wieland
concast

Lead-free and low-lead alloys

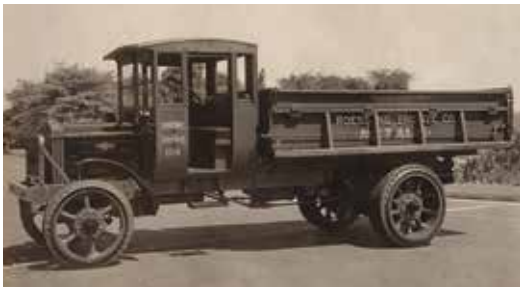
Wieland Concast

We are a manufacturer of specialty continuous-cast copper alloys. Wieland Concast has achieved a strong and stable market position through a sharp focus on evolving technologies, quality control, and a high level of customer service.

Rich history

We trace our roots back to 1891, when we began production of brass and bronze ingot in Pittsburgh, Pennsylvania. In 1960, Concast began producing continuous-cast products. Thirty years later we incorporated the production of copper alloys into our business. Then in 1995, we acquired our Birmingham, Ohio, facility and expanded our product line to include aluminum bronze and manganese bronze.

Today, Wieland Concast is a single-source supplier whose primary focus is the production of copper alloys in bars, rods, tubes, and rectangles as well as custom alloys.



Our facilities

More than 1,100 standard sizes are maintained in our distribution center in Birmingham, Ohio. This facility is a modern, environmentally sound 70,000-sq. ft. distribution warehouse located near the Ohio turnpike and is open six days a week.

While Birmingham is the site for our horizontal continuous casting production operation, our Mars, Pa. plant houses our vertical continuous casting operation. Mars is also the location for our administrative offices.

Our inventory of over 1,100 standard sizes is the largest inventory of standard-stocked, continuous-cast alloys in North America. Wieland Concast is well equipped to serve a large variety of industries, including construction equipment, water handling, and aerospace.

Quality

Wieland Concast is a team of professionals focused on manufacturing the highest quality materials at a fair value that meet and exceed customers' expectations, providing a 99.7% quality acceptance rating. Our goal is to ensure superior products by promoting and demanding adherence to strict requirements.

ISO 9001/AS9100

As an ISO 9001 certified manufacturer, we have been recognized as the premier producer of continuous-cast copper alloys. Concast is also certified to AS9100 standards and requirements. We continually adapt to changing markets and industry demand for greater diversity, higher quality, and more eco-friendly products. Additionally, we invest in state-of-the-art casting equipment and advanced product engineering, as well as comprehensive before-and-after sales service.

Serving the lead-free industry since 1993

Concast has been a leader in producing GreenAlloys™ since 1993. We are proud to have been at the forefront of offering the next generation of no- and low-lead regulatory-compliant alloys.

Commitment to the lead-free industry

Copper and copper alloys have long been very important materials for fittings, faucets, plumbing, and water handling components. For decades, the trend to reduce lead in plumbing systems has been ongoing. Within our lead-free replacement alloys, lead is replaced by other elements, but the products still offer exceptional lubricity, tightness, wear, strength, hardness, and machinability. The quality of the alloys remains exceptional while the concerns surrounding the use of lead disappear.

Ranging from aluminum bronze to high tin bronze, and bismuth alloys, our lead-free alloys are manufactured to ASTM B standards and specifications and are compliant with the 3874 Reduction of Lead in Drinking Water Act, and California legislation AB1953. At Concast, we promise to be an industry leader in delivering a broad range of alloys that are free of the elements that threaten health and the environment. This commitment is clearly shown in our GreenAlloys™ line of products which contain extremely low-lead content, often as low as .05%.

Product descriptions

Silicon brass

Silicon brass is a copper alloy that removes lead from the product and adds a small amount of silicon (2%-4%) to improve the performance of the alloy during the manufacturing processes. Silicon brass provides good manufacturing capabilities for casting, forging, and machining. This alloy is naturally corrosion resistant and its high-temperature performance is very good. Concast supplies C69300 (lead-free brass) and C87850 in this category.

Bismuth tin bronze

Bismuth tin bronze is a copper alloy which typically contains 1-3% bismuth, although some can contain over 6% Bi. This bronze alloy is corrosion resistant, making it suitable for use in harsh environments. Bismuth tin bronzes are more malleable, thermally conductive, and polish better than regular brasses. This line of no-lead bronze alloys that Concast produces includes C89320, C89325, C89831, C89833, C89835, and C89844.

