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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

American National Standard

AMS 6522A

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Superseding AMS 6522

STEEL PLATE
2.0Cr - 10Ni - 14Co - 1.0Mo (0.13 - 0.17C)
Vacuum Melted, Normalized, and Overaged

UNS K92571

1. SCOPE:

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

1.2 Application: Primarily for heat treated parts requiring a combination of high strength, high toughness, and weldability.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2248 - Chemical Check Analysis Limits, Wrought 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
MAM 2252 - Tolerances, Metric, Low-Alloy Steel Sheet, Strip, and Plate
AMS 2300 - Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
MAM 2300 - Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock
AMS 2750 - Pyrometry

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM A604 - Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E8 - Tension Testing of Metallic Materials
ASTM E8M - Tension Testing of Metallic Materials (Metric)
ASTM E45 - Determining the Inclusion Content of Steel
ASTM E112 - Determining Average Grain Size
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E399 - Plane-Strain Fracture Toughness of Metallic Materials

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS :

3.1 Composition : Shall conform to the following percentages by weight, Ø determined by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	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 requirements of AMS 2248.

3.2 Condition: Normalized, overaged, and descaled.
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3.3 Heat Treatment : Plate shall be normalized by heating to 1650°F ± 25 (899°C Ø ± 14), holding at heat for 60 minutes ± 5, and air cooling to room temperature, and overaged by heating to 1250°F ± 25 (677C ± 14), holding at heat for not less than 6 hours, and forced air cooling. Pyrometry shall be in accordance with AMS 2750.

3.4 Properties: Plate shall conform to the following requirements:

3.4.1 Macrostructure Rating: Visual examination of transverse section as in Ø 4.3.1 from slabs, etched in accordance with ASTM A604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the following macrographs of ASTM A604:

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

3.4.2 Micro-Inclusion Rating: No specimen as in 4.3.2 shall exceed the Ø following limits, determined in accordance with ASTM E45, Method D:

	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

3.4.2.1 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 III, ASTM E45.

3.4.3 Grain Size: Shall be 10 or finer, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

3.4.4 After Heat Treatment: Plate, 100 square inches (645 cm²) and under in Ø cross-sectional area, shall meet the requirements of 3.4.4.1 and 3.4.4.2 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 3.3. Properties of samples prepared from plate over 100 square inches (645 cm²) in cross-sectional area shall be as agreed upon by purchaser and vendor.

3.4.4.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8 or ASTM E8M on specimens taken in the longitudinal direction:

Tensile Strength, minimum	235,000 psi (1620 MPa)
Yield Strength at 0.2% Offset, minimum	215,000 psi (1482 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, minimum	12%
Reduction of Area, minimum	60%

3.4.4.2 Fracture Toughness: Shall be not lower than 130 ksi$\sqrt{\text{inch}}$ (143 MPa$\sqrt{\text{m}}$), determined in accordance with ASTM E339 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.

3.5 Quality:

3.5.1 Steel shall be premium aircraft-quality conforming to AMS 2300 or MAM 2300. It shall be multiple melted using vacuum induction melting followed by vacuum arc remelting.

3.5.2 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 Tolerances: Shall conform to all applicable requirements of AMS 2252 or MAM 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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the plate conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to 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), macro-structure rating (3.4.1), micro-inclusion rating (3.4.2), grain size (3.4.3), and frequency-severity cleanliness rating (3.5.1) of each heat.

4.2.1.2 Tensile properties (3.4.4.1) of each lot after heat treatment.

4.2.1.3 Tolerances (3.6).

4.2.2 Periodic Tests: Tests to determine conformance to requirements for fracture toughness after heat treatment (3.4.4.2) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser: