TIMETAL® 10-2-3

HIGH-STRENGTH FORGING ALLOY

TIMETAL 10-2-3 is a TIMET developed, high-strength, deep hardenable forging alloy useful for airframes and engines. Metallurgically it is a near beta alloy. It offers the opportunity to use near-net shape forging techniques and has excellent strength-toughness combinations. *TIMETAL* 10-2-3 has very high fatigue life and is well-suited for safe-life designs. Current applications for *TIMETAL* 10-2-3 encompass numerous aircraft structural parts, including landing gear components.

TABLE 1

CHEMICAL COMPOSITION

ELEMENT	WEIGHT %	
	Min.	*Max.*
Vanadium	9.0	11.0
Iron	1.6	2.2
Aluminum	2.6	3.4
Oxygen	—	0.13
Carbon	—	0.05
Nitrogen	—	0.05
Hydrogen	—	0.015
Residual Elements, each	—	0.10
Residual Elements, total	—	0.13
Titanium	Remainder	

TABLE 2

PHYSICAL PROPERTIES

PROPERTY	VALUE	
	English	*SI*
Density	0.168 lb in^{-3}	4.65 g cm^{-3}
Beta Transus	1470°F	800°C
Mean Coefficient of Thermal Expansion	5.4 x 10^{-6} in in^{-1} $°F^{-1}$ @ 75°-800°F	9.7 x 10^{-6} m m^{-1} $°C^{-1}$ @ 24°-427°C
Tensile Modulus	15.9 Msi	109.6 GPa
Compressive Modulus	16.3 Msi	112.3 GPa
Shear Modulus	6.1 Msi	42.1 GPa
Poisson's Ratio	0.32	

TABLE 3

GUARANTEED MINIMUM MECHANICAL PROPERTIES

SOLUTION TREATED THEN AGED 8 HRS

AMS Specification	*Aging Temperature °F (°C)*	*Maximum Section Thickness in (cm)*	*Ultimate Tensile Strength ksi (MPa)*	*0.2% Yield Strength ksi (MPa)*	*Elongation % in 2 in*	*Reduction in Area %*	*Fracture Toughness ksi√in (MPa√m)*
4984	900°-950° (482°-510°)	3 (7.6)	173 (1193)	160 (1103)	4	—	40 (44)
4986	950°-1000° (510°-538°)	4 (10.2)	160 (1103)	145 (998)	6	10	55 (60)
4987	1050°-1100° (566°-593°)	4 (10.2)	140 (965)	130 (896)	8	20	80 (88)

TABLE 4

HEAT TREATMENT

Solution Heat Treatment	50°-100°F (28°-56°C) below beta transus for a minimum of 30 minutes, then water quench (air cool may be used for parts less than 1 inch [2.5cm] thick)
Aging Heat Treatment	900°-1100°F (482°-593°C) for 8 hrs, air cool

TABLE 5

TYPICAL K_{1C} TREND WITH STRENGTH LEVEL

Ultimate Tensile Strength ksi (MPa)	*K_{1C} ksi √in (MPa√m)*
140 (965)	100 (110)
160 (1103)	74 (81)
180 (1241)	49 (54)

Typical K_{1SCC} Results from Forging, STA Condition

K_{1C} ksi √in (MPa√m)	*K_{1SCC} ksi √in (MPa√m)*
75 (82)	72 (79)
56 (62)	50 (55)

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TABLE 6

TYPICAL ELEVATED TEMPERATURE MECHANICAL PROPERTIES

SOLUTION TREATED THEN AGED AT 950°F (510°C) FOR 8 HRS

Test Temperature °F (°C)	Ultimate Tensile Strength ksi (MPa)	0.2 % Yield Strength ksi (MPa)	Elongation % in 2 in	Reduction in Area %	Tensile Modulus Msi (GPa)
75 (24)	176 (1214)	166 (1145)	12	25	16.2 (112)
400 (204)	162 (1117)	152 (1048)	13	33	—
600 (316)	160 (1103)	142 (979)	13	42	13.8 (95)

TABLE 7

MINIMUM COMPRESSION, SHEAR AND BEARING STRENGTH DIE FORGINGS; KSI (MPA)

SOLUTION TREATED AND AGED; L, LT, AND ST ORIENTATION

Property	Heat Treated Per: AMS 4984	AMS 4986	AMS 4987
Compression Yield Strength	166 (1145)	150 (1034)	134 (924)
Shear Ultimate Strength	97 (669)	90 (620)	78 (538)
Bearing Ultimate Strength			
(e/D = 1.5)	234 (1613)	217 (1446)	189 (1303)
(e/D = 2.0)	284 (1958)	262 (1807)	229 (1579)
Bearing Yield Strength			
(e/D = 1.5)	227 (1565)	206 (1420)	184 (1269)
(e/D = 2.0)	261 (1800)	236 (1627)	212 (1462)

TABLE 8

TYPICAL ELECTRON BEAM WELDMENT PROPERTIES

SOLUTION TREATED AT 1400°F FOR 1 HR, THEN AGED AT 950°F FOR 8 HRS (TRANSVERSED ORIENTATION; WELD K_{1C} ALONG WELD CENTERLINE)

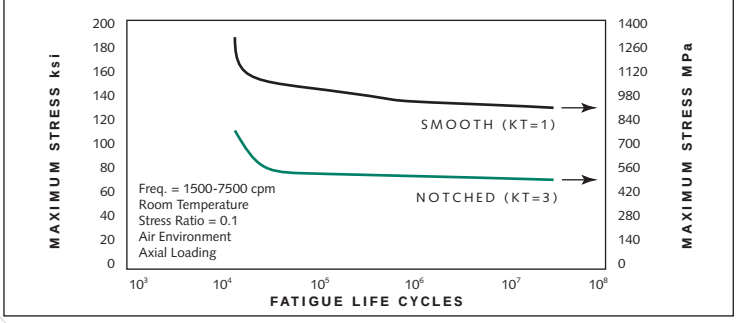
	Base Metal	Weld
Ultimate Tensile Strength ksi (MPa)	182 (1255)	182 (1255)
0.2% Yield Strength ksi (MPa)	166 (1145)	170 (1172)
Elongation %	5	5
Reduction of Area %	11	11
K_{1C} ksi √in (MPa√m)	52 (57)	52 (57)

Reference:
R. Messler, "EB Weldability of Advanced Titanium Alloys," *Weld, Res. Suppl.*, (May 1981).

FIGURE 1

BEST-FIT S/N CURVES HAND FORGINGS AND DIE FORGINGS

SOLUTION TREATED AND AGED TO HIGH STRENGTH (AMS 4984) CONDITION



TYPICAL APPLICATIONS

Landing Gear	*Actuators*
Fittings	*Flap Tracks*
Fasteners	*Rotor Heads*

The data and other information contained herein are derived from a variety of sources which TIMET believes are reliable. Because it is not possible to anticipate specific uses and operating conditions, TIMET urges you to consult with our technical service personnel on your particular applications.

For more information, please contact the TIMET Sales Office/Service Center nearest you, TIMET's Technical Laboratories or TIMET's Website @ www.timet.com

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