Specifically, alloy C89835 is a C932 lead-free replacement alloy and is offered as a standard-stocked product. Concast maintains an inventory of this alloy numbering over 100 items and in sizes up to 5.0" O.D. C89835 supports the market demand for lead-free material and compliance with the 3874 Reduction of Lead in Drinking Water Act.product engineering, as well as comprehensive before-and-after sales service.

High tin bronze

The bronze alloys which are described as tin bronzes have long been recognized for their low lead content (less than .25% lead) and high strength characteristics. These alloys from C90300 through C91000 and C91300 are not materially different than those produced more than 3,500 years ago in Europe and China.

High tin bronze alloys are typically found in gears as well as high-strength bushing and bearing applications where high strength, low speeds, and heavy loads are present. Other high-strength applications for these alloys are pump impellers, piston rings, steam fittings, and valve bodies. High tin bronze castings are utilized in movable bridge components, turntables for bridges and other structures requiring fixed and expansion bearings with slow or intermittent movement and heavy loads.

Aluminum bronze

Aluminum bronze is the highest strength no-lead standard copper-based alloy. Concast produces C95400, C95500 and C95900 in standard sizes of rounds, tubes and rectangles. Aluminum, in conjunction with iron and nickel in C95500, acts as a strengthener in these alloys. All of the aluminum bronzes can be heat treated, further increasing tensile strengths. Typical uses of aluminum bronze includes bushings, bearings, and wear plates. Also, many aluminum bronze alloys are corrosion resistant.

Product descriptions

Lead-free bearing bronze

Apart from providing excellent anti-friction and anti-wear properties for bearing alloys, lead is considered an environmentally hazardous material. Lead content in bearing bronze varies depending on the application and, in some cases, is fairly low. However, disposal of waste material from fabrication processes, disposal of used bearings, and contamination of lubricants can cause environmental and health concerns. Regulations prohibit the use of lead in many plumbing applications.

As an answer to these concerns, another subcategory of lead-free replacement bronze alloys has been noted in the bronze industry titled lead-free bearing bronze. This lead-free, environmentally friendly copper-based bearing material is designed for high speed/load applications. Bronzes in this group of alloys, also noted on the previous page, include C89835, C90300, C95400, C95500, and C95900.

Alloy offerings

High tin, silicon brass, aluminum bronze, and bismuth based are the primary groups of alloys serving the lead-free industry.

Adhering to strict lead-free alloy compliance standards, Concast offers:

Alloy offerings			
C69300	C89833	C90800	C95900*
C87850	C89835*	C90810	
C89325	C89844	C95400*	
C89831	C90300*	C95500*	

**standard-stocked alloy*

Wieland Concast certifications

- AS9100:2016-certified quality management system
- ISO 9001:2015-certified quality management system

Lead-free / low-lead alloys overview

	Copper Alloy UNS No.	Cu (%)	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[3]	Al (%)	Bi (%)	Mn (%)	S (%)	Sb (%)	Si (%)
Silicon Brass														
	C69300[†]	73.00-77.00	0.02*-0.09	0.20	Rem.	0.10	0.04-0.15	0.10			0.10		0.10	2.70-3.40
	C87850	75.00-78.00	0.02*-0.09	0.30	Rem.	0.10	0.05-0.20	0.20			0.10		0.10	2.70-3.40
Bismuth Tin Bronze														
	C89325	84.00-88.00	0.10	9.00-11.00	1.00	0.15	0.10	1.00	0.005	2.70-3.70		0.08	0.50	0.005
	C89831	87.00-91.00	0.10	2.70-3.70	2.00-4.00	0.30	0.05	1.00	0.005	2.70-3.70		0.08	0.25	0.005
	C89833	86.00-91.00	0.09	4.00-6.00	2.00-6.00	0.30	0.05	1.00	0.005	1.70-2.70		0.08	0.25	0.005
	C89835	85.00-89.00	0.09	6.00-7.50	2.00-4.00	0.20	0.10	1.00	0.005	1.70-2.70		0.08	0.35	0.005
	C89844	83.00-86.00	0.20	3.00-5.00	7.00-10.00	0.30	0.05	1.00	0.005	2.00-4.00		0.08	0.25	0.005
High Tin Bronze														
	C90300	86.00-89.00[1]	0.30	7.50-9.00	3.00-5.00	0.20	1.50	1.00	0.005			0.05	0.20	0.005
	C90800	85.00-90.00[1]	0.25	11.00-13.00	0.25	0.15	0.30	0.50	0.005			0.05	0.20	0.005
	C90810	Rem.[1]	0.25	11.00-13.00	0.30	0.15	0.15-0.80[2]	0.50	0.005			0.05	0.20	0.005
Aluminum Bronze														
	C95400	83.00 min				3.00-5.00		1.50	10.00-11.50		0.50			
	C95500	78.00 min				3.00-5.00		3.00-5.50	10.00-11.50		3.50			
	C95900	Rem.				3.00-5.00		0.50	12.00-13.50		1.50			

