

# SUPERIMPHY 718

## HEAT-RESISTANT ALLOY

### I. INTRODUCTION

SUPERIMPHY 718 is a nickel-based austenitic alloy containing chromium and iron and hardened by means of molybdenum, niobium and titanium. It has a very high tensile strength up to 700°C and excellent weldability. It also has very good resistance to oligocyclic fatigue.

The table below gives this alloy's chemical composition by % weight:

Ni	Fe	Cr	Ti	Mo	Al	Nb
52	rem	19	0.8	3	0.5	5.25

Precipitation hardening is achieved by precipitation of the Ni<sub>3</sub>Nb  $\gamma'$  phase following aging treatment. This hardening, combined with good resistance to oxidation, affords Superimphy 718 excellent hot mechanical properties and in particular very good creep resistance.

Typical areas of application include:

- Aeronautics: compressor blades and discs, fasteners...
- Automotive: clamps...
- Energy: gas turbine discs, springs for nuclear power stations...
- Hot tooling: shears...
- Cryogenics: gas rocket motors...

### II. PHYSICAL PROPERTIES

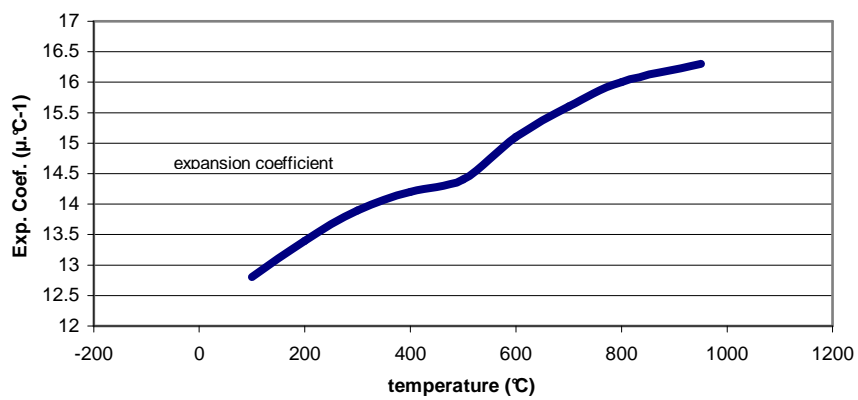
#### II.1 General physical properties

Properties	Units	Values
Melting point	°C	1200 – 1355
Density	g.cm <sup>-3</sup>	8,21
Electrical resistivity at 20 °C	μΩ.cm	120
Thermal conductivity at 20°C	W.m <sup>-1</sup> .°C <sup>-1</sup>	11,2
Expansion coefficient between 0 and 100°C	10 <sup>-6</sup> °C <sup>-1</sup>	12,8
Specific heat at 20°C	J.kg <sup>-1</sup> .°C <sup>-1</sup>	435
Magnetic properties	-	non-magnetic

## II.2 Physical properties as a function of temperature

T	Expansion coefficient (20°C – T°C)
°C	10 <sup>-6</sup> /°C
20	-
100	12,8
200	13,4
300	13,9
400	14,2
500	14,4
600	15,1
700	15,6
800	16,0

