

# Copper-Tin-Lead Alloy (High Leaded Tin Bronze) C93200

## Chemical Composition

(% max., unless shown as range or min.)

	Cu <sup>(1)(2)</sup>	Sn	Pb	Zn	Fe	Sb	Ni (incl Co)	S	P <sup>(3)</sup>	Al	Si	Mn
<b>Min./Max.</b>	81.0-85.0	6.3-7.5	6.0-8.0	1.0-4.0	.20	.35	1.0	.08	.15	.005	.005	—
<b>Nominal</b>	83.0	6.9	7.0	2.5	—	—	—	—	—	—	—	—

1. Cu + Sum of Named Elements, 99.0% min.

2. In determining Cu min., Cu may be calculated as Cu + Ni.

3. For continuous castings, P shall be 1.5% max.

## Applicable Specifications

Process or Ingot	Specification	
Centrifugal	ASTM	B 271
	SAE	J461, J462
Continuous	ASTM	B 505
	SAE	J461, J462
Ingot	ASTM	B 30
	INGOT	315
Sand	ASTM	B 584, B 763
	SAE	J461, J462

## Fabrication Practices

Joining Technique	Suitability
Soldering	Excellent
Brazing	Good
Oxyacetylene Welding	Not Recommended
Gas Shielded Arc Welding	Not Recommended
Coated Metal Arc Welding	Not Recommended

## Machinability Rating: 70

(C36000, Free Cutting Brass = 100)

## Typical Uses

General Utility Bearings and Bushings  
Washers

## Casting Characteristics

Characteristic	Value
Effect of Section Size	Medium
Patternmakers Shrinkage	7/32 in./ft
Drossing	Low
Gassing	Medium
Fluidity	Medium
Shrinkage	Low
Casting Yield	High

## Heat Treatment

Stress Relieving: 500 F (260 C) for 1h/in. of Section Thickness
Cannot be Strengthened by Heat Treatment

## Physical Properties

	US Customary	Metric
Melting Range, Liquidus	1790 F	977 C
	Solidus 1570 F	854 C
Density	0.322 lb/in. <sup>3</sup> at 68 F	8.91 g/cm <sup>3</sup> at 20 C
Specific Gravity	8.91	8.91
Coefficient of Thermal Expansion	10.0 10 <sup>-6</sup> per°F (68-212 F)	18.0 10 <sup>-6</sup> per°C (20-100 C)
Electrical Resistivity	85.9 ohm•cmil/ft at 68 F	14.3 microhm-cm at 20 C
Thermal Conductivity	33.6 Btu•ft/(hr•ft <sup>2</sup> •°F) at 68 F	58.2 W/m•°K at 20 C
Electrical Conductivity	12 %IACS at 68 F	0.070 Siemens/cm at 20 C
Specific Heat Capacity	0.09 Btu/lb/°F at 68 F	377 J/kg•°K at 20 C
Modulus of Elasticity in Tension	14,500 ksi	100,000 MPa

## Mechanical Properties\*

<i>M01 - AS SAND CAST</i>		US Customary	Metric	Applicable Specifications	
Tensile Strength	Minimum	30 ksi	207 MPa	ASTM B 584, B 763	
	Minimum	30 ksi	205 MPa	SAE J462-A	
	Typical	35 ksi	241 MPa		
Yield Strength	0.5% Ext. under load	Minimum	14 ksi	97 MPa	ASTM B 584, B 763
		Minimum	14 ksi	95 MPa	SAE J462-A
		Typical	18 ksi	124 MPa	
Proportional Limit	Typical	9 ksi	59 MPa		
Elongation	Minimum	15 %, in 2 in.	15 %, in 51 mm	ASTM B 584, B 763; SAE J462-A	
	Typical	20 %, in 2 in.	20 %, in 51 mm		
Brinell Hardness	500 kg load	Typical	65	65	
Compressive Strength	0.1 in. set/in.	Typical	46 ksi	317 MPa	
Impact Strength	Izod	Typical	6 ft-lb	8 J	
Fatigue Strength	at 10 <sup>6</sup> cycles	Typical	16 ksi	110 MPa	

<i>M05 - AS PERMANENT MOLD CAST</i>		US Customary	Metric	Applicable Specifications	
Tensile Strength	Minimum	30 ksi	207 MPa	ASTM B 271	
Yield Strength	0.5% Ext. under load	Minimum	14 ksi	97 MPa	ASTM B 271
		Minimum	15 %, in 2 in.	15 %, in 51 mm	ASTM B 271

<i>M07 - AS CONTINUOUS CAST</i>		US Customary	Metric	Applicable Specifications	
Tensile Strength	Minimum	35 ksi	241 MPa	ASTM B 505	
	Minimum	35 ksi	240 MPa	SAE J462-B	
Yield Strength	0.5% Ext. under load	Minimum	20 ksi	138 MPa	ASTM B 505
		Minimum	20 ksi	140 MPa	SAE J462-B
		Minimum	10 %, in 2 in.	10 %, in 51 mm	ASTM B 505; SAE J462-B

\* For alloys listed under SAE J462, suffix symbols are to distinguish between two or more sets of mechanicals properties, heat treatments, conditions, etc., as applicable. See Society of Automotive Engineers Inc., SAE Handbook, Vol. 1 Materials, 1989, Warrendale, PA 15096.