*[†]Lead-Free Brass *Pb content is greater than 0.02%. [1]In determining Cu min., Cu may be calculated as Cu + Ni.*
[2]For continuous castings, P shall be 1.5%, max. [3]Ni value includes Co.
Note: Unless otherwise noted, single values represent maximums.

Lead-Free Alloy Low-Lead Alloy Standard-Stocked Alloy Other Available Alloy

C69300

Extruded and drawn	GreenAlloys™

Product description	Lead-free brass
Tempers	H02 half hard
Solids	1/8" to 2 1/2" O.D.
Tubes	Consult mill
Hex	3/8" to 1" O.D.
Standard lengths	144"
Compliance	C69300 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, (4) Vermont Act 193, and is NSF/ANSI/CAN 61-2022 compliant

Typical uses

Automotive

Fluid connectors, sensor bodies, thermostat parts

Industrial

Automatic screw machine parts, bolts, condenser tube plates, nuts, pneumatic fittings, pump parts, screw machine parts, valve bodies for water, valve stems

Marine

Marine products, propeller shafts

Plumbing

Faucet stems, faucets, plumbing fittings, water meter cases

Similiar or equivalent specification

CDA	ASTM	SAE	AMS	Federal	Military	Other
C69300	B371 B371M					

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[2]	Mn (%)	Si (%)
73.00-77.00	0.02*-0.09	0.20	remain.	0.10	0.04-0.15	0.10	0.10	2.70-3.40

**Pb content is greater than 0.02%.* *[1]Cu value includes Ag.* *[2]Ni value includes Co.*

Note: Cu + sum of named elements, 99.5% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 °F)
C69300	85	0.300

Mechanical properties

Mechanical properties according to ASTM B371/B371M-19
C69300
H02 half hard

Size range up to ½" inclusive

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 4x diameter or thickness of specimen, min	Rockwell "B" hardness	Remarks
ksi	MPa	ksi	MPa	%	max HRB approve	
85	585	45	310	5	85	

Size range over ½" to 1" inclusive

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 4x diameter or thickness of specimen, min	Rockwell "B" hardness	Remarks
ksi	MPa	ksi	MPa	%	max HRB approx	
75	515	35	240	10	80	

Size range over 1" to 2 ½" inclusive

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 4x diameter or thickness of specimen, min	Rockwell "B" hardness	Remarks
ksi	MPa	ksi	MPa	%	max HRB approx	
70	480	30	205	10	75	

Physical properties

	US customary	Metric
Melting point – liquidus	1616 °F	880 °C
Melting point – solidus	1571 °F	855 °C
Density	0.3 lb/in³ at 68 °F	8.3 gm/cm³ at 20 °C
Specific gravity	8.3	8.3
Electrical conductivity	8% IACS at 68 °F	0.046 MegaSiemens/cm at 20 °C
Thermal conductivity	21.8 Btu/sq ft/ft hr/ °F at 68 °F	37.76 W/m at 20 °C
Coefficient of thermal expansion 68-212	10.3 · 10^{-6} per °F (68-212 °F)	17.8 · 10^{-6} per °C (20-100 °C)
Coefficient of thermal expansion 68-392	10.3 · 10^{-6} per °F (68-392 °F)	17.8 · 10^{-6} per °C (20-200 °C)
Coefficient of thermal expansion 68-572	10.4 · 10^{-6} per °F (68-572 °F)	18 · 10^{-6} per °C (20-300 °C)
Specific heat capacity	0.09 Btu/lb/ °F at 68 °F	377.1 J/kg at 20 °C
Modulas of elasticity in tension	15200 ksi	104801 MPa

Physical properties provided by CDA

Fabrication properties

Technique	Suitability
Soldering	Excellent
Brazing	Good
Oxyacetylene welding	Good
Gas shielded arc welding	Good
Coated metal arc welding	Good
Spot weld	Good
Seam weld	Good
Butt weld	Good
Capacity for being cold worked	Poor
Capacity for being hot formed	Excellent
Forgeability rating	95
Machinability rating	85

