

TCA-713LC

Vacuum-Cast Low-Carbon Nickel-Base Superalloy | Alloy 713LC | AMS 5377

Overview

TCA-713LC is TCA's vacuum-cast version of Alloy 713LC (commonly referred to as INCONEL® 713LC), a low-carbon nickel-base superalloy developed for applications that require high strength at elevated temperature, such as turbine blades in jet engines. Its principal strengthening mechanism is precipitation of the coherent γ' phase, $\text{Ni}_3(\text{Al}, \text{Ti})$, with additional strengthening from NbC carbides. The high aluminum content produces a large γ' volume fraction (~65%), one of the main reasons for the alloy's high stress-rupture resistance.

The maximum service temperature of Alloy 713LC is generally limited to about 950 °C. Above about 1050 °C the γ' phase begins to dissolve into the matrix, and the alloy loses its main strengthening mechanism.

TCA produces near-net-shape TCA-713LC investment castings directly from the customer's CAD data, using master alloy melted in-house, with material conforming to AMS 5377. The nominal chemical composition is given in Table 1.

Key Features

- ~65% γ' volume fraction plus NbC carbide strengthening
- UTS of 777 – 832 MPa from room temperature to 800 °C
- Stress-rupture life of 83.2 h at 980 °C / 152 MPa — about 2.8× the AMS 5377 minimum of 30 h
- Near-net-shape castings made directly from customer CAD files

Table 1 – Nominal Composition (wt.%)

Element	wt.%
Carbon	0.06
Manganese	0.25
Silicon	0.50
Phosphorus	<0.015
Sulfur	<0.015
Chromium	12.00
Molybdenum	4.50
Niobium (Cb) + Tantalum	2.00
Titanium	0.70
Aluminum	6.00
Cobalt	1.00
Boron	0.010
Zirconium	0.10
Iron	0.50
Copper	0.50
Nickel	Bal.

* Conforms to AMS 5377

Table 2 – Physical Properties

Property	Value
Density, g/cm ³	7.91
Melting range, °C	1260 – 1364
Melting range, °F	2300 – 2488
Linear thermal expansion coefficient, 10 ⁻⁶ /°C	
RT – 427 °C	12.1
RT – 872 °C	14.6
RT – 1097 °C	17.1

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

Mechanical Properties

TCA-713LC 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-713LC specimens.

Tensile Properties

Tensile tests were performed in accordance with ASTM E8/E8M. TCA-713LC maintains high tensile and yield strength from room temperature to about 950 °C: the UTS stays between 777 and 832 MPa up to 800 °C and is still 702 MPa at 900 °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-713LC

Temperature °C	Temperature °F	Tensile strength MPa	Yield strength MPa	Elongation %
RT	77	832	716	9.6
500	932	777	693	10.2
600	1112	813	719	13.5
700	1292	799	679	11.5
800	1472	795	643	8.6
900	1652	702	520	10.3
1000	1832	434	307	14.3

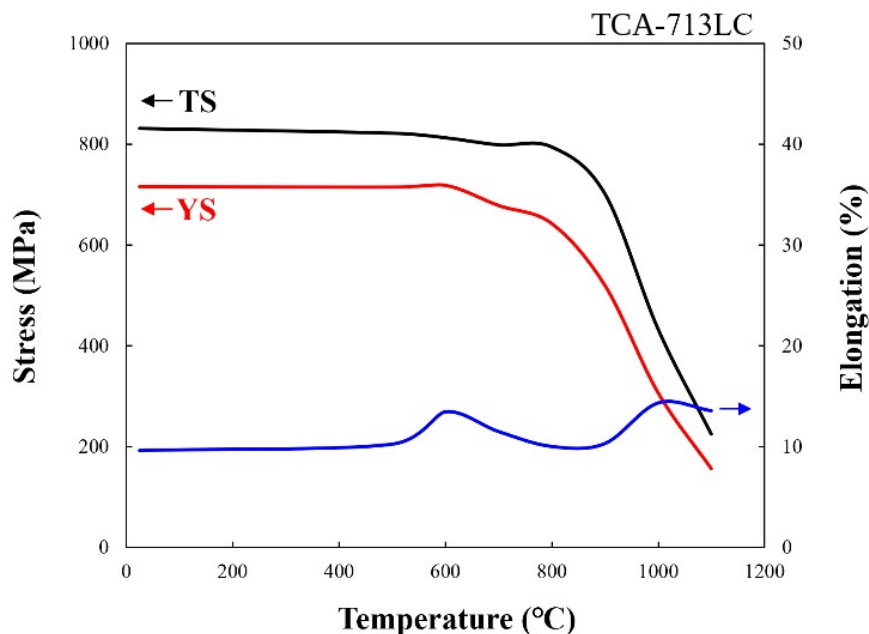


Fig. 1 – Temperature dependence of the tensile properties of as-cast TCA-713LC

Stress-Rupture Properties

The stress-rupture performance of TCA-713LC is verified against AMS 5377. Under this specification, a specimen held at 1800 ± 3 °F (982 ± 2 °C) under a load producing an initial axial stress of 22,000 psi (151.7 MPa) or higher, applied continuously, shall not rupture in less than 30 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 5% in 4D.

Stress-rupture tests were conducted in accordance with ASTM E139. As shown in Table 4 and Fig. 2, as-cast TCA-713LC tested at 980 °C / 152 MPa ruptured after 83.2 h with an elongation after rupture of 59.2% — well above both AMS 5377 requirements.

Table 4 – Stress-rupture results vs. AMS 5377 requirements

Item	AMS 5377 requirement	TCA test result
Test temperature	1800 ± 3 °F (982 ± 2 °C)	980 °C
Initial axial stress	$\geq 22,000$ psi (151.7 MPa)	152 MPa
Rupture life	≥ 30 h	83.2 h
Elongation after rupture (RT)	$\geq 5\%$ in 4D	59.2%

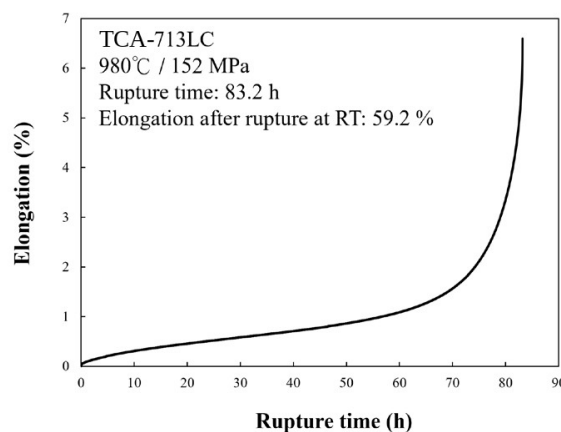


Fig. 2 – Stress-rupture curve of as-cast TCA-713LC at 980 °C / 152 MPa

Typical Applications

- Turbine blades for jet engines
- Hot-section parts needing high rupture resistance
- Service temperatures up to about 950 °C

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-713LC specimens and are representative values for reference only; they are not guaranteed minimums or design allowables. TCA-713LC 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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