Wrought Products Technical Data

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Certified Mechanical Properties.

Covers **Stellite**®**6B** in the form of sheet and plate up to 1 inch thickness and round bar up to 3.5” diameter.

Minimum Properties of Wrought Stellite® 6B

Property	Value	
Tensile Strength	130 ksi (896 MPa)	MIN
Yield Strength at 0.2% offset	70 ksi (483 MPa)	MIN
Elongation in 4D	5%	MIN
Reduction in Area	7%	MIN
Hardness	33-43 HRC	

Properties Data

The properties listed in this booklet are typical or average values based on laboratory tests conducted by the manufacturer. They are indicative only of the results obtained in such tests and should not be considered as guaranteed maximums or minimums. Materials must be tested under actual service conditions to determine their suitability for a particular purpose. All data represent the average of four or less tests unless otherwise noted. The secondary units (metric) used in this booklet are those of the SI system.

Chemical Composition, Percent

Stellite®	Cobalt	Nickel	Silicon	Iron	Manganese	Chromium	Molybdenum	Tungsten	Carbon
6B	Bal.	3.00*	2.00*	3.00*	2.00*	28.00-32.00	1.50*	3.50-5.50	0.90-1.40
6K	Bal.	3.00*	2.00*	3.00*	2.00*	28.00-32.00	1.50*	3.50-5.50	1.40-1.90

*Maximum

Average Physical Properties

Physical Properties	Temp., degrees C	Metric Units Stellite 6B	Metric Units Stellite 6K	Temp., degrees F	British Units Stellite 6B	British Units Stellite 6K
Hardness Limits Typical	22	33-43 RC 36-40 RC	40-42* RC 43-47 RC	72	33-43 RC 36-40 RC	40-42* RC 43-47 RC
Density	22	Kg/m^3 8387	8387	72	lb/in.^{3} 0.303	0.303
Melting Range		1265 to 1354°C			2310 to 2470 deg. F	
Electrical Resistivity	22	microhm-m 0.91	-	72	microhm-m 36	-
Thermal Conductivity	22	watt-cm/sq. cm-deg. C 0.147	-	72	Btu-in/sq.ft.hr.-deg. F 103 (546 ohms per cil. mil. ft.)	-
Mean Coefficient of Thermal Expansion		x 10-6/m/m.K			microinches/in.-deg. F	
	0-100	13.9	13.8	32-212	7.7	7.7
	0-200	14.1	13.8	32-392	7.8	7.7
	0-300	14.5	13.8	32-572	8.0	7.7
	0-400	14.7	13.8	32-752	8.2	7.7
	0-500	15.0	13.8	32-932	8.3	7.7
	0-600	15.3	14.0	32-1112	8.5	7.8

	0-700	15.8	14.2	32-1292	8.8	7.9
	0-800	16.3	14.5	32-1472	9.1	8.1
	0-900	16.9	14.9	32-1 652	9.4	8.3
	0-1000	17.4	15.5	32-1832	9.7	8.6
Electrical Conductivity Compared to Copper, percent	22	1.90	-	72	1.90	-
Specific Heat (calculated)	Room	J/kg•K 423	Room -		Btu/lb-deg. F 0.101	-
Magnetic Permeability at 200 Oersteds (15.900 A/m)	22	<1.2	<1.2	72	<1.2	<1.2
Reflecting Power, percent		57-70			57-70	

*Minimum depending on gauge

Average Hot Hardness

Stellite®	Test Temp., deg. F (deg. C)		Brinell Hardness at Temperature, Mutual Indentation Method
6B	1000	(538)	226
	1200	(649)	203
	1400	(760)	167
	1600	(871)	102

Average Compressive Strength

Stellite®	Form	Test Temp.	Average Compressive Strength Ksi	(MPa)
6B	1/2-in. (12.7 mm), Plate 1	Room	347	(2392)
6K	Sheet 1	Room	325	(2241)

Average Modulus of Rupture

Stellite®	Form	Test Temp.	Average Modulus of Rupture Ksi	(MPa)
6B	Sheet 1	Room	338	(2360)

Average Modulus of Elasticity

Stellite®	Form	Test Temp.	Average Modulus of Elasticity psi x 10^6 (MPa)
6B	Sheet 1	Room	30.4 (210,000)
6B	5/8-in. (15.9 mm), Bar	Room	31.1 (214,000)

Average Izod Impact Strength (un-notched)

Stellite®	Form	Test Temp.	Average Izod Impact Strength (un-notched) ft. lbs.	J
6B	1/2-in (12.7 mm), Plate 1	Room	62	84

