



NICKEL-COBALT BASE SUPERALLOY

TMW

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TMW

TMW is a nickel-cobalt base superalloy developed in the National Institute for Materials Science in Japan. This alloy is age hardenable by the precipitation of a gamma prime second phase and can be produced by casting and wrought (C&W) process routes. TMW4 alloy has improved strength and creep resistance over current C&W alloys. Potential applications include gas turbine discs and blades. TMW is available in ingot, billet, forged round bar, and hot-rolled plate...etc.

TMW Chemistry Range, wt%

Element	Co	Cr	Mo	W	Al	Ti	C	B	Ni
Min.	26.0	14.5	2.5	1.0	1.7	5.8	0.010	0.015	Bal.
Max.	26.5	15.2	3.0	1.5	2.0	6.2	0.015	0.020	Bal.

Heat Treatment Condition (Typical)

Solution; 1100°C/2h → R.T. *, Aging; 650°C/24h → R.T. +760°C/16h → R.T.*

*oil quench

Solidus Temperature: 40°C (244°F)

Solvus Temperature: 1132°C (2069°F)

Heat Window for Solution Treatment: 208°C (375°F)

Physical Constants and Thermal Properties

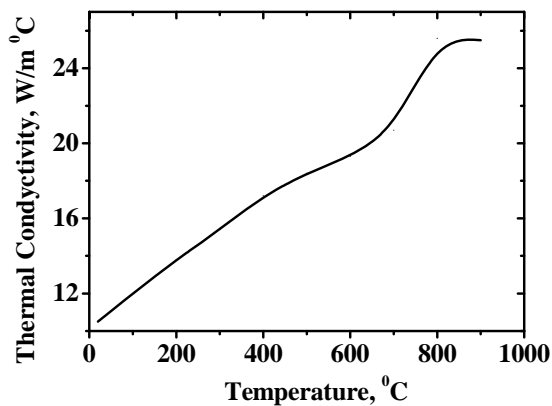
Density..... at R.T... 8.11 g/cc

Coefficient of Expansion..... 20 – 200 °C.....12.2 x10⁻⁶/°C

20 – 900 °C.....15.8 x10⁻⁶/°C

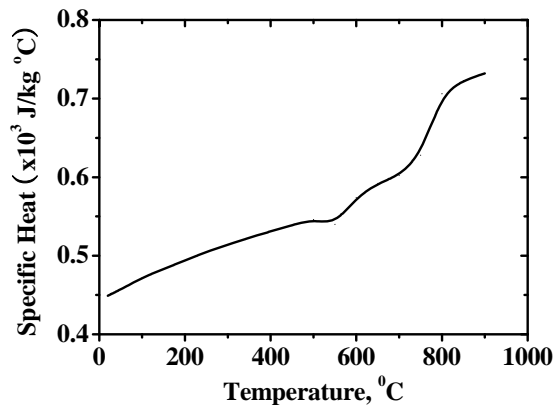
Thermal Conductivity

Laser-Flush Method

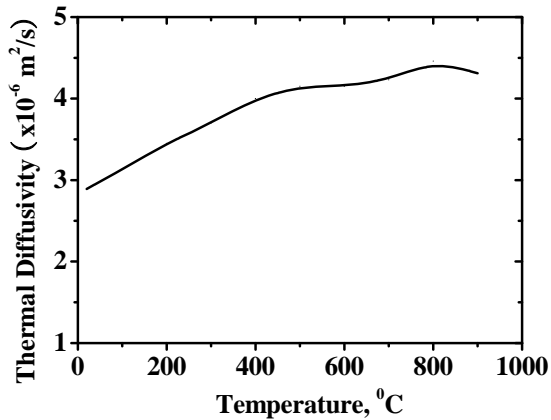


Specific Heat

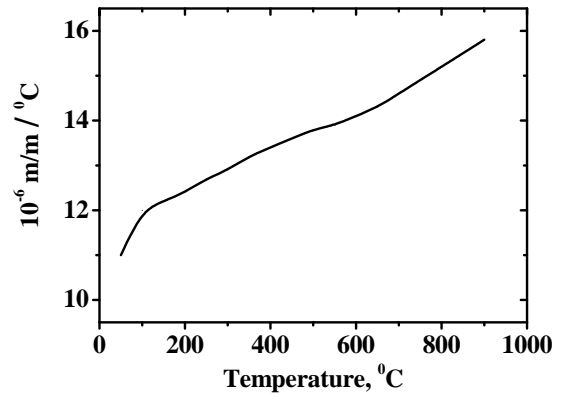
Adiabatic calorimeter (Nernst method)