Fabrication properties provided by CDA

Thermal properties

Treatment	Min*	Max*	Value*	Time*
Stress relief			0	
Solution treatment				0
Annealing	932	1112		
Hot treatment	1202	1517		

Thermal properties provided by CDA

**Temperature is measured in Fahrenheit. **For stress relief, solution treatment and annealing - time is measured in hours/inch of thickness. For precipitation heat treatment - time is measured in hours.*

Common fabrication properties

Forming and bending, machining, shearing

Common fabrication processes provided by CDA

C87850

Continuous cast	GreenAlloys™

Product description	Silicon brass
Solids	Consult mill for sizes
Tubes	Consult mill for sizes
Rectangles	Consult mill for sizes
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C87850 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Industrial

Valve bodies for water

Marine

Marine products

Plumbing

Faucets, plumbing fittings, water meter cases

Similiar or equivalent specification

CDA	ASTM	SAE	AMS	Federal	Military	Other
C87850	B505 B505M					

Chemical composition

Cu (%)	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P	Ni (%)[1]	Mn (%)	Sb (%)	Si (%)
75.00-78.00	0.02*-0.09	0.30	remain.	0.10	0.05-0.20	0.20	0.10	0.10	2.70-3.40

Chemical composition according to ASTM B505/B505M-23

**Pb content is greater than 0.02%.* *[1]Ni value includes Co.*
Note: Cu + sum of named elements, 99.5% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 $^\circ$F
C87850	70	0.3

Mechanical properties

Mechanical properties according to ASTM B505/B505M-19

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	minimum BHN	
65	448	25	172	8	103	

Physical properties

	US customary	Metric
Melting point – liquidus	1616 °F	880 °C
Melting point – solidus	1571 °F	855 °C
Density	0.3 lb/in³ at 68 °F	8.3 gm/cm³ at 20 °C
Electrical conductivity	8% IACS at 68 °F	0.046 MegaSiemens/cm at 20 °C
Thermal conductivity	21.8 Btu/sq ft/ft hr/ °F at 68 °F	37.8 W/m at 20 °C
Coefficient of thermal expansion 68-212	10.3 · 10^{-6} per °F (68-212 °F)	17.8 · 10^{-6} per °C (20-100 °C)
Coefficient of thermal expansion 68-392	10.3 · 10^{-6} per °F (68-392 °F)	17.8 · 10^{-6} per °C (20-200 °C)
Coefficient of thermal expansion 68-572	10.4 · 10^{-6} per °F (68-572 °F)	18 · 10^{-6} per °C (20-300 °C)
Specific heat capacity	0.09 Btu/lb/ °F at 68 °F	377.1 J/kg at 20 °C
Modulas of elasticity in tension	15200 ksi	104801 MPa

Physical properties provided by CDA

Fabrication properties

Technique	Suitability
Soldering	Excellent
Brazing	Excellent
Oxyacetylene welding	Good
Spot weld	Good
Seam weld	Good
Butt weld	Good
Capacity for being cold worked	Poor
Capacity for being hot formed	Excellent
Machinability rating	70

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	Medium
Drossing	Low
Effect of section size	Medium
Fluidity	High
Gassing	Low
Patternmakers shrinkage (inches per foot)	3/16
Shrinkage in solidification	Medium

Casting characteristics provided by CDA

C89325 Lead-free replacement for C937

Continuous cast	GreenAlloys™

Product description	Bismuth tin bronze
Solids	1/2" to 10" O.D.
Tubes	1 1/8" to 9" O.D.
Rectangles	Up to 15"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C89325 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Industrial

Bushings, high-speed/ high-pressure bearings

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[2]	Al (%)	Bi (%)	S (%)	Sb (%)	Si (%)
84.00-88.00	0.10	9.00-11.00	1.00	0.15	0.10	1.00	0.005	2.70-3.70	0.08	0.50	0.005

Chemical composition provided by CDA

[1]0.01 - 2.0% as any single or combination of Ce La or other rare earth(x) elements as agreed upon. (x)ASM International definition: one of the group of chemically similar metals with atomic numbers 57 through 71 commonly referred to as lanthanides. *[2]Ni value includes Co.*
Note: Cu + sum of named elements, 99.0% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 °F
C89325	80	0.323