Average Charpy Impact Strength

Stellite®	Test Temp., deg. F (deg. C)	Type of Test	Average Charpy Impact Strength, ft. lbs. (J) Longitudinal		Transverse	
6B 1/2-in. (12.7 mm), Plate 1	Room	Un-notched	72	(98)	65	(88)
		notched	6	(8)	-	
	1000 (538)	Un-notched	81	(110)	-	
		notched	15	(20)	-	
	1250 (677)	Un-notched	116	(157)	-	
		notched	15	(20)	-	
	1500 (816)	Un-notched	126	(171)	-	
		notched	15	(20)	-	

1 Solution heat-treated at 2250 deg. F (1232 deg. C), air cooled

Average Room Temperature Data - Stellite® 6B

FORM	Condition	Ultimate Tensile Strength, Ksi (MPa)		Yield Strength at 0.2% offset Ksi (MPa)		Elongation in 2 in. 50.8 mm, percent	Hardness, Rockwell C
Sheet, 0.040 in. (1.0 mm), thick	Solution Heat-treated*	145.0 a	(1000)	90.1	(621)a	12a	36a
Sheet, 0.065 in. (1.7 mm), thick	Solution Heat-treated*	140.8 a	(971)	86.7	(598)a	11a	36a
Sheet, 0.125 in. (3.2 mm), thick	Solution Heat-treated*	144.7 a	(998)	89.8	(619)a	11a	37a
Sheet, 0.187 in. (4.8 mm), thick	Solution Heat-treated*	144.5 a	(996)	89.3	(616)a	10a	37a

Solution heat-treated at 2250 deg. F (1232 deg. C), air cooled
a Average of 27-31 tests

Average Tensile Data 1

Stellite®	Form	Test Temp., deg. F	(deg. C)	Ultimate Tensile Strength Ksi	(MPa)	Yield Strength at 0.2% offset, Ksi	(MPa)	Elongation in 2 in. 50.8 mm, percent
6B	0.063 in. (1.6 mm), Sheet	Room		146.0	(1007)	91.6	(632)	11
		1500	(816)	73.9	(509)	45.4	(313)	17
		1600	(871)	55.8	(385)	39.2	(270)	18
		1800	(982)	32.6	(225)	19.8	(137)	36
		2000	(1093)	19.5	(134)	10.9	(75)	44
		2100	(1149)	13.3	(92)	7.7	(53)	22
	1/2 in. (12.7 mm), Plate	Room		148.0	(1020)	88.0	(607)	7
		1000	(538)	133.0	(917)	58.5	(403)	9
		1250	(677)	115.0	(793)	60.6	(418)	9
	5/8 in. (15.9 mm), Bar	Room		154.1	(1063)	92.6	(638)	17*
		600	(316)	147.8	(1019)	74.5	(514)	30*
		1000	(538)	129.1	(890)	67.3	(464)	28*
		1500	(816)	75.4	(520)	46.5	(321)	28
		1600	(871)	58.3	(402)	37.9	(261)	34*
6K	0.063 in. (1.6 mm), Sheet	Room		176.5	(1217)	102.7	(708)	4
		1200	(649)	146.0	(1007)	-	-	8
		1500	(816)	70.2	(484)	44.5	(307)	17
		1800	(982)	34.1	(235)	19.3	(133)	28
		2000	(1093)	17.4	(120)	8.6	(59)	53

1 Solution heat-treated at 2250 deg. F (1232 deg. C), air cooled.
*Elongation, percent in 1 in. (25.4 mm).

Average Cavitation-Erosion Data

Alloy	Test Duration, hrs.	Weight loss, mg.
Stellite® 6B	100	42.3
Type 304 Stainless Steel	7	39.9

Average Abrasive Wear Data

Alloy	Condition	Volume Loss, mm^3	Hardness, Rockwell	Wear Coefficient[1]
Stellite® 6B	Mill annealed	8.2	C-38	0.471×10^{-3}
Stellite® 6K	Mill annealed	13.3	C-46	0.946×10^{-3}
Stellite® 25	Mill annealed	53.0	C-24	2.00×10^{-3}
1090 Steel	1 hr. at 1600 deg. F (871 deg. C) water quenched + 4 min, at 900 deg. F (482 deg. C)	37.2	C-55	8.00×10^{-3}
Type 316 Stainless Steel	As received sheet	81.4	B-86	2.0×10^{-3}
Type 304 Stainless Steel	As received sheet	102.1	B-92	3.00×10^{-3}

