NICKEL-COBALT BASE SUPERALLOY

TMW-4

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High Temperature Materials Center
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TMW-4

TMW-4 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. TMW-4 alloy has improved strength and creep resistance over current C&W alloys. Potential applications include gas turbine discs and blades. TMW-4 is available in ingot, billet, forged round bar, and hot-rolled plate…etc.

TMW-4 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℃/2h → R.T. *, Aging; 650℃/24h → R.T. +760℃/16h → R.T.*

*oil quench

Solidus Temperature: 40℃ (2444°F)
Solvus Temperature: 1132℃ (2069°F)
Heat Window for Solution Treatment: 208℃ (375°F)

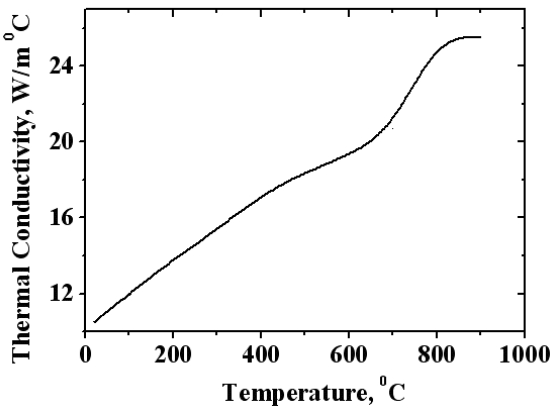
Physical Constants and Thermal Properties

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

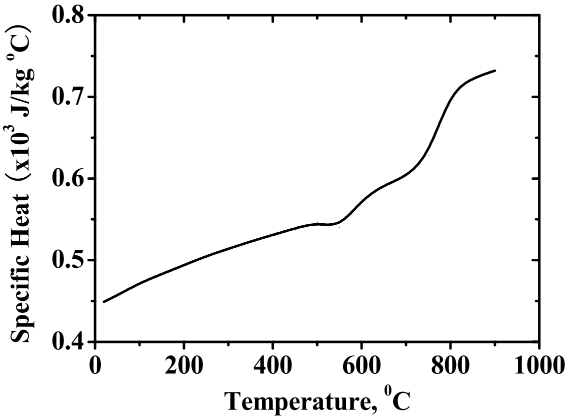
Coefficient of Expansion……………..… 20 – 200℃………..12.2 x10^{-6}/℃

