

# Inconel 713LC<sup>TM</sup>

has been produced for applications requiring high strength at high temperature, such as turbine blades in the jet aircraft. Several strengthening mold take effect in this alloy, main mechanism is precipitation strengthen by coherent precipitates of  $\gamma'$  phase ( $\text{Ni}_3(\text{Al}, \text{Ti})$ ) and auxiliary phase is a NbC carbide phase. This alloy has a high percentage of Al element, and this was a consequence high content of  $\gamma'$  phase volume (~65%). It is one of the reasons why this alloy has high Stress-rupture resistance. Generally, the maximum operation temperature of Inconel 713LC is limited to 950°C. The  $\gamma'$  phase starts to dissolve in the matrix when the temperature heats up 1050°C, lead to loss strengthening mechanism. Vacuum cast is the method to process Inconel 713LC. The nominal chemical composition of the alloy is listed in Table 1.

TCA is able to provide near-shape Inconel 713LC investment castings from the customer's CAD file with material requirements in accordance with the AMS 5377 specification.

**Table.1 - Composition (wt.%)**

Element	Nominal
Carbon	0.06
Manganese	0.25
Silicon	0.50
Phosphorus	<0.015
Sulfur	<0.015
Chromium	12.00
Molybdenum	4.50
Columbium+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 the AMS 5377 specification

## Physical Properties

Basic physical constants of Inconel 713LC alloy are listed in Table. 2. The values from the table will vary slightly due to the changing composition from each heat.

**Table. 2 – Physical Constants**

Density	7.91 g/cm <sup>3</sup>
Melting range	
°F	2300 - 2488
°C	1260 - 1364

Linear Thermal Expansion Coefficient	$10^{-6} / ^\circ\text{C}$
RT - 427°C	12.1
RT - 872°C	14.6
RT - 1097°C	17.1

## Mechanical Properties

The outstanding characteristic of Inconel 713LC alloy is its excellent high-temperature mechanical properties including tensile and Stress-rupture properties.

The mechanical data contained in the current publication is tested with as-cast Inconel 713LC alloy.

## Tensile Properties

Inconel 713LC possesses high tensile and yield strength in the range RT ~ 950°C. The tensile test

methods are in accordance with the ASTM E8/E8M specification. The data of Inconel 713LC tensile properties is listed in Table.3 and the temperature dependence of tensile properties is shown in Fig. 1.

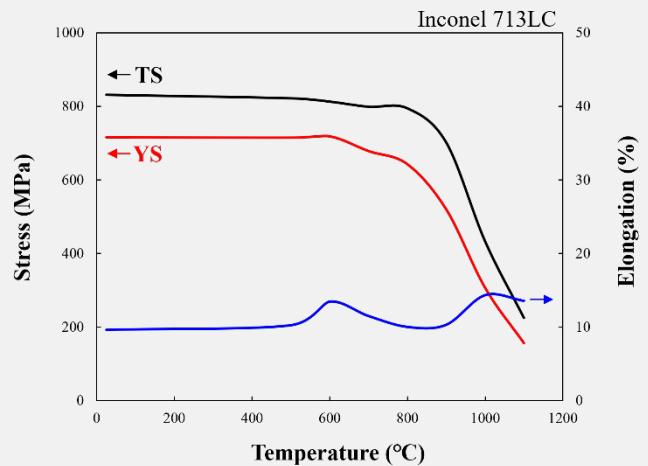


Fig. 1 The temperature dependence of Inconel 713LC tensile properties

Table. 3 – Tensile properties of as-cast Inconel 713LC

測試溫度 Temperature °C	測試溫度 Temperature °F	抗拉強度 Tensile stress MPa	降伏強度 Yield strength MPa	伸長率 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

## Stress-rupture Properties

The Stress-rupture performance of the Inconel 713LC alloy is verified based on the AMS 5377 specification, which requires that specimens, maintained at  $1800\text{ }^{\circ}\text{F} \pm 3$  ( $980\text{ }^{\circ}\text{C} \pm 2$ ) while a load sufficient to produce an initial axial stress of 22000 psi (150 MPa) or higher is applied continuously, shall not in less than 30 hours.

