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| AEROSPACE MATERIAL SPECIFICATION | AMS6454™ | REV. G |
| | Issued 1984-01 Reaffirmed 1995-05 Revised 2023-08 Superseding AMS6454F | |
| Steel, Sheet, Strip, and Plate 1.8Ni - 0.80Cr - 0.25Mo (0.38 - 0.43C) (SAE 4340) Vacuum Consumable Electrode Remelted (Composition similar to UNS G43406) | | |

RATIONALE

AMS6454G is the result of a Five-Year Review and update of the specification. The revision clarifies composition reporting (see 3.1.1), updates heat-treatment conditions consistent with similar specifications (see 3.3), provides for both the producer and purchaser agreement on condition (see 3.3.3), updates Jominy testing requirements (see 3.4.4), revises decarburization testing requirements (see 3.4.5), and prohibits unauthorized exceptions (see 3.7, 4.4.2, and 8.5).

1. SCOPE

1.1 Form

This specification covers a premium-aircraft-quality, low-alloy steel in the form of sheet, strip, and plate.

1.2 Application

These products have been used typically for heat-treated parts requiring good tensile and fatigue strengths in combination with good ductility, but usage is not limited to such applications. The product may be through-hardened to tensile strength ranges of 260 to 280 ksi (1793 to 1931 MPa) in nominal section thicknesses of 1.5 inches (38 mm) and under and 180 to 220 ksi (1241 to 1517 MPa) in nominal section thicknesses of 3 inches (76 mm) and under.

1.2.1 Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking after heat treatment; ARP1110 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

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<https://www.sae.org/standards/content/AMS6454G>

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

| | |
|---------|--|
| AMS2252 | Tolerances, Low-Alloy Steel Sheet, Strip, and Plate |
| AMS2259 | Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels |
| AMS2300 | Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure |
| AMS2370 | Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock |
| AMS2807 | Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys Sheet, Strip, Plate, and Aircraft Tubing |
| ARP1110 | Minimizing Stress Corrosion Cracking in Wrought Forms of Steels, and Corrosion Resistant Steels and Alloys |
| AS7766 | Terms Used in Aerospace Metals Specifications |

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

| | |
|------------|---|
| ASTM A255 | Determining Hardenability of Steel |
| ASTM A370 | Mechanical Testing of Steel Products |
| ASTM A604 | Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets |
| ASTM A751 | Chemical Analysis of Steel Products |
| ASTM E45 | Determining the Inclusion Content of Steel |
| ASTM E112 | Determining Average Grain Size |
| ASTM E140 | Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness |
| ASTM E290 | Bend Testing of Material for Ductility |
| ASTM E1077 | Standard Test Methods for Estimating the Depth of Decarburization of Steel Specimens |

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to the purchaser.

Table 1 - Composition

| Element | Min | Max |
|------------|------|-------|
| Carbon | 0.38 | 0.43 |
| Manganese | 0.65 | 0.90 |
| Silicon | 0.15 | 0.35 |
| Phosphorus | -- | 0.010 |
| Sulfur | -- | 0.010 |
| Chromium | 0.70 | 0.90 |
| Nickel | 1.65 | 2.00 |
| Molybdenum | 0.20 | 0.30 |
| Copper | -- | 0.35 |

3.1.1 The producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection, unless limits of acceptability are specified by the purchaser.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

3.2 Melting Practice

Steel shall be multiple melted using vacuum consumable electrode remelting.

3.3 Condition

The product shall be supplied in the following condition; hardness shall be determined in accordance with ASTM A370:

3.3.1 Sheet and Strip

Product shall be as specified by the purchaser in one of the conditions below (see 8.7). Hardness shall not be higher than 98 HRB, or equivalent (see 8.2).

3.3.1.1 Cold finished, bright or atmosphere annealed, sub-critically annealed or normalized and tempered, and descaled if necessary.

3.3.1.2 Hot rolled, annealed, sub-critically annealed or normalized and tempered, if necessary, and descaled.

3.3.2 Plate

Hot rolled, annealed, sub-critically annealed or normalized and tempered, if necessary, and descaled, having hardness not higher than 25 HRC, or equivalent (see 8.2).

3.3.2.1 If allowed by the purchaser, cold rolled, annealed, sub-critically annealed or normalized and tempered, if necessary, and descaled as necessary, having hardness not higher than 25 HRC, or equivalent (see 8.2).

3.3.3 If product is ordered spheroidize annealed, the degree of spheroidization shall be acceptable to the purchaser and producer.

