

TCA-718

Vacuum-Cast Nickel-Base Superalloy | Alloy 718 | AMS 5383 | UNS N07718

Overview

TCA-718 is TCA's vacuum-cast version of Alloy 718 (commonly referred to as INCONEL® 718), a nickel-base superalloy widely used in aerospace for its combination of good mechanical properties at high temperature, weldability and corrosion resistance. Its high niobium content produces a multiphase microstructure: a face-centered cubic γ matrix strengthened mainly by the γ'' phase (Ni_3Nb), with the γ' phase, $\text{Ni}_3(\text{Al,Ti})$, as a secondary strengthening phase.

The metastable γ'' phase has limited thermal stability and can transform into the δ phase above 650 °C. Needle-shaped δ pins the grain boundaries and restrains their migration, but the δ fraction increases with temperature, and excessive or coarse δ concentrates stress and promotes microcracks along the matrix/ δ interfaces, leading to brittle fracture. The maximum service temperature of Alloy 718 is therefore generally limited to about 700 °C.

TCA produces near-net-shape TCA-718 investment castings directly from the customer's CAD data, using master alloy melted in-house, with material conforming to AMS 5383. The nominal chemical composition is given in Table 1.

Key Features

- γ'' (Ni_3Nb)-strengthened nickel-base superalloy, vacuum investment cast
- UTS 887 MPa and YS 807 MPa at room temperature
- Stress-rupture life of 30.5 h at 705 °C / 450 MPa — about 1.3× the AMS 5383 minimum of 23 h
- Good weldability and corrosion resistance; also used in cryogenic service

Table 1 – Nominal Composition (wt.%)

Element	wt.%
Carbon	0.10
Manganese	0.35
Silicon	0.35
Phosphorus	<0.015
Sulfur	<0.015
Chromium	19.00
Nickel	52.50
Molybdenum	3.05
Niobium (Cb) + Tantalum	5.12
Titanium	0.90
Aluminum	0.60
Cobalt	1.00
Boron	0.006
Copper	0.30
Iron	Bal.

* Conforms to AMS 5383

Table 2 – Physical Properties

Property	Value
Density, g/cm ³	8.22
Melting range, °C	1210 – 1344
Melting range, °F	2210 – 2450
Linear thermal expansion coefficient, 10⁻⁶/°C	
RT – 427 °C	14.2
RT – 649 °C	15.1
RT – 760 °C	16.0

Typical values; they vary slightly from heat to heat with composition.

Mechanical Properties

TCA-718 is distinguished by its excellent mechanical properties at high temperature, including tensile and stress-rupture strength. All mechanical data in this brochure were measured on as-cast TCA-718 specimens.

Tensile Properties

Tensile tests were performed in accordance with ASTM E8/E8M. TCA-718 possesses high tensile and yield strength from room temperature to about 700 °C (UTS 887 MPa and YS 807 MPa at room temperature; 690 MPa and 636 MPa at 700 °C). Above 700 °C strength decreases sharply, while elongation rises markedly from 870 °C. The results are listed in Table 3, and the temperature dependence of the tensile properties is plotted in Fig. 1.

Table 3 – Tensile properties of as-cast TCA-718

Temperature °C	Temperature °F	Tensile strength MPa	Yield strength MPa	Elongation %
RT	77	887	807	5.3
500	932	745	697	11.1
600	1112	724	683	10.2
700	1292	690	636	9.5
800	1472	511	447	8.7
870	1598	293	231	33.7
1000	1832	111	98	47.2