Thermal diffusivity



Linear Coefficient of Thermal Expansion



Typical Mechanical Properties

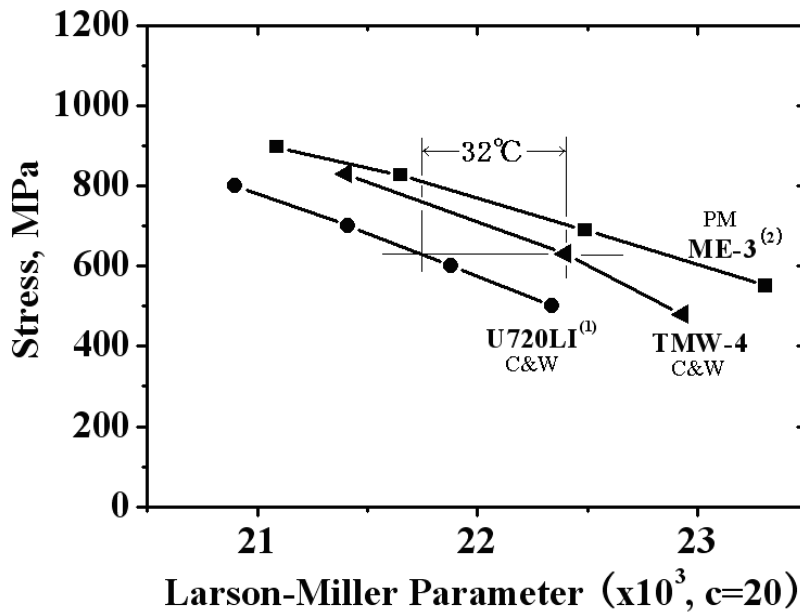
Strength to 0.2% Creep Strain (500 hour)

	MPa	ksi
650 °C/ 1202 °F	795	115
700 °C/ 1292 °F	630	91
725 °C/ 1337 °F	470	68
750 °C/ 1400 °F	310	45

Creep Rupture Strength (1000 hour)

	MPa	ksi
650 °C/ 1202 °F	840	122
700 °C/ 1292 °F	635	92
725 °C/ 1337 °F	465	67
750 °C/ 1400 °F	340	49

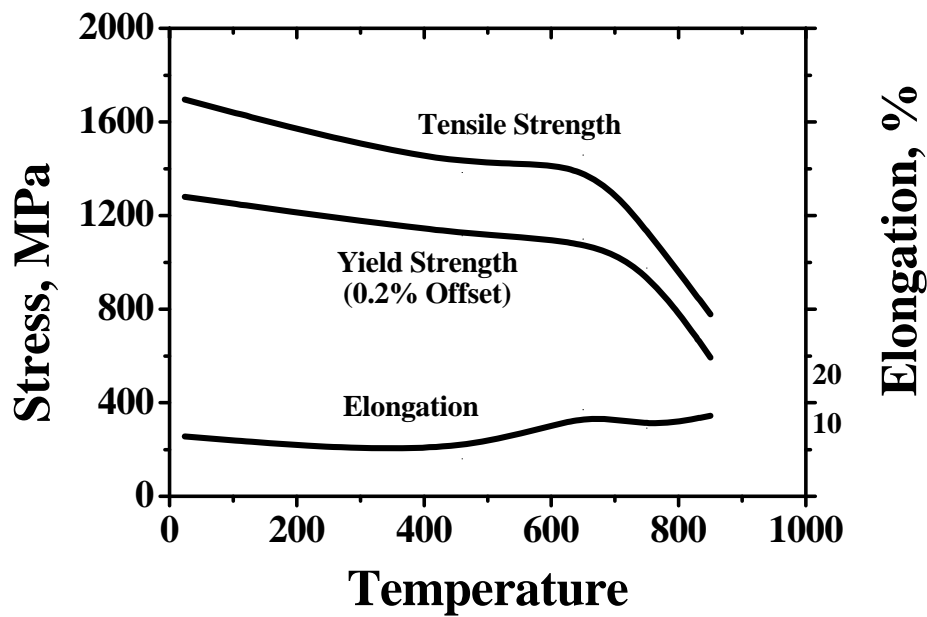
Larson-Miller Plot (= T(20+log(t))



(1) Xiao X, Zhou LZ, Guo JT, “Microstructural stability and creep behavior of nickel base superalloy U720Li”, Acta Metall. Sinca, 37(11) 2001, pp1159-1164.

(2) T. P. Gabb, et al.: NASA/TM-2002-211796.

Tensile Strength and Elongation:



Related Article

- 1) C.Cui, Y.Gu, H.Harada, A.Sato; etall. Trans. 36A (2005) 2921.
- 2) Y.Gu, C.Cui, A.Sato, J.Fujioka, M.Osawa and H.Harada; Proc. JIM meeting 2005 (2005) 163.
- 3) Y.Gu, C.Cui, D.H.Ping, A.Sato, J.Fujioka and H.Harada; Proc. JIM meeting 2006 (2006) 476.
- 4) C.Cui, Y.Gu, H.Harada, J.Fujioka and A.Sato; Proc. JIM meeting 2006 (2006) 476.

High Temperature Materials 21 Project

On June 1, 1999, ex-NRIM (now NIMS) launched an R&D project, "High Temperature Materials 21 (HTM 21)" Project, (1999. 6--2008. 3). In this Project we develop high temperature materials for 1700°C ultra-efficient gas turbines in power generations, small but efficient gas turbines for local power systems, next generation jet engines, high performance space rockets, and so on. These materials include Ni-base single crystal superalloys up to 5th generation alloys with new coating systems, as well as alloys with new concepts, e.g., platinum group metals (PGMs)-base refractory superalloys, Cr-base alloys, and so on. Materials design of empirical and theoretical approaches and microstructure analysis to support the alloy design and developments are also conducted with a major importance. We have world wide collaborations to enhance the high temperature materials researches mentioned above (Director; Hiroshi Harada).