20 – 900℃………..15.8 x10^{-6}/℃

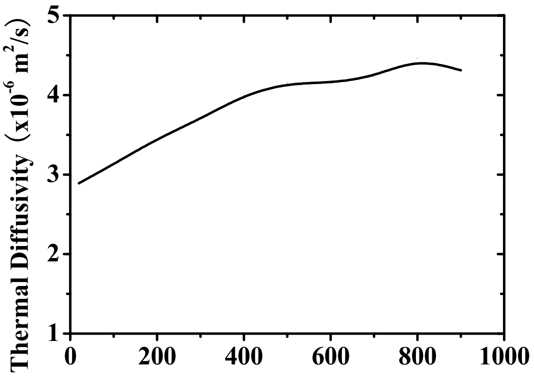
Thermal Conductivity



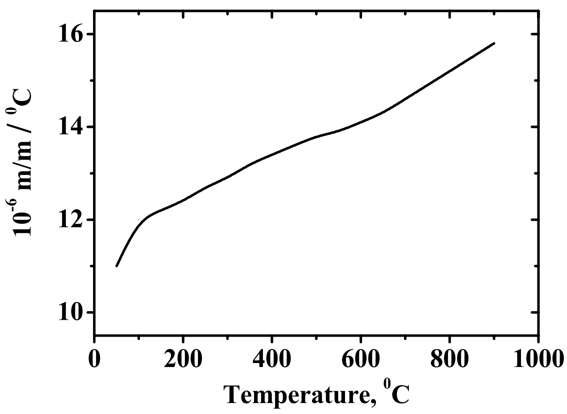
Specific Heat



Thermal diffusivity



Linear Coefficient of Thermal Expansion



Typical Mechanical Properties

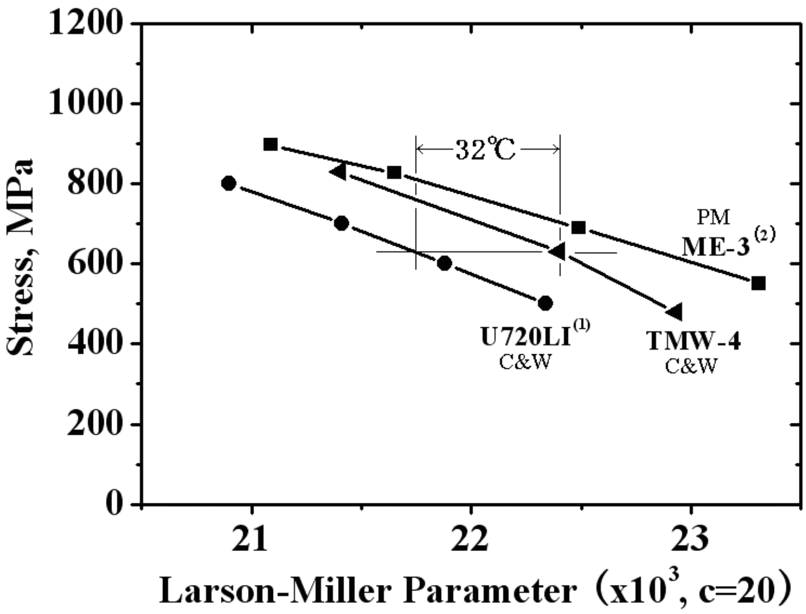
Strength to 0.2% Creep Strain (500 hour)

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

Creep Rupture Strength (1000 hour)

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

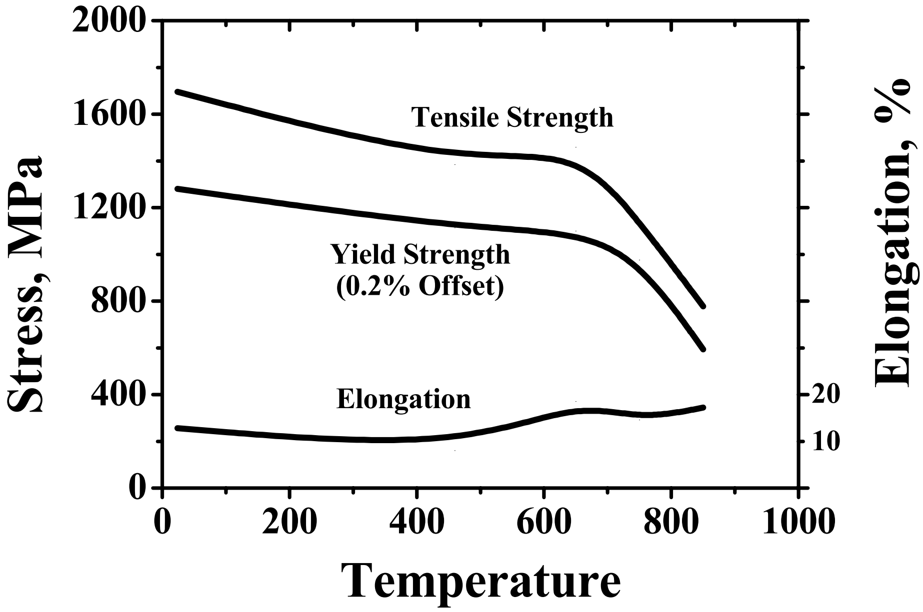
Larson-Miller Plot (= T(20+log(t))



(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 Articles

1) C.Cui, Y.Gu, H.Harada, A.Sato; Metall. 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--2010. 3). In this Project we develop high temperature materials for 1700℃ 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).