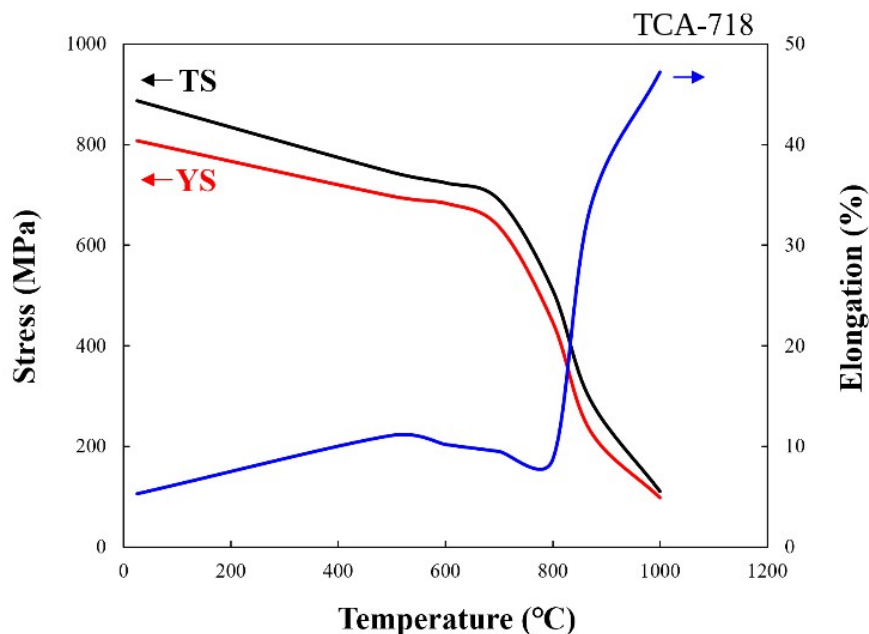


Fig. 1 – Temperature dependence of the tensile properties of as-cast TCA-718

Stress-Rupture Properties

The stress-rupture performance of TCA-718 is verified against AMS 5383. Under this specification, a specimen held at 1300 ± 3 °F (705 ± 2 °C) under a load producing an initial axial stress of 65,000 psi (450 MPa) or higher, applied continuously, shall not rupture in less than 23 hours. The test is continued to rupture without change of load, and the elongation after rupture, measured at room temperature, shall be not less than 3% in 4D.

Stress-rupture tests were conducted in accordance with ASTM E139. As shown in Table 4 and Fig. 2, as-cast TCA-718 tested at 705 °C / 450 MPa ruptured after 30.5 h with an elongation after rupture of 7.3% — exceeding both AMS 5383 requirements.

Table 4 – Stress-rupture results vs. AMS 5383 requirements

Item	AMS 5383 requirement	TCA test result
Test temperature	1300 ± 3 °F (705 ± 2 °C)	705 °C
Initial axial stress	$\geq 65,000$ psi (450 MPa)	450 MPa
Rupture life	≥ 23 h	30.5 h
Elongation after rupture (RT)	$\geq 3\%$ in 4D	7.3%

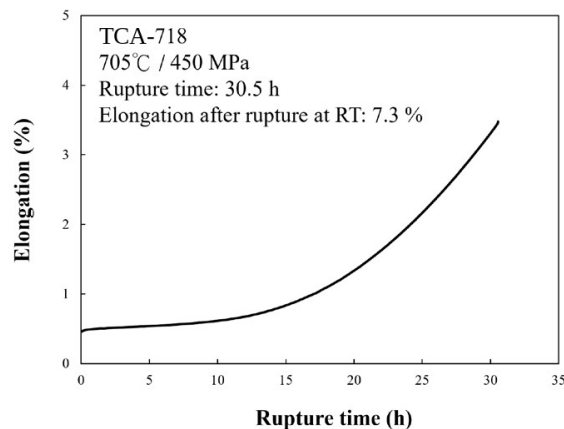


Fig. 2 – Stress-rupture curve of as-cast TCA-718 at 705 °C / 450 MPa

Typical Applications

- Jet-engine and airframe parts
- Liquid-fuelled rocket components
- Land-based power-generation turbines
- Cryogenic tankage

Why TCA

- Ni- & Co-base superalloy caster since 1984
- Near-net-shape vacuum investment castings
- In-house master alloy, supplied to AMS specs
- ISO 9001 / AS9100D and ISO/IEC 27001 certified
- ISO/IEC 17025 accredited laboratory (TAF No. 4378)

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The data in this publication were obtained from tests on as-cast TCA-718 specimens and are representative values for reference only; they are not guaranteed minimums or design allowables. TCA-718 is produced by TCA from master alloy melted in-house. Generic alloy designations are used for identification purposes only. INCONEL® is a registered trademark of Special Metals Corporation; TCA is not affiliated with or endorsed by Special Metals Corporation. © 2026 Transcrystal Alloy Industrial Corporation. All rights reserved.



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