The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 5% in 4D. The Stress-rupture tests were conducted in accordance with the ASTM E139 specification. The data of Inconel 713LC stress-rupture properties was shown in Fig. 2

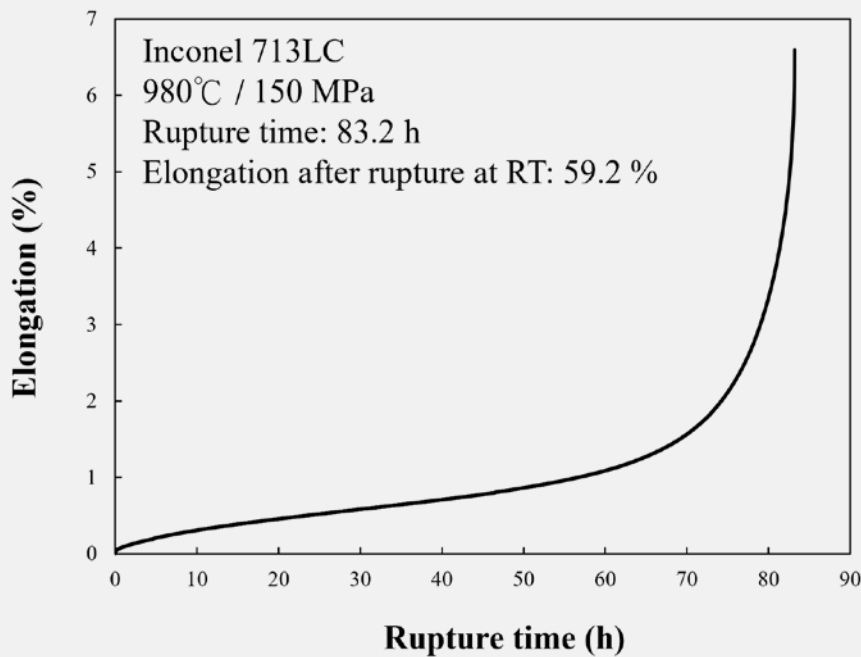


Fig. 2 Stress-rupture curve of as-cast Inconel 713LC

# TCA

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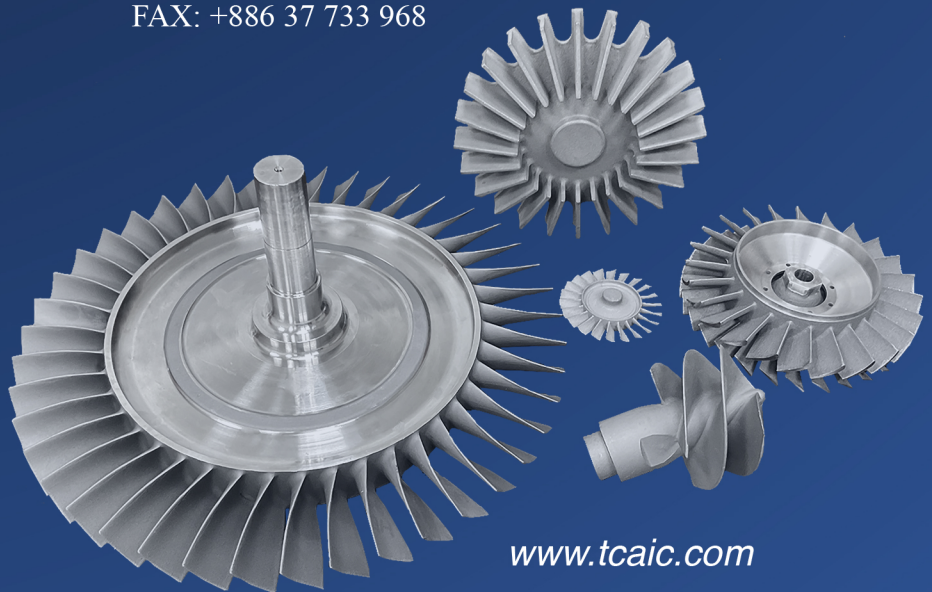


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