

General information

Designation

pewter

Typical uses

Ornamental domestic utensils and vessels, e.g. mugs, trays, bowls, candlesticks, etc.; Organ pipes;

Composition overview

Compositional summary

Sn90-93 / Sb5-7.5 / Cu1.5-3 (impurities: As<0.05, Pb<0.05, Fe<0.015,

Material family	Metal
Base material	Sn

Composition detail (metals, ceramics and glasses)

As (arsenic)	0	-	0.05	%
Cu (copper)	1.5	-	3	%
Fe (iron)	0	-	0.015	%
Pb (lead)	0	-	0.05	%
Sb (antimony)	5	-	7.5	%
Sn (tin)	90	-	93	%
Zn (zinc)	0	-	0.005	%

Price

Price	* 21.2	-	23.3	USD/kg
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Physical properties

Density	7.2e3	-	7.35e3	kg/m^3
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Mechanical properties

Young's modulus	51	-	55	GPa
Yield strength (elastic limit)	* 10	-	40	MPa
Tensile strength	25	-	65	MPa
Elongation	12	-	56	% strain
Compressive strength	* 10	-	40	MPa
Flexural modulus	* 51	-	55	GPa
Flexural strength (modulus of rupture)	* 10	-	40	MPa
Shear modulus	* 15	-	25	GPa
Bulk modulus	* 50	-	65	GPa
Poisson's ratio	* 0.33	-	0.35	
Shape factor	30			
Hardness - Vickers	13	-	25	HV

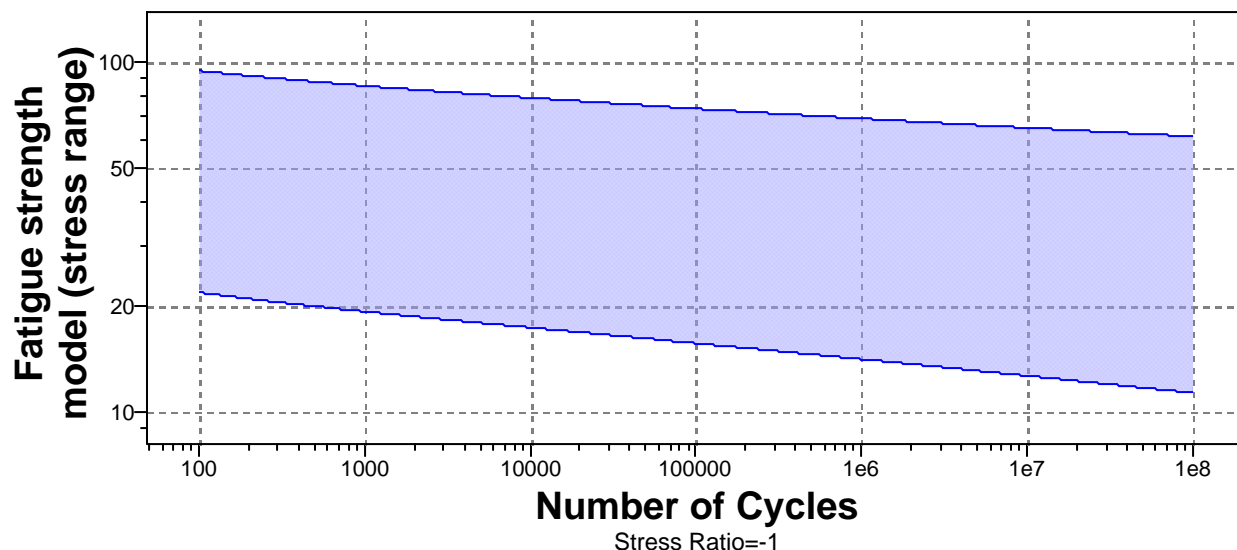
Fatigue strength at 10^7 cycles

* 25 - 33 MPa

Fatigue strength model (stress range)

* 12.7 - 64.9 MPa

[Parameters:](#) Stress Ratio = -1, Number of Cycles = $1e7$ cycles



Mechanical loss coefficient (tan delta)