T	Thermal conductivity (W/m/K)
°C	
100	12.2
500	18.4
700	21.8
900	21.8



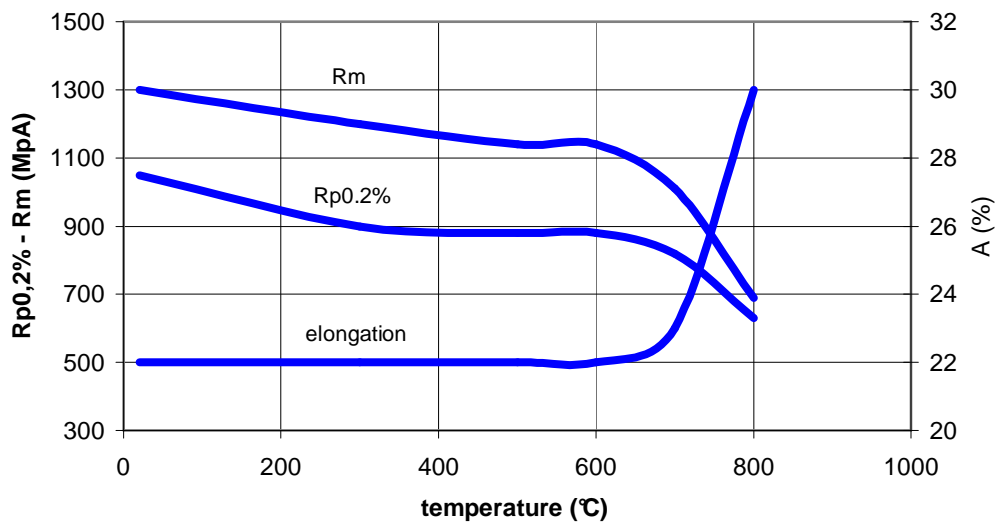
## III TENSILE PROPERTIES

- solution treated condition

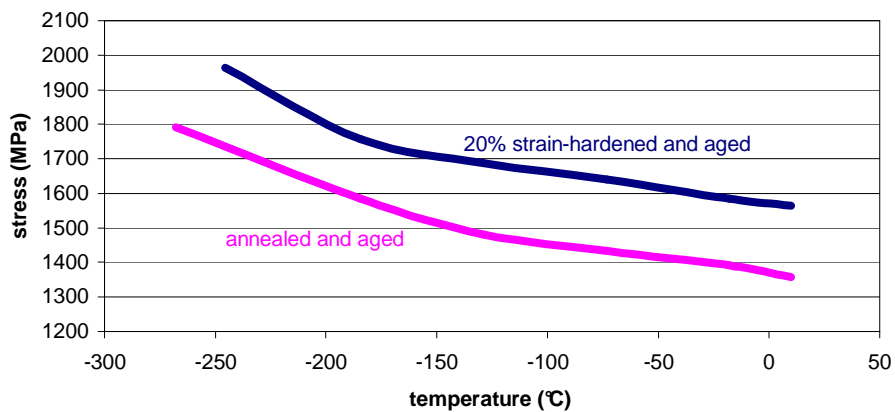
Properties	Units	Values
Proof stress Rp <sub>0.2%</sub>	MPa	410
UTS Rm	MPa	850
Elongation A (% on 50 mm)	%	45
Young's modulus E	MPa	200000

- aged condition (720°C for 8 hours, cooled in furnace at 50°C/hr down to 620°C then held at 620°C for 8 hours and cooled in air)

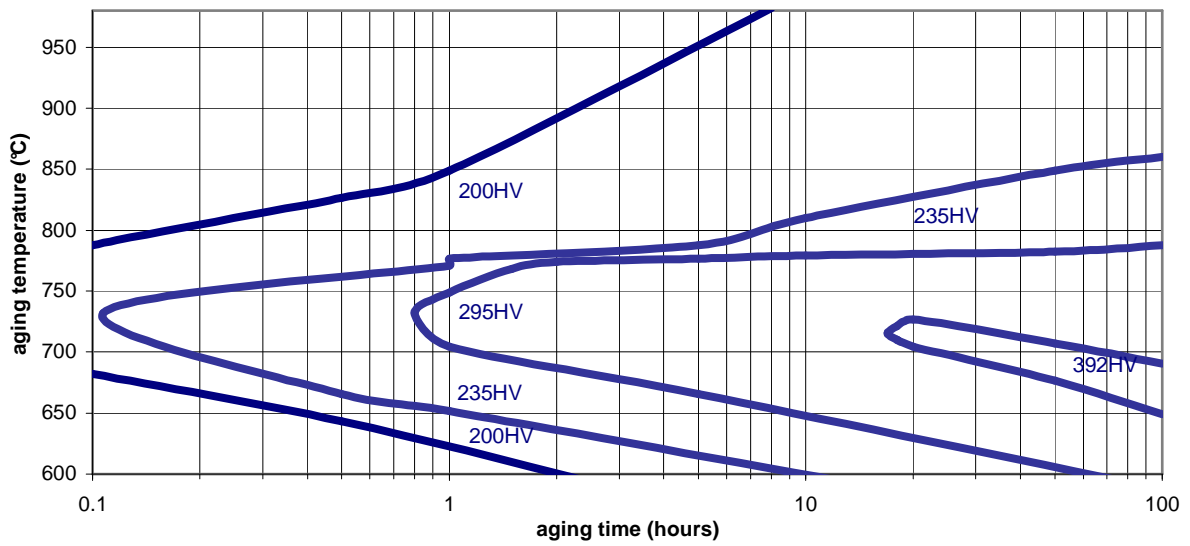
Properties	Units	Values
<b>Proof stress <math>R_{p0.2\%}</math></b>	MPa	1100
<b>UTS <math>R_m</math></b>	MPa	1300
<b>Elongation A (% on 50 mm)</b>	%	> 12
<b>Young's modulus E</b>	MPa	200000



*Tensile properties on hot-rolled strip after aging as a function of the test temperature (short holding time before tensile test)*