Average Adhesive Wear Data*

Alloy	Condition	Ring Alloy	Volume Loss, mm^3	Wear Coefficient[1]
Stellite® 6B	Mill annealed	4620 Steel	0.293	3.70×10^{-5}
Stellite® 6K	Mill annealed	4620 Steel	0.561	8.73×10^{-5}
Stellite® 25	Mill annealed	4620 Steel	0.285	2.50×10^{-5}
1090 Steel	1 hr. at 1600 deg. F (871 deg. C) water quenched + 4 min, at 900 deg. F (482 deg. C)	4620 Steel	0.293	6.00×10^{-5}

Average Coefficients Of Static Friction For Some Common Materials

Material Against	Stellite® 6B	Cast Iron	Bronze	Aluminium	Lead
Stellite® 6B	0.119	0.123	0.125	0.138	0.119
Cast Iron	0.123	0.199	0.245	0.213	0.225
Bronze	0.125	0.245	0.231	0.257	0.249
Aluminium	0.138	0.213	0.257	0.213	0.328
Lead	0.119	0.225	0.249	0.328	0.290

Coefficient represents tangent of angle of repose. Tests made on dry surface having better than 120 grit finishes. All values based on averages and are to be used comparatively and not as absolute values.

* Average of two or more tests against a case-hardened SAE 4620 steel ring (Rockwell C-63).

1 The wear coefficient (K) was calculated using the equation where V = Wear volume (mm^3)

P = Load (kg)

L = Sliding distance (mm)

h = Diamond pyramid hardness

A combination of a low wear coefficient and a high hardness is desirable for good wear resistance.

Average Corrosion Data - Stellite® 6B*

Media	Concentration, percent by Weight	Test Temp., deg F (deg. C)	Average Penetration Rate per Year**	
			mils	mm
Acetic Acid	10	Boiling	0.08	0.002
Acetic Acid	30	Boiling	0.04	0.001
Acetic Acid	50	Boiling	0.02	<0.001
Acetic Acid	70	Boiling	0.06	<0.002
Acetic Acid	99	Boiling	0.03	<0.001
Chromic Acid	10	150 (66)	95	2.41
Formic Acid	10	Boiling	20	0.51
Formic Acid	30	Boiling	26	0.66
Formic Acid	50	Boiling	47	1.19
Formic Acid	70	Boiling	50	1.27
Formic Acid	88	Boiling	23	0.58
Hydrochloric Acid	2	Room	0.1	<0.003
Hydrochloric Acid	5	Room	63	1.60
Hydrochloric Acid	10	Room	108	2.74
Hydrochloric Acid	20	Room	93	2.36
Hydrochloric Acid	2	150 (66)	0.1	<0.003
Hydrochloric Acid	5	150 (66)	>1000	>25.4
Hydrochloric Acid	10	150 (66)	>1000	>25.4
Hydrochloric Acid	20	150 (66)	>1000	>25.4
Nitric Acid	10	Boiling	0.15	<0.004
Nitric Acid	30	Boiling	6	0.15
Nitric Acid	50	Boiling	>1000	>25.4
Nitric Acid	70	Boiling	>1000	>25.4
Phosphoric Acid	10	Boiling	Nil	Nil
Phosphoric Acid	30	Boiling	2	0.05
Phosphoric Acid	50	Boiling	19	0.48
Phosphoric Acid	70	Boiling	23	0.58
Phosphoric Acid	85	Boiling	611	15.5
Sodium Hydroxide	30	Boiling	13	0.33
Sulfuric Acid	10	Room	0.02	<0.001
Sulfuric Acid	30	Room	Nil	Nil
Sulfuric Acid	50	Room	0.4	0.01
Sulfuric Acid	77	Room	0.7	0.02
Sulfuric Acid	10	150 (66)	0.02	<0.001
Sulfuric Acid	30	150 (66)	0.09	<0.003
Sulfuric Acid	50	150 (66)	>1000	>25.4
Sulfuric Acid	77	150 (66)	176	4.5
Sulfuric Acid	2	Boiling	31	0.79
Sulfuric Acid	5	Boiling	91	2.31
Sulfuric Acid	10	Boiling	157	3.99
Sulfuric Acid	20	Boiling	360	9.14
Sulfuric Acid	50	Boiling	>1000	>25.4
Sulfuric Acid	30	Boiling	>1000	>25.4
Sulfuric Acid	77	Boiling	>1000	>25.4
Ferric Chloride	10	Room	13	0.33***

(10 days without crevice)				
Ferric Chloride (10 days with crevice bolt)	10	Room	9**	0.23***
Ferric Chloride + Sodium Chloride (10 days)	5 10	Room	18	0.46***
Potassium Permanganate + sodium Chloride (120 hrs)	2 2	194 (90)	8	0.20

* Determined in laboratory tests. It is recommended that samples be tested under actual plant conditions.
** Corrosion rates for all duplicate samples based on an average of 4-24 hour test periods.
*** Samples pitted during test.

