Society of Automotive Engineers, Inc.
485 LEXINGTON AVENUE, NEW YORK, N.Y. 10017

AEROSPACE MATERIAL SPECIFICATION

AMS 6546A
Superseding AMS 6546
Issued 2-15-65
Revised 5-1-68

STEEL SHEET, STRIP, AND PLATE
0.48Cr - 8.0Ni - 4.0Co - 0.48Mo - 0.09V (0.24 - 0.30C)
Premium Quality, Consumable Electrode Melted, Annealed

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 heat treated parts, such as pressure vessels, requiring through hardening to high strength levels, and where such parts may require welding.

3. COMPOSITION:

	min	max
Carbon	0.24	0.30
Manganese	0.10	0.35
Silicon	--	0.10
ø Phosphorus	--	0.010
Sulfur	--	0.010
Chromium	0.35	0.60
Nickel	7.00	9.00
Cobalt	3.50	4.50
Molybdenum	0.35	0.60
Vanadium	0.06	0.12
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"; check analysis limits for cobalt shall be 0.05 under min or over maximum.

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

4.1 ø 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 36 or equivalent.

4.2 ø Plate: Hot rolled, annealed, and pickled, having hardness not higher than Rockwell C 36 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 method listed in the latest issue of AMS 2350.

5.1 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined, unless otherwise specified, in accordance with ASTM E112, McQuaid-Ehn test.

5.2 Decarburization:

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

Ø 5.2.2 Material 0.045 In. and Over in Thickness:

5.2.2.1 Specimens: Shall be the full thickness of the material except that specimens from plate over 0.250 Ø 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.

5.2.2.2 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 Ø 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

Ø 5.2.2.3 Allowance:

5.2.2.3.1 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 Ø 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.

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

5.3 Micro-Inclusion Rating: Unless otherwise specified, the inclusion rating, determined in accordance with ASTM E45, Method D, using not less than 9 specimens per heat or lot selected parallel to the direction of rolling and representing the worst area of inclusions in the inspection sample, shall be as specified below. The method of selection of specimens shall be such that suitable rating of the heat or lot of steel being qualified is assured. Two-thirds of all specimens shall not exceed the following limits, except that the length of any inclusion shall be not greater than 0.015 inch.

	Inclusion Rating			
Type	A	B	C	D
Thin	1.5	1.5	1.5	2.0
Heavy	1.0	1.0	1.0	1.5

5.4 Properties After Heat Treatment: Material heat treated as in 5.4.1, except that annealing (5.4.1.1) is optional, shall conform to the requirements of 5.4.2 and 5.4.3.

5.4.1 Heat Treatment:

5.4.1.1 Annealing: Heat to 1140 F ± 25 (615.6 C ± 14), hold at heat for 8 - 24 hr, and cool in air to room Ø temperature.

5.4.1.2 Normalizing: Heat to a temperature within the range of 1600 - 1700 F (871.1 - 926.7 C), hold at the selected temperature within ± 25 F (± 14 C) for 1 hr per inch of section thickness, and cool in air to room temperature.

5.4.1.3 Hardening: Heat to 1550 F ± 25 (843.3 C ± 14), hold at heat for 1 hr per inch of section thickness but ø at least 1 hr, and then from that temperature quench sections up to 4 in. in thickness into room-temperature oil or water.

5.4.1.4 Tempering: Heat to required temperature not higher than 1050 F (565 C), hold at heat for 2 hr per ø inch of thickness but at least 2 hr, and cool in air to room temperature.

5.4.2 Tensile Properties:
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Tensile Strength, psi	185,000 min
Yield Strength at 0.2% Offset or at 0.0159 in. in 2 in. Extension Under Load (E = 29,500,000), psi	175,000 min
Elongation, % in 2 in.	
Nominal Thickness, in.	
0.020 to 0.060, incl	5 min
Over 0.060 to 0.100, incl	8 min
Over 0.100 to 0.187, incl	10 min
Over 0.187	13 min
Reduction of Area (round specimens), %	50 min

5.4.3 Fracture Toughness: When specified, shall be determined by a suitable method. Standards shall be ø as agreed upon by purchaser and vendor.

6. QUALITY: Steel shall be premium quality and shall conform to the requirements of the latest issue of AMS 2300. Unless otherwise permitted, material shall be multiple melted using consumable electrode practice in the remelt cycle; at least one of the melting cycles shall be under vacuum. 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.

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, tensile properties, grain size, inclusion rating, 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 requirements after heat ø 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 electrode remelted product of individual melts of similar composition produced from the same lots of controlled raw materials 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.