

INCONEL® alloy 751 (UNS N07751) is a precipitation hardenable nickel-chromium alloy, used mainly for the exhaust valves of internal combustion engines. Its limiting chemical composition is shown in Table 1. The alloy has essentially the same excellent physical, mechanical and corrosion-resistance properties as INCONEL alloy X-750. Some physical constants for INCONEL alloy 751 are shown in Table 2. Its thermal properties correspond closely to those published for INCONEL alloy X-750.

In the evaluation of materials for exhaust valve applications, nickel-chromium alloys have performed well in a 1675°F (913°C) lead oxide screening test. INCONEL alloy 751 repeatedly offered good results, with corrosion rates averaging 4.31 g/dm<sup>2</sup>/h. Like other nickel-chromium alloys, INCONEL alloy 751 also resists attack by other exhaust stream impurities such as sulfur, bromine and chlorine.

**Table 1 - Limiting Chemical Composition, %**

Nickel (+ Cobalt).....	70.0 min.
Chromium.....	14.0-17.0
Iron.....	5.0-9.0
Titanium.....	2.0-2.6
Aluminum.....	0.9-1.5
Niobium (+ Tantalum).....	0.7-1.2
Manganese.....	1.0 max.
Silicon.....	0.5 max.
Sulfur.....	0.01 max.
Copper.....	0.5 max.
Carbon.....	0.10 max.

## Physical Constants and Thermal Properties

**Table 2 - Physical Constants & Thermal Properties**

Density, lb/in <sup>3</sup> .....	0.297
g/cm <sup>3</sup> .....	8.22
Melting Range, °F.....	2540-2600
°C.....	1390-1430
Specific Heat, Btu/lb °F.....	0.103
J/kg °C.....	431
Curie Temperature, °F.....	-193
°C.....	-125
Permeability at 200 oersted (15.9 kA/m).....	1.0035
Coefficient of Expansion, 10 <sup>-6</sup> in/in °F (µm/m °C)	
70-200°F (21-93°C).....	7.0 (12.6)
Thermal Conductivity, Btu in/ft <sup>2</sup> h °F.....	83
W/m °C.....	12.0
Electrical Resistivity, ohm•circ•mil/ft.....	731
µΩ ohm•m.....	1.22
Young's Modulus, 10 <sup>3</sup> ksi.....	31
GPa.....	214
Modulus of Rigidity, 10 <sup>3</sup> ksi.....	11
GPa.....	76