3.4 Properties

The product shall conform to the following requirements; hardness testing shall be performed in accordance with ASTM A370:

3.4.1 Macrostructure of Each Heat

Visual examination of transverse full cross sections from full transverse cross sections of finished slab or billet or suitable rerolled product in accordance with ASTM A604 in hot hydrochloric acid, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM A604 shown in Table 2.

Table 2 - Macrostructure limits

| Class | Condition | Severity |
|-------|--------------------|----------|
| 1 | Freckles | A |
| 2 | White Spots | A |
| 3 | Radial Segregation | B |
| 4 | Ring Pattern | B |

3.4.2 Micro-Inclusion Rating of Each Heat

No specimen shall exceed the limits shown in Table 3, determined in accordance with ASTM E45, Method D, except that the length of any inclusion shall be not greater than 0.015 inch (0.38 mm):

Table 3 - Micro-inclusion rating limits

| | A | | B | | C | | D | |
|---|------|-------|------|-------|------|-------|------|-------|
| | Thin | Heavy | Thin | Heavy | Thin | Heavy | Thin | Heavy |
| Worst Field Severity | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.5 | 1.0 |
| Worst Field Frequency, Maximum | a | 1 | a | 1 | a | 1 | 3 | 1 |
| Total Rateable Fields, Frequency, Maximum | b | 1 | b | 1 | b | 1 | 8 | 1 |

a. Combined A+B+C, not more than three fields.
b. Combined A+B+C, not more than eight fields.

3.4.2.1 A ratable 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 ASTM E45.

3.4.3 Average Grain Size of Each Lot

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E112.

3.4.4 Hardenability of Each Heat

Shall be J 12/16 inch (J 19 mm) = 53 HRC, minimum, and J 20/16 inch (J 32 mm) = 50 HRC, minimum, determined on the standard end-quench test specimen in accordance with ASTM A255 except that the steel shall be normalized at 1600 °F ± 10 °F (871 °C ± 6 °C) and the specimen austenitized at 1550 °F ± 10 °F (843 °C ± 6 °C). Cast specimens do not need to be normalized.

3.4.5 Decarburization of Each Lot

Decarburization shall be evaluated by one of the methods of 3.4.5.1 or 3.4.5.2.

3.4.5.1 Metallographic (Microscopic) Method

A cross section of the surface shall be prepared in accordance with ASTM E1077 and examined metallographically at a magnification not to exceed 200X. The sample shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 4.

3.4.5.2 Hardness Traverse (Microindentation) Method

The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E1077. Samples shall be hardened and protected during heat treatment to prevent changes in surface carbon content. Samples may be tempered at the option of the producer. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization on the adjacent surface. Acceptance shall be as listed in Table 4.

Table 4A - Maximum decarburization limits, inch/pound units

| Nominal Thickness Inches | Total Depth of Decarburization Inches |
|-----------------------------|---|
| Up to 0.500, incl | 0.015 |
| Over 0.500 to 1.000, incl | 0.025 |
| Over 1.000 | 0.035 |

Table 4B - Maximum decarburization limits, SI units

| Nominal Thickness Millimeters | Total Depth of Decarburization Millimeters |
|----------------------------------|--|
| Up to 12.70, incl | 0.38 |
| Over 12.70 to 25.40, incl | 0.64 |
| Over 25.40 | 0.89 |

3.4.5.3 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the above limits by more than 0.005 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

3.4.5.4 In the case of dispute, the total depth of decarburization determined using the microindentation hardness traverse method shall govern.

3.4.6 Bending

Product 0.749 inch (19.02 mm) and under in nominal thickness shall be tested in accordance with ASTM E290 using a sample prepared nominally 0.75 inch (19.0 mm) in width with its axis of bending parallel to the direction of rolling and shall withstand without cracking when bending at room temperature through the angle and bend radius shown in Table 5. In case of dispute, the results of tests using the guided bend test of ASTM E290 shall govern.

Table 5 - Bend requirements

| Nominal Thickness Inches | Nominal Thickness Millimeters | Bend Angle Degrees | Bend Radius t = Nominal Thickness |
|-----------------------------|----------------------------------|-----------------------|--------------------------------------|
| Up to 0.249, incl | Up to 6.32, incl | 180 | 1.5t |
| Over 0.249 to 0.749, incl | Over 6.32 to 19.02, incl | 90 | 1.5t |

3.5 Quality

The product, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.