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
30	207	12	83	4	73	

Physical properties

	US customary	Metric
Melting point – liquidus	1805 °F	985 °C
Melting point – solidus	1432 °F	777 °C
Density	0.323 lb/in³ at 68 °F	8.94 gm/cm³ at 20 °C
Specific gravity	8.94	8.94
Electrical conductivity	10.8% IACS at 68 °F	0.062 MegaSiemens/cm at 20 °C
Thermal conductivity	29 Btu/sq ft/ft hr/ °F at 68 °F	50.2 W/m at 20 °C
Coefficient of thermal expansion 68-392	10.3 · 10^{-6} per °F (68-392 °F)	17.8 · 10^{-6} per °C (20-200 °C)
Specific heat capacity	0.089 Btu/lb/ °F at 68 °F	372.9 J/kg at 20 °C
Modulas of elasticity in tension	16400 ksi	113074 MPa

Physical properties provided by CDA

Fabrication properties

Technique	Suitability
Soldering	Good
Brazing	Good
Oxyacetylene welding	Not recommended
Gas shielded arc welding	Not recommended
Coated metal arc welding	Not recommended
Machinability rating	80

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	High
Drossing	Low
Effect of section size	Low
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	3/32
Shrinkage in solidification	Low

Casting characteristics provided by CDA

C89831 Lead-free replacement for C844

Continuous cast	GreenAlloys™

Product description	Bismuth tin bronze
Solids	1/2" to 10" O.D.
Tubes	1 1/8" to 9" O.D.
Rectangles	Up to 15"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C89831 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Industrial

Bushings, high-speed/ high-pressure bearings

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[2]	Al (%)	Bi (%)	S (%)	Sb (%)	Si (%)
87.00-91.00	0.10	2.70-3.70	2.00-4.00	0.30	0.05	1.00	0.005	2.70-3.70	0.08	0.25	0.005

Chemical composition provided by CDA

[1]0.01 - 2.0% as any single or combination of Ce La or other rare earth(x) elements as agreed upon. (x)ASM International definition: one of the group of chemically similar metals with atomic numbers 57 through 71 commonly referred to as lanthanides. *[2]Ni value includes Co.*
Note: Cu + sum of named elements, 99.0% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 $^\circ$F
C89831	85	0.318

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
29	200	13	90	5	55	

Physical properties

	US customary	Metric
Melting point – liquidus	1893 °F	1033 °C
Melting point – solidus	1518 °F	825 °C
Density	0.318 lb/in³ at 68 °F	8.81 gm/cm³ at 20 °C
Specific gravity	8.81	8.81
Electrical conductivity	20.38% IACS at 68 °F	0.117 MegaSiemens/cm at 20 °C
Thermal conductivity	50 Btu/sq ft/ft hr/ °F at 68 °F	86.6 W/m at 20 °C
Coefficient of thermal expansion 68-392	10 · 10^{-6} per °F (68-392 °F)	17.3 · 10^{-6} per °C (20-200 °C)
Specific heat capacity	0.092 Btu/lb/ °F at 68 °F	385.4 J/kg at 20 °C
Modulas of elasticity in tension	13700 ksi	94458 MPa

Physical properties provided by CDA

Fabrication properties

Technique	Suitability
Soldering	Excellent
Brazing	Good
Oxyacetylene welding	Not recommended
Gas shielded arc welding	Not recommended
Coated metal arc welding	Poor
Machinability rating	85

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	High
Drossing	Low
Effect of section size	Low
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	5/32
Shrinkage in solidification	Low

Casting characteristics provided by CDA

C89833 Lead-free replacement for C836

Continuous cast	GreenAlloys™

Product description	Bismuth tin bronze
Solids	1/2" to 10" O.D.
Tubes	1 1/8" to 9" O.D.
Rectangles	Up to 15"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C89833 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, (4) Vermont Act 193, and is NSF/ANSI/CAN 61-2022 compliant

Typical uses

Industrial

Corrosion-resistant/ pressure-tight castings, impellers, pumps

Chemical composition										
Cu (%)	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[1]	Al (%)	Bi (%)	S (%)	Sb (%)	Si (%)
86.00-91.00	0.09	4.00-6.00	2.00-6.00	0.30	0.05	1.00	0.005	1.70-2.70	0.08	0.25	0.005

Chemical composition provided by CDA

[1]Ni value includes Co.
Note: Cu + sum of named elements, 99.3% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 $^\circ$F
C89833	81	0.317

