

TIMETAL[®] 685**HIGH-TEMPERATURE, HIGH-STRENGTH CREEP RESISTANT ALLOY**

TIMETAL 685, a near alpha alloy, combines excellent tensile strength with high temperature (968°F / 520°C) creep resistance. It is a weldable alloy that has good forging characteristics - forging temperatures above the beta transus can be used.

The alloy may be joined by the processes normally used in the fabrication of titanium, including argon-arc, electron beam and friction welding. Material should be fully heat treated prior to welding, and also given a suitable post-weld treatment (example 4-8hrs at 1022°F / 550°C). The weld zone of material treated in this way will have similar structure and properties to the parent metal.

TIMETAL 685 alloy was specifically developed for the aero-engine industry.

TABLE 1

CHEMICAL COMPOSITION

ELEMENT	WEIGHT %	
	Minimum	Maximum
Aluminum	5.70	6.30
Zirconium	4.50	6.00
Molybdenum	0.25	0.75
Silicon	0.015	0.35
Iron	—	0.05
Carbon	—	0.08
Oxygen	—	0.20
Nitrogen	—	0.03
Hydrogen	—	0.01
Residual Elements, each	—	0.10
Residual Elements, total	—	0.40
Titanium	Remainder	

TABLE 2

PHYSICAL PROPERTIES

PROPERTY	VALUE	
	English	SI
Density	0.161 lb in ⁻³	4.45 g cm ⁻³
Beta Transus	1868°F	1020°C
Thermal Conductivity*	2.40 Btu hr ⁻¹ ft ⁻¹ °F ⁻¹	4.15 W m ⁻¹ K ⁻¹
Electrical Resistivity*	66 μΩ·in	1.67 μΩ·m
Magnetic Permeability	Nonmagnetic	
Coefficient of Linear Thermal Expansion	68-212°F(20-100°C) 5.4 x 10 ⁻⁶ in in ⁻¹ °F ⁻¹ 9.7 x 10 ⁻⁶ m m ⁻¹ °C ⁻¹	
	68-572°F(20-300°C) 5.3 x 10 ⁻⁶ in in ⁻¹ °F ⁻¹ 9.5 x 10 ⁻⁶ m m ⁻¹ °C ⁻¹	
	68-932°F(20-500°C) 5.6 x 10 ⁻⁶ in in ⁻¹ °F ⁻¹ 10.1 x 10 ⁻⁶ m m ⁻¹ °C ⁻¹	
Elastic Modulus*	~18.1 Msi	~125 GPa
Rigidity Modulus*	6.7 Msi	47 GPa

* Typical values at ambient temperature, 68-78°F (20-25°C)

TABLE 3

HEAT TREATMENT

Solution Heat Treatment

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Aging Heat Treatment

1922°F (1050°C) / 30 minutes / Oil Quench*

1022°F (550°C) / 24 hours / Air Cool

*The transfer time from furnace to oil bath should not exceed 30 seconds.

TABLE 4

TYPICAL MECHANICAL PROPERTIES

Test Temperature	0.2% YS ksi (MPa)	UTS ksi (MPa)	Elongation 5D%	Reduction in Area %	Notched Tensile Strength (k _t = 3) 1.6 x actual tensile strength	Fracture Toughness K _{1c} ksi√in (MPa√m)
68°F (20°C)	131 (900)	149 (1030)	10	20	1.6 x actual tensile strength	62 (68)
968°F (520°C)	76 (525)	97 (670)	12	36	—	—



TABLE 5

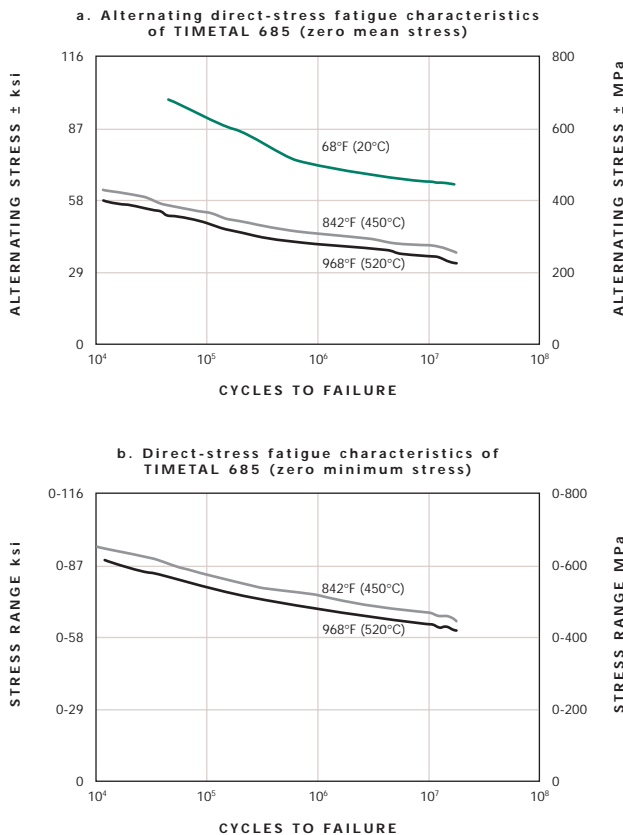
TYPICAL CREEP RESISTANCE AND STABILITY

AIR COOLED AND AGED CONDITION

Test Temperature	Creep-Test Conditions			Subsequent Post-Creep Tensile Test*			
	Time in hours	Stress ksi (MPa)	Total Plastic Strain %	0.2% YS ksi (MPa)	UTS ksi (MPa)	Elongation 5D%	Reduction in Area %
842°F (450°C)	1000	57 (390)	0.040	135 (935)	151 (1040)	9	16
932°F (500°C)	3000	28 (193)	0.051	138 (950)	151 (1040)	9	16
968°F (520°C)	100	45 (310)	0.061	134 (927)	148 (1020)	9.5	16.5
968°F (520°C)	300	45 (310)	0.145	134 (923)	149 (1030)	9	14

* The creep test piece is subjected to a room temperature tensile test after surface removal.

FIGURE 1
FATIGUE PROPERTIES



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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TECHNICAL SUPPORT

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TABLE 6

CHARPY IMPACT PROPERTIES

TYPICAL CHARPY IMPACT PROPERTIES OF 25MM ROD

Temperature	Energy Absorbed
70°F (20°C)	32 ft lbf (4.3 daJ)
-108°F (-78°C)	29 ft lbf (4.0 daJ)
-321°F (-196°C)	23 ft lbf (3.1 daJ)



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