



AEROSPACE MATERIAL SPECIFICATION	AMS6435™	REV. H
	Issued 1960-06 Reaffirmed 1984-10 Revised 2022-04	
Superseding AMS6435G		
Steel, Sheet, Strip, and Plate 0.75Mn - 0.78Cr - 1.8Ni - 0.35Mo - 0.20V (0.33 - 0.38C) (4335 Mod) Vacuum Consumable Electrode Melted, Annealed (Composition similar to UNS K33517)		

RATIONALE

AMS6435H is the result of a Five-Year Review and update of the specification. The revision prohibits unauthorized exceptions (3.7, 4.4.1, 5.1.1, 8.6), updates composition testing and evaluation (3.1, 3.1.1), adds a jominy test allowance (3.4.3), updates decarburization evaluation method (3.4.4), adds equivalent cooling methods (3.4.5), adds strain rate control for tensile testing (3.4.5.1), updates grain size requirements (4.2, 4.4, 8.5), and allows prior revisions (8.7).

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 parts, that may be welded during fabrication, requiring through-hardening to high strength levels and that may be used at operational stress levels approaching the yield strength, but usage is not limited to such applications. Steel may become notch sensitive when heat treated to a tensile strength level of 240 ksi (1655 MPa) or higher.

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.

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

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2022 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS6435H/>

- 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
- 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 A751 Chemical Analysis of Steel Products
- ASTM E45 Determining the Inclusion Content of Steel
- ASTM E112 Determining Average Grain Size
- ASTM E140 Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
- ASTM E1077 Estimating the Depth of Decarburization of Steel Specimens

3. TECHNICAL REQUIREMENTS

3.1 Composition

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

Table 1 - Composition

Element	Min	Max
Carbon	0.33	0.38
Manganese	0.60	0.90
Silicon	0.40	0.60
Phosphorus	--	0.010
Sulfur	--	0.010
Chromium	0.65	0.90
Nickel	1.65	2.00
Molybdenum	0.30	0.40
Vanadium	0.17	0.23
Copper	--	0.35

3.1.1 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, except that carbon shall vary not more than 0.01 under minimum or over maximum and no variation over maximum will be permitted for phosphorus and sulfur.

3.2 Melting Practice

Steel shall be multiple melted using vacuum consumable electrode practice in the remelt cycle.

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

Cold finished, bright or atmosphere annealed, and descaled if necessary, or hot rolled, annealed, and descaled, unless otherwise ordered, having hardness not higher than 30 HRC or equivalent (see 8.2).

3.3.2 Plate

Hot rolled, annealed, and descaled having hardness not higher than 30 HRC or equivalent (see 8.2).

3.3.2.1 If allowed by purchaser, cold rolled, annealed, and descaled having hardness not higher than 30 HRC or equivalent (see 8.2).

3.3.3 When product is ordered spheroidize annealed, hardness shall be not higher than 100 HRB or equivalent (see 8.2).

3.4 Properties

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

3.4.1 Micro-Inclusion Rating of Each Heat

No specimen shall exceed the limits shown in Table 2, determined in accordance with ASTM E45, Method D.

Table 2 - Micro-inclusion rating limits

Limits	A		B		C		D	
	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
Worst Field Severity	2.0	1.0	1.5	1.0	1.5	1.0	1.5	1.0
Worst Field Frequency, maximum	a	1	a	1	a	1	5	3
Total Rateable Fields								
Frequency, maximum	b	1	b	1	b	1	c	3

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

b - Combined A+B+C, not more than five fields.

c - Any number of lower rateable D-type thin fields per specimen is permitted.

3.4.1.1 Thickness of the D-type heavy shall not exceed 0.0005 inch (0.012 mm).

3.4.1.2 A rateable field is defined as one that has a type A, B, C, or D inclusion rating of at least 1.0 thin or heavy in accordance ASTM E45 (see 8.3).

3.4.2 Average Grain Size of Plate, Sheet and Strip

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

3.4.3 Hardenability of Each Heat

Shall be J1/16 inch (1.6 mm) = 58 HRC maximum and J15/16 inch (23.8 mm) = 47 HRC minimum, determined in accordance with ASTM A255 except that the steel shall be normalized at 1700 °F ± 10 °F (925 °C ± 5 °C) and the test specimen austenitized at 1625 °F ± 10 °F (885 °C ± 5 °C). Cast specimens do not need to be normalized.

3.4.4 Decarburization of Each Lot

Decarburization shall be evaluated by one of the methods of 3.4.4.1 or 3.4.4.2.

3.4.4.1 Metallographic (Microscopic) Method

A cross section taken perpendicular to the surface shall be prepared in accordance with ASTM E1077, etched, and examined metallographically at a magnification not to exceed 200X. The specimen shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 3.

3.4.4.2 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 but untempered and protected during heat treatment to prevent changes in surface carbon content. 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 3.

Table 3A - 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 3B - Maximum decarburization limits, SI units

Nominal Thickness Millimeters	Total Depth of Decarburization Millimeters
Up to 12.50, incl	0.38
Over 12.50 to 25.00, incl	0.62
Over 25.00	0.88

3.4.4.3 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.

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

3.4.5 Response to Heat Treatment

Specimens shall meet the requirements shown in Table 4 after being hardened by heating to 1625 °F ± 25 °F (885 °C ± 15 °C), holding at heat for 60 minutes ± 5 minutes, and quenching in oil, and tempered by heating to a temperature between 400 °F and 500 °F (205 °C and 260 °C), holding at heat for not less than 2 hours, and cooling in air or at a rate equivalent to air cooling or faster.

Table 4A - Minimum tensile properties, inch/pound units

Property	Value
Tensile Strength	240 ksi
Yield Strength at 0.2% Offset	210 ksi
Elongation in 2 inches or 4D, min	
Nominal Thickness, Inches	
Up to 0.070, incl	5%
Over 0.070 to 0.249, incl	6%
Over 0.249	8%

Table 4B - Minimum tensile properties, SI units

Property	Value
Tensile Strength	1655 MPa
Yield Strength at 0.2% Offset	1450 MPa
Elongation in 50 mm or 4D, min	
Nominal Thickness, Millimeters	
Up to 1.75, incl	5%
Over 1.75 to 6.25, incl	6%
Over 6.25	8%

- 3.4.5.1 Unless otherwise specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ± 0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min).

3.5 Quality

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

- 3.5.1 Steel shall be premium aircraft-quality conforming to AMS2300, except that a maximum average frequency (F) rating of 0.10 and a maximum average severity (S) rating of 0.20 shall apply.

3.6 Tolerances

Shall be in accordance with AMS2252.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.