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
30	207	14	97	6	60	

Physical properties

	US customary	Metric
Melting point – liquidus	1877˚F	1025˚C
Melting point – solidus	1454˚F	790˚C
Density	0.317 lb/in³ at 68˚F	8.78 gm/cm³ at 20˚C
Specific gravity	8.78	8.78
Electrical conductivity	17.8% IACS at 68˚F	0.103 MegaSiemens/cm at 20˚C
Thermal conductivity	41 Btu/sq ft/ft hr/˚F at 68˚F	71 W/m at 20˚C
Coefficient of thermal expansion 68-392	13 · 10^{-6} per˚F (68-392˚F)	22.5 · 10^{-6} per˚C (20-200˚C)
Specific heat capacity	0.085 Btu/lb/˚F at 68 ˚F	356.1 J/kg at 20˚C
Modulas of elasticity in tension	15500 ksi	106869 MPa

Physical properties provided by CDA

Fabrication properties

Technique	Suitability
Soldering	Excellent
Brazing	Good
Oxyacetylene welding	Not recommended
Gas shielded arc welding	Not recommended
Coated metal arc welding	Poor
Machinability rating	81

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	High
Drossing	Low
Effect of section size	Low
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	11/64
Shrinkage in solidification	Low

Casting characteristics provided by CDA

C89835 Lead-free replacement for C932, C836, C844

Standard-stocked product	Continuous cast	GreenAlloys™

Product description	Bismuth tin bronze
Solids	1/2" to 10" O.D.
Tubes	1 1/8" to 14" O.D.
Rectangles	Up to 15"
Standard lengths	105"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C89835 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, (4) Vermont Act 193, and is NSF/ANSI/CAN 61-2022 compliant

Typical uses

Industrial

Housing, small gears

Industrial

Faucets, pipe fittings, plumbing goods, pump components, water pump impellers

Chemical composition											
Cu (%)	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[1]	Al (%)	Bi (%)	S (%)	Sb (%)	Si (%)
85.00-89.00	0.09	6.00-7.50	2.00-4.00	0.20	0.10	1.00	0.005	1.70-2.70	0.08	0.35	0.005

Chemical composition provided by CDA

[1]Ni value includes Co.
Note: Cu + sum of named elements, 99.3% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 $^\circ$F
C89835	70	0.321

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
30	207	14	97	6	65	

Physical properties

	US customary	Metric
Melting point – liquidus	1855 °F	1012 °C
Melting point – solidus	1445 °F	785 °C
Density	0.321 lb/in³ at 68 °F	8.89 gm/cm³ at 20 °C
Specific gravity	8.89	8.89
Electrical conductivity	14.5% IACS at 68 °F	0.084 MegaSiemens/cm at 20 °C
Thermal conductivity	38 Btu/sq ft/ft hr/ °F at 68 °F	65.8 W/m at 20 °C
Coefficient of thermal expansion 68-392	10 · 10^{-6} per °F (68-392 °F)	17.3 · 10^{-6} per °C (20-200 °C)
Specific heat capacity	0.093 Btu/lb/ °F at 68 °F	389.6 J/kg at 20 °C
Modulas of elasticity in tension	16900 ksi	116522 MPa

Physical properties provided by CDA

Fabrication properties

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

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	High
Drossing	Low
Effect of section size	Low
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	1/8
Shrinkage in solidification	Low

Casting characteristics provided by CDA

C89844 Lead-free replacement for C844

Continuous cast	GreenAlloys™

Product description	Bismuth tin bronze
Solids	1/2" to 10" O.D.
Tubes	1 1/8" to 9" O.D.
Rectangles	Up to 15"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C89844 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Plumbing

Fittings/valves for potable water

Chemical composition

Cu (%)	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[1]	Al (%)	Bi (%)	S (%)	Sb (%)	Si (%)
83.00-86.00	0.20	3.00-5.00	7.00-10.00	0.30	0.05	1.00	0.005	2.00-4.00	0.08	0.25	0.005

Chemical composition provided by CDA

[1]Ni value includes Co.
Note: Cu + sum of named elements, 99.3% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 $^\circ$F
C89844	70	0.31

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
28	193	13	90	5	55	

Physical properties

	US customary	Metric
Melting point – liquidus	1850 °F	1010 °C
Melting point – solidus	1550 °F	853 °C
Density	0.31 lb/in³ at 68 °F	8.58 gm/cm³ at 20 °C
Specific gravity	8.58	8.58
Electrical conductivity	16.8% IACS at 68 °F	0.095 MegaSiemens/cm at 20 °C
Thermal conductivity	46.7 Btu/sq ft/ft hr/ °F at 68 °F	80.9 W/m at 20 °C
Coefficient of thermal expansion 68-392	10 · 10^{-6} per °F (68-392 °F)	17.3 · 10^{-6} per °C (20-200 °C)
Specific heat capacity	0.08 Btu/lb/ °F at 68 °F	335.2 J/kg at 20 °C
Modulas of elasticity in tension	13000 ksi	89622 MPa