Average Stress Rupture and Creep Data

Stellite®	Test Temp., deg. F	(deg. C)	Stress Ksi	(MPa)	Initial Elongation, percent	Life, hrs.	Time in hours for total Elongation, % of: 0.5	1.0	2.0	Elongation at Rupture, percent
6B 0.063 in. (1.6 mm), Sheet[2]	1000	(538)	60	(414)	0.70	192.8[1]	-	-	-	0.8
	1200	(649)	50	(345)	0.45	361.4	0.5	113.8	-	3.0
	1400	(760)	35	(241)	0.35	59.3	0.4	3.8	16.3	5.1
	1500	(816)	25	(172)	0.35	70.6	0.2	4.3	19.9	4.7
	1600	(871)	19	(131)	0.10	57.9	0.5	2.2	11.1	4.3
	1700	(927)	12	(83)	0.19	104.0	1.8	20.9	89.9	2.6
	1800	(982)	8	(55)	0.05	113.4	5.1	22.7	57.6	5.5
	2000	(1093)	2	(14)	0.004	116.7	4.4	-	-	13.3

1 Test discontinued before rupture.
2 Specimens were solution heat-treated at 2250 deg. F (1232 deg. C) and air cooled prior to testing.

Fusion Welding

Stellite® 6B (AMS 5894) and **Stellite® 6K** can be welded by gas tungsten-arc (TIG) with an argon flow of 25 CFH, gas metal-arc (MIG), shielded metal-arc (coated electrode), and oxy-acetylene in this order of preference. The oxy-acetylene method should be used with discretion and care in that Stellite will "boil" during welding which may cause porosity. Use a 3x reducing flame to minimize oxidation, penetration, and inter-alloying.

Stellite® 6B (AMS 5894) and **Stellite® 6K** should be preheated and maintained at 1000°F (35 8°C) to prevent cracking during welding and then still air cooled. Fixturing which would chill the weld rapidly should not be used. Standard weld joints are recommended. **Inconel®** 82, 92, or 625 filler metals are recommended for joining **Stellite® 6B (AMS 5894)** to softer materials such as carbon steel or stainless steel, while the harder cobalt-base filler metals such as **Stellite® 6** and **Stellite® 21** are recommended for joining **Stellite® 6B** (AMS 5894) to itself, especially if wear resistance is required in the weld areas. In the latter case, **Inconel®** 82, 92, or 625 may be used for root passes and then be overlayed with the harder

materials. Gas shielding of the root side of the gas tungsten-arc weldments is not mandatory but is recommended in order to improve weld penetration.

Adequate ventilation is required to control exposure to airborne dust, fumes, and particulate when machining, grinding or welding Stellite alloys. MSDS sheets are available.

Brazing

Stellite® 6B (AMS 5894) and **Stellite® 6K** are readily joined to other materials by brazing. All forms of surface dirt such as paint, ink, oil, chemical residues, etc., must be removed from the mating parts by etching, solvent scrubbing, degreasing, or other means. In addition, fluxing will be required during torch brazing operations when using silver brazing filler metal to help clean the joint and allow the filler metal to flow more freely over the mating surfaces. Brush joining areas generously with brazing flux prior to heating. When torch or induction brazing, as soon as the brazing filler metal melts, the source of heat should be removed and the parts positioned. The assembly should then be pressed together to squeeze out the excess flux and still air cooled. The parts should not be quenched.

Other brazing filler metals (i.e., gold, palladium, or nickel-based alloys) are satisfactory for joining **Stellite® 6B** (AMS 5894) and **Stellite® 6K**. Brazing filler metal selection depends on the service conditions expected.

A close fit of the mating surfaces is recommended. The finished joints will have greater strength if the filler metal is very thin, generally 0.001 - 0.005" (0.03 - 0.13 mm) thick.

Brazing with high-temperature filler materials is generally performed in a furnace. Induction and resistance heating with salt-bath and
metal-bath dip brazing have limited application. Vacuum furnaces held at less than one micron pressure or controlled atmosphere furnaces, having adequate moisture control at brazing temperatures (less than 60° F (15°C)

dew point), produce the most satisfactory results. Controlled atmospheres such as hydrogen or cracked ammonia are suitable for brazing **Stellite® 6B (AMS 5894)** and **Stellite® 6K** base materials.