* 0.005 - 0.03

Impact & fracture properties

Fracture toughness

* 20 - 55 MPa.m^{0.5}

Thermal properties

Melting point

244 - 295 °C

Maximum service temperature

90 - 100 °C

Minimum service temperature

-273 °C

Thermal conductivity

* 40 - 70 W/m.°C

Specific heat capacity

* 205 - 230 J/kg.°C

Thermal expansion coefficient

* 20 - 24 µstrain/°C

Latent heat of fusion

* 60 - 75 kJ/kg

Electrical properties

Electrical resistivity

* 11 - 22 µohm.cm

Galvanic potential

* -0.52 - -0.44 V

Magnetic properties

Magnetic type

Non-magnetic

Optical properties

Transparency

Opaque

Processing properties

Metal casting	Unsuitable
Metal cold forming	Limited use
Metal hot forming	Excellent
Metal press forming	Acceptable
Metal deep drawing	Acceptable

Durability

Water (fresh)	Excellent
Water (salt)	Acceptable
Weak acids	Limited use
Strong acids	Unacceptable
Weak alkalis	Acceptable
Strong alkalis	Limited use
Organic solvents	Acceptable
Oxidation at 500C	Unacceptable
UV radiation (sunlight)	Excellent
Galling resistance (adhesive wear)	Acceptable
Flammability	Non-flammable

Primary production energy, CO2 and water

Embodied energy, primary production	* 209	-	230	MJ/kg
CO2 footprint, primary production	* 14.6	-	16.1	kg/kg
Water usage	* 9.73e3	-	1.08e4	l/kg

Processing energy, CO2 footprint & water

Casting energy	* 5.52	-	6.1	MJ/kg
Casting CO2	* 0.414	-	0.457	kg/kg
Casting water	* 10.4	-	15.7	l/kg
Rough rolling, forging energy	* 0.459	-	0.507	MJ/kg
Rough rolling, forging CO2	* 0.0344	-	0.0381	kg/kg
Rough rolling, forging water	* 1.75	-	2.62	l/kg
Extrusion, foil rolling energy	* 0.633	-	0.7	MJ/kg
Extrusion, foil rolling CO2	* 0.0475	-	0.0525	kg/kg
Extrusion, foil rolling water	* 1.82	-	2.73	l/kg
Wire drawing energy	* 1.59	-	1.76	MJ/kg
Wire drawing CO2	* 0.119	-	0.132	kg/kg
Wire drawing water	* 0.6	-	0.9	l/kg
Metal powder forming energy	* 4.82	-	5.32	MJ/kg
Metal powder forming CO2	* 0.385	-	0.426	kg/kg
Metal powder forming water				

	* 5.25	-	7.88	l/kg
Vaporization energy	* 2.68e3	-	2.96e3	MJ/kg
Vaporization CO2	* 201	-	222	kg/kg
Vaporization water	* 1.12e3	-	1.67e3	l/kg
Coarse machining energy (per unit wt removed)	* 0.501	-	0.554	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0.0376	-	0.0415	kg/kg
Fine machining energy (per unit wt removed)	* 0.736	-	0.814	MJ/kg
Fine machining CO2 (per unit wt removed)	* 0.0552	-	0.061	kg/kg
Grinding energy (per unit wt removed)	* 0.997	-	1.1	MJ/kg
Grinding CO2 (per unit wt removed)	* 0.0748	-	0.0827	kg/kg
Non-conventional machining energy (per unit wt removed)	* 26.8	-	29.6	MJ/kg
Non-conventional machining CO2 (per unit wt removed)	* 2.01	-	2.22	kg/kg

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 34.7	-	38.4	MJ/kg
CO2 footprint, recycling	* 2.73	-	3.01	kg/kg
Recycle fraction in current supply	5.68	-	6.28	%
Downcycle	✓			
Combust for energy recovery	✗			
Landfill	✓			
Biodegrade	✗			

Notes

Warning

Tin(II) salts can be poisonous by ingestion and other routes, and there is evidence that tin can have experimental carcinogenic and human mutagenic effects. Some organotin compounds are very toxic.

Keywords

W.M. 903, Billiton International Metals BV

Links

ProcessUniverse

Producers

Reference

Shape