Physical properties provided by CDA

Fabrication properties

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

Fabrication properties provided by CDA

**Since brazing is performed within the hot-short range, strain must be avoided during brazing and cooling.*

Casting characteristics

Casting attribute	Level
Casting yield	High
Drossing	Medium
Effect of section size	High
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	3/16
Shrinkage in solidification	Medium

Casting characteristics provided by CDA

C90300

Standard-stocked product	Continuous cast	GreenAlloys™

Product description	Tin bronze
Solids	1/2" to 10" O.D.
Tubes	1" to 16" O.D.
Rectangles	Up to 20"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar

Typical uses

Building

Heavy construction equipment

Fasteners

Swivel

Industrial

Bearings, bushings, gear blanks, gears, piston rings, pump bodies, pump impellers, valve bodies, valves

Plumbing

Steam fittings

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[1,2]	Al (%)	S (%)	Sb (%)	Si (%)
86.00-89.00	0.30	7.50-9.00	3.00-5.00	0.20	1.50	1.00	0.005	0.05	0.20	0.005

Chemical composition according to ASTM B505/B505M-23

[1]In determining Cu min., Cu may be calculated as Cu + Ni. [2]Ni value includes Co.
Note: Cu + sum of named elements, 99.4% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 $^\circ$F
C90300	30	0.318

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
44	303	22	152	18	70	

Physical properties

	US customary	Metric
Melting point – liquidus	1832˚F	1000˚C
Melting point – solidus	1570˚F	854˚C
Density	0.318 lb/in³ at 68˚F	8.8 gm/cm³ at 20˚C
Specific gravity	8.8	8.8
Electrical conductivity	12% IACS at 68˚F	0.069 MegaSiemens/cm at 20˚C
Thermal conductivity	43.2 Btu/sq ft/ft hr/˚F at 68˚F	74.8 W/m at 20˚C
Coefficient of thermal expansion 68-392	$10 \cdot 10^{-6}$ per˚F (68-392˚F)	$17.3 \cdot 10^{-6}$ per˚C (20-200˚C)
Specific heat capacity	0.09 Btu/lb/˚F at 68 ˚F	377.1 J/kg at 20˚C
Modulas of elasticity in tension	14000 ksi	96527 MPa
Magnetic permeability	1	1

Physical properties provided by CDA

Fabrication properties

Technique	Suitability
Soldering	Excellent
Brazing*	Good
Oxyacetylene welding	Fair
Gas shielded arc welding	Fair
Coated metal arc welding	Fair
Machinability rating	30

Fabrication properties provided by CDA

**Since brazing is performed within the hot-short range, strain must be avoided during brazing and cooling.*

Casting characteristics

Casting attribute	Level
Casting yield	Medium
Drossing	Low
Effect of section size	High
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	3/16
Shrinkage in solidification	Medium

Casting characteristics provided by CDA

C90800

Continuous cast	GreenAlloys™

Product description	Tin bronze
Solids	1" to 6" O.D.
Tubes	1" to 6" O.D.
Rectangles	Up to 10"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C90800 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Industrial

Speed reducers, worm gears

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)[2]	Ni (%)[3]	Al (%)	S (%)	Sb (%)	Si (%)
85.00-89.00	0.25	11.00-13.00	0.25	0.15	0.30	0.50	0.005	0.05	0.20	0.005

Chemical composition according to ASTM B505/B505M-23

[1]In determining Cu min., Cu may be calculated as Cu + Ni. [2]For continuous castings, P shall be 1.5% max. [3]Ni value includes Co.
Note: Cu + sum of named elements, 99.4% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 °F
C90800		0.317

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
35	241	17	117	10	65	

C90810

Continuous cast	GreenAlloys™

Product description	High tin bronze
Solids	1" to 6" O.D.
Tubes	1" to 6" O.D.
Rectangles	Up to 10"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C90810 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Industrial

Bearings, gears, shafts, worm gears

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)[2]	Ni (%)[3]	Al (%)	S (%)	Sb (%)	Si (%)
remain.	0.25	11.00-13.00	0.30	0.15	0.15-0.80	0.50	0.005	0.05	0.20	0.005

