AEROSPACE
MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York, N.Y. 10017

AMS 5399

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Revised

ALLOY CASTINGS, INVESTMENT, CORROSION AND HEAT RESISTANT
Nickel Base - 19Cr - 11Co - 9.75Mo - 3.15Ti - 1.6Al
Vacuum Melted and Vacuum Cast, Solution Treated

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. APPLICATION: Primarily for parts requiring high strength to 1600 F (871 C) and oxidation resistance up to 1800 F (982 C).

3. COMPOSITION: Castings shall conform to the following:

	min	max
Carbon	0.06	0.12
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	18.00	20.00
Cobalt	10.00	12.00
Molybdenum	9.00	10.50
Titanium	3.00	3.30
Aluminum	1.40	1.80
Boron	0.003	0.010
Iron	--	5.00
Nickel	remainder	

4. CONDITION: Solution heat treated, unless otherwise specified.

5. TECHNICAL REQUIREMENTS:

5.1 Casting: Castings shall be produced from master heat metal remelted and poured under vacuum without loss of vacuum between melting and pouring. A master heat is metal of a single furnace charge melted and cast into ingot under vacuum. Gates, sprues, risers, and rejected castings shall be used only in preparation of master heats; they shall not be remelted directly for pouring of castings.

5.2 Test Specimens:

5.2.1 Separately Cast Specimens: Unless otherwise specified, tensile test specimens shall be cast to represent each master heat of metal in castings and, when requested, shall be supplied with the castings. The specimens shall be of standard proportions with 0.250 in. diameter at the reduced parallel section, shall be cast to size in molds made of the same refractory and heated to the same temperature as the molds for castings, and shall be cooled at approximately the same rate as the castings. If the metal for castings is given any treatment such as fluxing, cooling and reheating, or grain refining, similar techniques shall be used for producing test specimens.

5.2.2 Specimens Machined from Castings: When agreed upon by purchaser and vendor, tensile test specimens may be machined from castings selected at random from each master heat in the shipment. Size and location of specimens and mechanical properties required shall be as delineated on the drawing or as agreed upon by purchaser and vendor.

5.3 Heat Treatment: Castings and representative test specimens shall be solution heat treated by heating to 1950 F ± 25 (1065.6 C ± 14) in a suitable protective atmosphere, holding at heat for not less than 3 hr, and suitably quenching.

5.4 Hardness: Castings shall have hardness not higher than Rockwell C 30 or equivalent.

5.5 Properties after Re-solution and Precipitation Heat Treatment: Test specimens produced in accordance with 5.2.1 or 5.2.2, heat treated as in 5.3, and then heat treated by heating to 1950 F ± 25 (1065.6 C ± 14), holding at heat for 30 min., cooling rapidly in air, reheating to 1400 F ± 25 (760 C ± 14), holding at heat for 16 hr, and cooling in air shall be capable of meeting the requirements of 5.5.1 and shall conform to the requirements of 5.5.2 and 5.5.3:

5.5.1 Tensile Properties at 1200 F (648.9 C): Test specimens shall be heated to 1200 F ± 10 (648.9 C ± 5.6), held at heat for 30 min. before testing, and tested at 1200 F ± 10 (648.9 C ± 5.6) at a strain rate of 0.003 - 0.007 in. per in. per min. to the 0.2% yield strength and at a rate of 0.03 - 0.07 in. per in. per min. above the yield strength.

Tensile Strength, psi	110,000 min
Yield Strength at 0.2% Offset or at 0.0089 in. in 2 in. Extension Under Load (E = 25,900,000), psi	90,000 min
Elongation, % in 1 in. or 4D	3 min
Reduction of Area, %	5 min

5.5.2 Hardness: Shall be not lower than Rockwell C 30 or equivalent.

5.5.3 Stress-Rupture Test at 1650 F (898.9 C): Tensile test specimens, maintained at 1650 F ± 5 (898.9 C ± 2.8) while an axial stress of 25,000 psi is applied continuously, shall not rupture in less than 25 hours. The test shall be continued until the specimen ruptures. Elongation after rupture, measured at room temperature, shall be not less than 5% in 4D.

5.5.4 Grain Size: When specified, castings shall have substantially uniform grain size without pronounced segregation of fine and coarse grained areas. Actual grain size and method of measurement shall be in accordance with standards and procedures agreed upon by purchaser and vendor.

6. QUALITY:

6.1 Castings shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts. Castings shall have smooth surfaces and shall be well cleaned. Unless otherwise specified, metallic shot or grit shall not be used for final cleaning.

6.2 When castings are broken for fracture test, the fracture shall have uniform color and be substantially free from oxides and other defects.

6.3 Radiographic and other quality standards shall be as agreed upon by purchaser and vendor.

6.4 Unless otherwise specified, castings shall be produced under radiographic control. This shall consist of radiographic examination of castings until proper foundry technique, which will produce castings free from harmful internal imperfections, is established for each part number, and of production castings as necessary to ensure maintenance of satisfactory quality.

6.5 Castings shall not be repaired by plugging, welding, or other methods, without written permission from purchaser.