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**INCONEL® alloy 751**



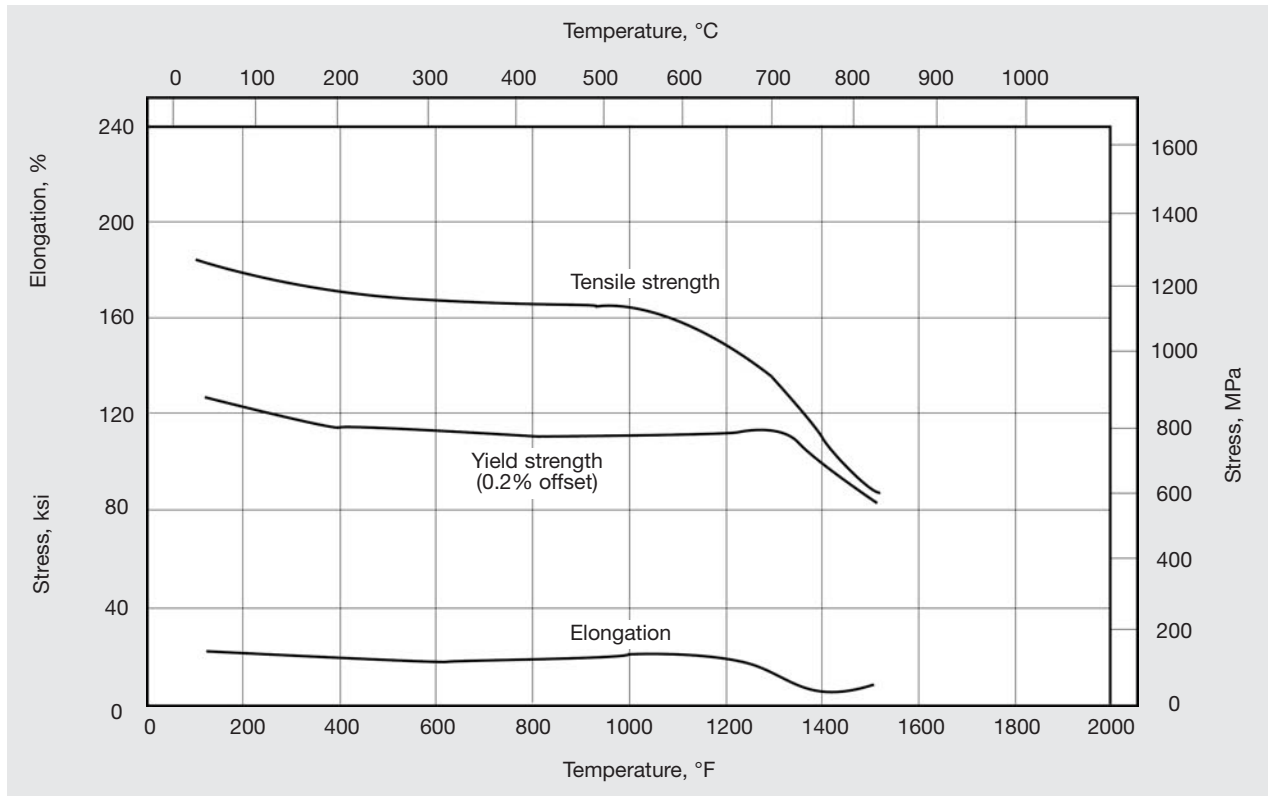
## Mechanical Properties

Tensile properties for INCONEL alloy 751 are presented in Table 3 and Figure 1. These are average properties derived from production material. High-temperature stress-rupture properties are listed in Table 4. Fatigue strengths, at room and elevated temperatures, are shown in Table 5.

INCONEL alloy 751 has excellent hot hardness. As a result, hard facing of valve seat areas for good wear-resistance is unnecessary in most applications. Table 3 lists the results of hot hardness tests at typical valve operating conditions.

**Table 3 - Tensile Properties**

Temperature		Yield Strength (0.2% Offset)		Tensile Strength		Elongation	Reduction of Area	Hardness
°F	°C	ksi	MPa	ksi	MPa	%	%	BHN
Room	Room	141.5	976	190.0	1310	22.5	38.2	352
1200	649	128.9	889	159.6	1100	22.5	32.1	291
1350	732	113.5	783	124.8	860	18.5	25.7	235
1500	816	76.3	526	80.3	554	26.0	35.9	173



**Figure 1 - High temperature tensile properties of precipitation hardened INCONEL alloy 751.**

**Table 4.** Stress Rupture Properties

Temperature		Stress to Produce Rupture in 100 h		Stress to Produce Rupture in 1000 h*	
°F	°C	ksi	MPa	ksi	MPa
1200	649	69	476	40	276
1350	732	51	352	35	241
1500	816	28	193	14	96.5

\* Extrapolated

**Table 5.** Fatigue Strength

Temperature		10 <sup>6</sup> Cycles		10 <sup>7</sup> Cycles		10 <sup>8</sup> Cycles	
°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
80	27	99.5	686	92.5	638	90.0	621
1350	732	73.5	507	62.0	427	40.0	276
1500	816	47.0	324	39.5	272	20.0	138

## Fabrication

### *Hot Working*

The hot working range for INCONEL alloy 751 is 1800-2200°F (980-1205°C). The alloy should be reheated to 2200°F (1205°C) whenever its temperature falls below 1800°F (980°C).

### *Machining*

INCONEL alloy 751 is readily machined in the as-hot finished condition. The best procedure is to machine to slightly oversize, precipitation heat treat, then finish to size. A slight permanent contraction (about 0.0003 in/in) takes place during precipitation. Precipitation treated material can be finish machined to fine finishes and close tolerances, and will have good dimensional stability.

## Available Products and Specifications

INCONEL alloy 751 is designated as UNS N07751 and is produced as round bar.

### *Joining*

INCONEL alloy 751 can be joined by the flash butt welding procedures commonly used in valve manufacture. The alloy can also be inertia welded.

### *Heat Treatment*

All properties listed in this publication were derived from material direct aged for two hours at 1350°F (732°C). This short-time heat treatment has been found to produce material with the optimum combination of properties consistent with economy. Longer, more complex, aging treatments may be used to improve specific properties required for particular applications. Please consult Special Metals Corporation for further information.



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