

AEROSPACE MATERIAL SPECIFICATION

Steel Plate
2.0Cr - 10Ni - 14Co - 1.0Mo (0.13 - 0.17C)
Vacuum Melted, Normalized, and Overaged
(Composition similar to UNS K92571)

1. SCOPE:

1.1 Form:

This specification covers a premium aircraft-quality alloy steel in the form of plate.

1.2 Application:

This plate has been used typically for heat treated parts requiring a combination of high strength, high toughness, and weldability, but usage is not limited to such applications

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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SAE WEB ADDRESS:

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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2252	Tolerances, Low-Alloy Steel Sheet, Strip, and Plate
AMS 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure
AMS 2370	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock
AMS 2750	Pyrometry
AMS 2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM A 604	Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 45	Determining the Inclusion Content of Steel
ASTM E 112	Determining Average Grain Size
ASTM E 353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E 399	Plane-Strain Fracture Toughness of Metallic Materials

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 E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

TABLE 1 - Composition

Element	min	max
Carbon	0.13	0.17
Manganese	--	0.10
Silicon	--	0.10
Phosphorus	--	0.008
Sulfur	--	0.005
Phosphorus plus Sulfur	--	0.010
Chromium	1.80	2.20
Nickel	9.50	10.50
Cobalt	13.50	14.50
Molybdenum	0.90	1.10
Titanium	--	0.015
Aluminum	--	0.015
Oxygen	--	0.0020 (20 ppm)
Nitrogen	--	0.0015 (15 ppm)

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248.

3.2 Melting Practice:

Steel shall be multiple melted using vacuum induction melting followed by vacuum arc remelting.

3.3 Condition:

Normalized, overaged, and descaled.

3.4 Heat Treatment:

Plate shall be normalized by heating to 1650 °F ± 25 (899 °C ± 14), holding at heat for 60 minutes ± 5, and cooling at a rate equivalent to air cooling to room temperature, and overaged by heating to 1250 °F ± 25 (677 °C ± 14), holding at heat for not less than 6 hours, and forced air cooling. Pyrometry shall be in accordance with AMS 2750.

3.5 Properties:

Plate shall conform to the following requirements:

- 3.5.1 Macrostructure Rating: Visual examination of transverse full cross section from billets or slabs, etched in hot hydrochloric acid in accordance with ASTM A 604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM A 604 shown in Table 2.

TABLE 2 - Macrostructure Limits

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

3.5.2 Micro-Inclusion Rating: No specimen as in 4.3.1 shall exceed the limits shown in Table 3, determined in accordance with ASTM E 45, Method D:

TABLE 3 - Micro-Inclusion Rating Limits

	A		B		C		D	
	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
Worst Field Severity	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Worst Field Frequency, maximum	*	1	*	1	*	1	3	1
Total Rateable Fields, Frequency, maximum	**	1	**	1	**	1	8	1
	* Combined A+B+C, not more than 3 fields							
	** Combined A+B+C, not more than 8 fields							

3.5.2.1 A rateable field is defined as one which has a type A, B, C, or D inclusion rating of at least 1.0 thin or heavy in accordance with the Jernkontoret Chart, Plate I-r, ASTM E 45 (see 8.2).

3.5.3 Average Grain Size: Shall be ASTM No. 10 or finer, determined in accordance with ASTM E 112.

3.5.4 After Heat Treatment: Plate, 100 square inches (645 cm²) and under in cross-sectional area, shall meet the requirements of 3.5.4.1 and 3.5.4.2 after being heated to 1650 °F ± 25 (899 °C ± 14) held at heat for 60 minutes ± 5, forced-air cooled to room temperature, reheated to 1525 °F ± 25 (829 °C ± 14), held at heat for 60 minutes ± 5, forced-air cooled to room temperature, cooled to -100 °F ± 15 (-73 °C ± 8), held at that temperature for 60 minutes ± 5, warmed in air to room temperature, and aged by heating to 950 °F ± 10 (510 °C ± 6), holding at heat for not less than 5 hours, and forced-air cooling. The 1650 °F ± 25 (899 °C ± 14) normalizing portion of the cycle applied to test samples may be deleted if the parent product has previously been treated as in 3.4.

- 3.5.4.1 Tensile Properties: Shall be as shown in Table 4, determined in accordance with ASTM E 8 or ASTM E 8M on specimens taken in the longitudinal direction:

TABLE 4 - Minimum Tensile Properties

Property	Value
Tensile Strength	235 ksi (1620 MPa)
Yield Strength at 0.2% Offset	215 ksi (1482 MPa)
Elongation in 2 Inches (50.8 mm) or 4D	12%
Reduction of Area	60%

- 3.5.4.2 Fracture Toughness: Shall be not lower than 130 ksi $\sqrt{\text{inch}}$ (143 MPa $\sqrt{\text{m}}$), determined in accordance with ASTM E 399 on specimens taken in the T-L orientation from plate 1.50 inches (38.1 mm) and over in nominal thickness. Acceptance values and method of test for plate under 1.50 inches (38.1 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.6 Quality:

Plate, 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 plate.

- 3.6.1 Steel shall be premium aircraft-quality conforming to AMS 2300.

3.7 Tolerances:

Shall conform to all applicable requirements of AMS 2252.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of plate shall supply all samples for vendor'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 plate conforms to specified requirements.

4.2 Classification of Tests:

- 4.2.1 Acceptance Tests: The following requirements are classified as acceptance tests and shall be performed on each heat or lot as applicable.

- 4.2.1.1 Composition (3.1), macrostructure rating (3.5.1), micro-inclusion rating (3.5.2), and frequency-severity cleanliness rating (3.6.1) of each heat.

- 4.2.1.2 Average grain size (3.5.3) and tensile properties (3.5.4.1) of each lot after heat treatment.

- 4.2.1.3 Tolerances (3.7).