



Extreme Alloys for Extreme Environments

Elite Bearing Alloys

Material Data

Unique high performance material
for bearing applications.

Freerun[®] SL - Self Lubricating bearing
material

Freerun[®] LW - Long Wearing bearing material



Elite Bearing Alloys

Highly Engineered Alloys for Extreme Environments

What is Freerun®?

Why settle for standard bearing material or complicated combinations of material? Freerun is a solid bearing material which comes in a self lubricating (Freerun®SL) format and a long wearing format (Freerun®LW).

How special is Freerun®?

As a bearing material, these alloys are designed to wear. Freerun® alloys have the benefit of reducing friction, whilst increasing strength. This means will not only last longer, but will be able to take higher loads and perform in more extreme environments.

Copper Alloys Ltd has developed a range of materials called Freerun® optimised for use in extreme and aggressive bearing applications.

The metallurgy of Freerun® solid bearing metal

By applying the proprietary process technology called Microfine® unique to Copper Alloys, it is possible to significantly enhance mechanical properties.

This unique combination allows previously 'cast only' alloys to be manufactured with a fine grain structure. This facilitates the application of mechanical work in order to push the mechanical properties to the extreme.

New material technology

The result is two of the most advanced solid bearing materials.





Freerun[®] SL

Self-Lubricating Alloy

Ideal when lubrication is difficult or unfeasible, or to be used as a contingency against lubrication failure.

This is a Leaded Phosphor Bronze conforming to UNS C93800 and supplied in three grades **SL340** (hard wearing), **SL300** (medium wearing) and **SL240** (soft wearing) with increasing self-lubrication and reducing yield strength.

Chemical Composition

Freerun[®] Self Lubricating Alloy

Cu	Sn	Pb	Zn	Ni	Fe	Sb	S	P	Al	Si
Balance	6.3-7.5	13-16	0.8*	1.0**	0.15*1	0.8*	0.05*	1.5*	0.005*	0.005*

The benefits of composition

Freerun[®] SL is a self-lubricating metal. It's composition is designed specifically to enable in to meet a number of national material standards.

Freerun[®] SL also meets the following industry standards:

- EN 1982-2008 C496K
- ASTM C93800
- BS1400 LB1
- SAE 67

Engineering Advantages

- High mechanical strength, three times greater than the all industry standards whilst still retaining good ductility
- Super strength, four-times the strength with reduced ductility
- High fatigue strength
- High lead content gives excellent resistance to seizure
- Increased hardness improves the wear resistance
- Excellent corrosion resistance
- Good machinability at 80% of free machining brass





Freerun[®] SL

Mechanical Properties

Material	Condition	Yield Strength (0.2% N/mm ²)	Tensile Strength (0.2% N/mm ²)	Elongation (%)	Hardness HB	Static Friction Coef. cient*
Freerun [®] SL-250	Soft	160	250	15	85	μ 0.011-0.20
Freerun [®] SL-300	Half Hard	340	300	6	120	μ 0.011-0.20
Freerun [®] SL-350	Hard	440	350	3	140	μ 0.011-0.20

Freerun[®] SL bearing alloy also meets the following material specification requirements

ASTM C95800	N/A	110	172	5	N/A	N/A
EN1982 CC496K	N/A	90	200	8	65	N/A

*estimated with grease and without against mild steel

Physical Properties

	Imperial	Metric
Melting Point - Liquidus	1730° F	943° C
Melting Point - Solidus	1570° F	854° C
Incipient Melting	600° F	316° C
Density	0.334 lb/in ³ at 68° F	9.25 gm/cm ³ @ 20° C
Specific Gravity	9.250	9.25
Electrical Resistivity	91.10 ohms-cmil/ft @ 68° F	15.15 microhm-cm @ 20° C
Electrical Conductivity	11 %IACS @ 68° F	0.066 MegaSiemens/cm @ 20° C
Thermal Conductivity	30.20 Btu • ft/(hr • ft ² • °F) at 68°F	52.3 W/m • °K at 20° C
Coef. cient of Thermal Expansion	10.30 • 10 ⁻⁶ per of (68-392° F)	18.5 • 10 ⁻⁶ per °C (20-200° C)
Specific Heat Capacity	0.090 Btu/lb/°F at 68° F	377.1 J/kg • °K at 293° K
Modulus of Elasticity in Tension	10500 ksi	72400 MPa
Compressive Strength	18900psi	130MPa
Machinability	80%	80%
Magnetic Permeability	1.0μ	1.0μ





Freerun[®] LW

Long Wearing Alloy

Originally developed for the military aerospace bearings, Copper Alloys' proprietary process technology enables extreme wear resistance and survivability.