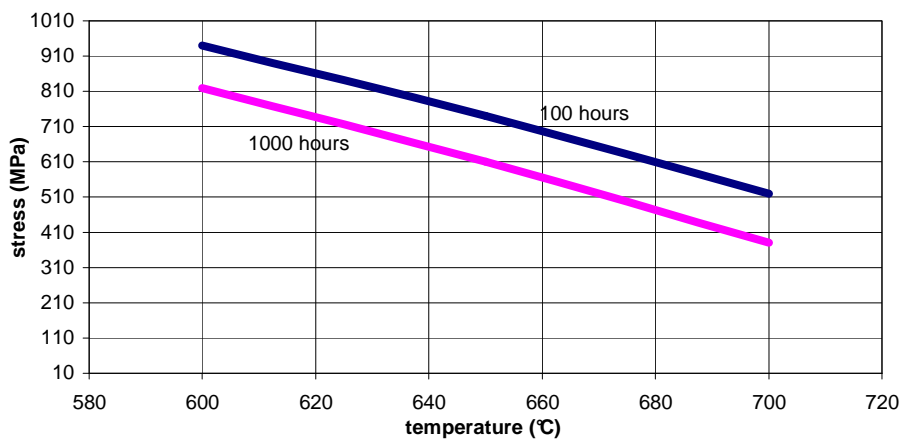


*Influence of metallurgical condition of cold-rolled strip and of temperature on  $R_m$  after aging*



*Effect of aging conditions on the hardness of annealed strip*

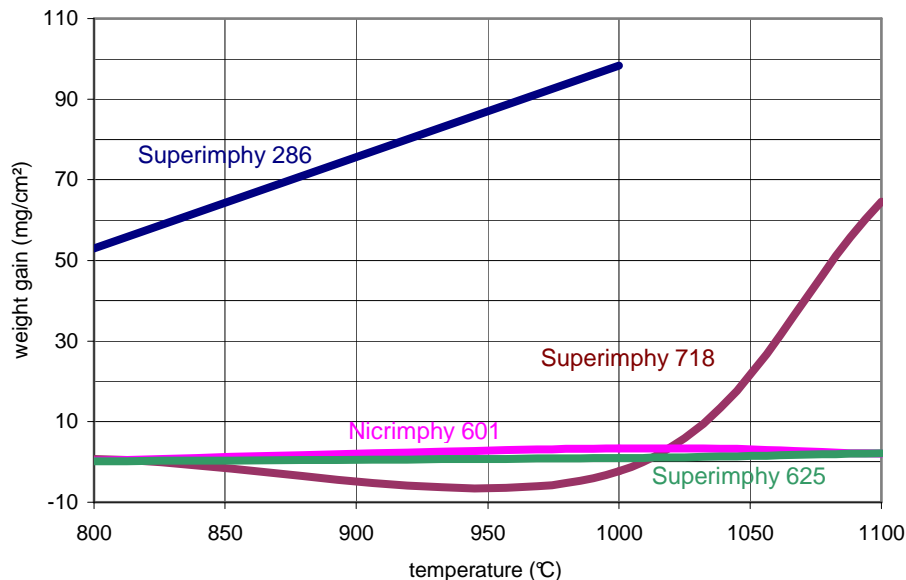
#### IV CREEP PROPERTIES



*Stress-temperature combinations resulting in failure after holding for 100 hours or 1000 hours*

## V. RESISTANCE TO OXIDATION

Superimphy 718 is highly resistant to high-temperature oxidation. It can be used up to 700°C while retaining its mechanical properties. Prolonged holding above 700°C results in softening of the material. Resistance to oxidation remains excellent up to 800°C. Above this temperature, the material begins to spall and then to oxidise.



*Alloys' weight gain as a function of temperature with 500 hours holding time*

## VI CORROSION RESISTANCE

In common with most other nickel-chromium alloys, Superimphy 718 possesses excellent corrosion resistance in all environments. The nickel plays a predominant role in corrosion resistance in organic and mineral environments and in a wide range of acids and bases. It can be employed in chloride stress corrosion environments. The alloy's chromium content affords resistance in oxidising and sulphurous environments and the molybdenum enhances resistance to pitting.

## VII TECHNOLOGICAL DATA

### VII.1 Heat treatment

Solution treatment:  $955 \pm 5^\circ\text{C}$  for 1 hour – quenched in oil or air

Aging:  $720 \pm 10^\circ\text{C}$  for 8 hours, cooled in furnace at  $50^\circ\text{C/h}$  down to  $620 \pm 10^\circ\text{C}$ , held at  $620 \pm 10^\circ\text{C}$  for 8 hours then cooled in air.

### VII.2 Machining –forming

Superimphy 718 can be machined in all heat treatment conditions. Following solution treatment, machinability is enhanced, although chip fragmentation is better in the aged condition. Abundant lubrication is recommended.

### **VII.3 Welding - brazing**

Superimphy 718 has good weldability due to the slow precipitation of the hardening phases. This alloy is generally welded using the TIG process. It is itself employed as filler metal. The protective gases are argon and helium, which are preferred for deep penetration welds. Samples are annealed, welded and then aged but better properties are obtained by post-weld annealing prior to aging.

## **VIII PRODUCT FORMS**

Superimphy 718 can be supplied as cold-rolled strip or hot-rolled sheet. Imphy Alloys is at its customers' disposal for any specific requirements.