



Elite Bearing Alloys

Highly Engineered Alloys for Extreme Environments

What is Freerun®?

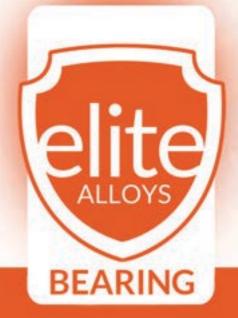
Why settle for standard bearing material or complicated combinations of material? Freerun is a solid bearing material which comes in a self lubricating (Freerun®SL) format and a long wearing format (Freerun®LW).

How special is Freerun®?

Name and Address of the Owner, where the Owner, which the

As a bearing material, these alloys are designed to wear. Freerun[®] alloys have the benef t 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 Microfne 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.



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Freerun® SL

Self-Lubricating Alloy

Ideal when lubrication is dif cult 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

Pb

13-16

national material standards.

6.3-7.5

Freerun[®] Self Lubricating Alloy

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

Zn

0.8*

Ni

1.0**

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 also meets the following industry standards:

1.5*

ΑI

0.005*

0.005*

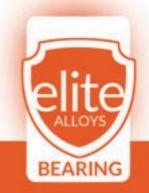
- EN 1982-2008 C496K ASTM C93800 BS1400 LB1

0.05*

Sb

0.8*

0.15*1



Cu

Balance



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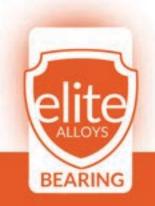
Freerun® SL

Mechanical Properties

Material	Condition	Yield Strength (0.2% N/mm²)	Tensile Strength (0.2% N/mm²)	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 @ 68º F	0.066 MegaSiemens/cm @ 20° C	
Thermal Conductivity	30.20 Btu • ft/(hr • ft2•°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.Oµ	





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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

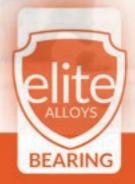
Chemical Composition

Freerun® Long Wearing Alloy

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

The benef ts of composition

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





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Freerun[®] LW

Mechanical Properties

Material	Condition	Yield Strength (0.2% N/mm²)	Tensile Strength (0.2% N/mm²)	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	
Specif c 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 • ft2•°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	





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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
- A vailable in proof machined and f nished machine (to print) condition



Extreme Alloys for Extreme Environments he Elite Bearin 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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