Engineering Advantages

- High strength, double industry standards
- Excellent wear resistance whilst maintaining low friction
- Can sustain high load and fatigue resistance
- A fine grain size allowing ultrasonic inspection
- Properties can be adapted to suit specific applications
- Decades of successful operation in critical engineering industries

Based on the nominal composition CuSn8P, this is a Phosphor Bronze conforming to UNS C52100 and supplied in several grades including LW-600 (hard wearing) and LW-400 (soft wearing) with increasing tensile strength and reducing friction.

Freerun[®] LW also meets the following industry standards:

- NF L 14-702
- ASTM C52100
- CW453K
- CW459K

Chemical Composition

Freerun[®] Long Wearing Alloy

Cu	Sn	Pb	Zn	P	Others
Balance	7.25-9.75	0.01*	0.5*	0.05-0.35	0.5*

The benefits of composition

Freerun[®] SL is a lead-free anti-galling bearing metal that is designed to last. Its composition is designed specifically to enable it to meet industry and national material standards.





Freerun[®] LW

Mechanical Properties

Material	Condition	Yield Strength (0.2% N/mm ²)	Tensile Strength (0.2% N/mm ²)	Elongation (%)	Hardness HB	Friction Coef cient*
Freerun [®] LW-400	Soft Wearing	400	450	40	150	μ 0.011-0.30
Freerun [®] LW-600	Hard Wearing	600	700	20	229	μ 0.011-0.30

Freerun[®] Long Wearing alloy also meets the following material specification requirements

NF L 14-702	Half Hard	290	440	25	>100	N/A
ASTM C52100	Hard	230*	419	20	90	N/A
CW453K	R390/H085	280	390	45	>100	N/A
CW459K	R450/H135	280	450	26	135	N/A

*estimated with grease and without against mild steel

Physical Properties

	Imperial	Metric
Melting Point - Liquidus	1880° F	1027° C
Melting Point - Solidus	1620° F	882° C
Density	0.318 lb/in ³ at 68°F	8.8 gm/cm ³ @ 20° C
Specific Gravity	8.800	8.80
Electrical Resistivity	79.80 ohms-cmil/ft @ 68°F	13.27 μ cm @ 20° C
Electrical Conductivity	13 %IACS @ 68° F	0.076 MegaSiemens/cm @ 20° C
Thermal Conductivity	360 Btu · ft/(hr · ft ² · °F) at 68°F	62.3 W/m · °K at 20° C
Coef cient of Thermal Expansion	10.10 · 10 ⁻⁶ per oF (68-392° F)	18.2 · 10 ⁻⁶ per °C (20-200° C)
Specific Heat Capacity	0.090 Btu/lb/°F at 68°F	377.1 J/kg · °K at 293° K
Modulus of Elasticity in Tension	16000 ksi	110000 MPa
Modulus of Rigidity	6400 ksi	41370 MPa





Guide to Relative Performance of Bearing Materials

Bearing Material	Load Capacity and Fatigue	Maximum Operating Temp.	Conformability and Embeddability	Resistance to Seizure	Hardness and wear resistance
Tin Bronze	High	High	Moderate	Moderate	High
Freerun [®] LW	Very High	High	Poor	Moderate	Very High
Leaded Bronze	Moderate/High	High	Good	Good	High
Freerun [®] SL	Moderate	High	Very Good	Very Good	Low
Aluminium Bronze	Very High	Very High	Poor	Moderate	Very High
Gunmetal	Moderate/High	High	Good	Moderate/Good	High

Fabrication Properties

Joining Technique	Suitability
Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Fair
Gas Shielded Arc Welding	Good
Coated Metal Arc Welding	Fair
Spot Weld	Good
Seam Weld	Fair
Butt Weld	Excellent
Capacity for Being Cold Worked	Good
Capacity for Being Hot Formed	Poor

Formats

- Available in a range of formats made to order and ex-stock including bar, rings, tubes and sections
- Available in proof machined and finished machine (to print) condition



Extreme Alloys for Extreme Environments

The Elite Bearing Alloys

Brought to you by Copper Alloys Ltd.
creators of the most advanced alloys
ever made, including Thermalloy, T-1000
and the game-changing CNC-1.

Visit www.copperalloys.net/elite-alloys to find out
more.

Unique high performance material for advanced
applications.



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