the coil. The inside end of the coil also shall be marked or shall have a tag or label attached and marked with the information of 9.1 above.