Chemical composition provided by CDA

[1]In determining Cu min., Cu may be calculated as Cu + Ni. [2]For continuous castings, P shall be 1.5% max. [3]Ni value includes Co.
Note: Cu + sum of named elements, 99.4% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 °F
C90810	20	0.323

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
					95	

C95400

Standard-stocked product	Continuous cast	GreenAlloys™

Product description	Aluminum bronze
Solids	1/2" to 10" O.D.
Tubes	1 1/8" to 12" O.D.
Rectangles	Up to 15"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C95400 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Automotive

Weld guns

Fasteners

Large hold-down screws, nuts

Industrial

Bearing segments for the steel industry, bearings, bushings, gears, heavily loaded worm gears, high-strength clamps, landing gear parts, machine parts, pawl, pickling hooks, pressure blocks for the steel industry, pump parts, spur gears, valve bodies, valve guides, valve seats, valves, worm gears

Marine

Covers for marine hard-ware, ship building

Ordnance

Government fittings

Note: also available in heat-treated condition

Similiar or equivalent specification

CDA	ASTM	SAE	AMS	Federal	Military	Other
C95400	B505 B505M	J461 J462		QQ-C-390, G5 QQ-B-671, Class 3	MIL-B-16033, Class 3	Aluminum Bronze 9C

Chemical composition

Cu (%)	Fe (%)	Ni (%)[1]	Al (%)	Mn (%)
83.00 min	3.00-5.00	1.50	10.00-11.50	0.50

Chemical composition according to ASTM B505/B505M-23

[1]Ni value includes Co.
Note: Cu + sum of named elements, 99.5% min. Unless otherwise noted, single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in³ at 68 °F
C95400	60	0.269

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
85	586	32	221	12	170	

Mechanical properties according to ASTM B505/B505M-23

Physical properties

	US customary	Metric
Melting point – liquidus	1900 °F	1038 °C
Melting point – solidus	1880 °F	1027 °C
Density	0.269 lb/in³ at 68 °F	7.45 gm/cm³ at 20 °C
Specific gravity	7.45	7.45
Electrical conductivity	13% IACS at 68 °F	0.075 MegaSiemens/cm at 20 °C
Thermal conductivity	33.9 Btu/sq ft/ft hr/ °F at 68 °F	58.7 W/m at 20 °C
Coefficient of thermal expansion 68-572	9 · 10^{-6} per °F (68-572 °F)	15.5 · 10^{-6} per °C (20-300 °C)
Specific heat capacity	0.1 Btu/lb/ °F at 68 °F	419 J/kg at 20 °C
Modulas of elasticity in tension	15500 ksi	107000 MPa
Magnetic permeability*	1.27	1.27
Magnetic permeability**	1.2	1.2

Physical properties provided by CDA

**As cast, field strength 16 kA/m **TQ 50 temper, field strength 16 kA/m*

Fabrication properties

Technique	Suitability
Soldering	Good
Brazing	Good
Oxyacetylene welding	Not recommended
Gas shielded arc welding	Good
Coated metal arc welding	Good
Machinability rating	60

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	Low
Drossing	High
Effect of section size	Low
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	3/16
Shrinkage in solidification	High

Casting characteristics provided by CDA

C95500

Standard-stocked product	Continuous cast	GreenAlloys™

Product description	Nickel-aluminum bronze
Solids	1/2" to 9" O.D.
Tubes	1 1/8" to 9" O.D.
Rectangles	Up to 15"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C95500 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Similiar or equivalent specification

CDA	ASTM	SAE	AMS	Federal	Military	Other
C95500	B505 B505M	J461 J462		QQ-C-390, G3	MIL-B-16033, Class 4	Aluminum Bronze 9D

Chemical composition

Cu (%)	Fe (%)	Ni (%)[1]	Al (%)	Mn (%)
78.00 min	3.00-5.00	3.00-5.50	10.00-11.50	3.50

Chemical composition according to ASTM B505/B505M-23

[1]Ni value includes Co.
Note: Cu + sum of named elements, 99.5% min. Unless otherwise noted, single values represent maximums.

Typical uses

Builders Hardware

Window hardware

Consumer

Musical instruments, piano keys

Electrical

Electrical hardware

Fasteners

Stuffing box nuts

Industrial

Aircraft components, bearings, bushings, gears, glands, glass molds, handgun recoil mechanisms, hot mill guides, landing gear parts, machine parts, pickling equipment, piston guides, pump fluid ends, sewage treatment applications, valve bodies, valve components, valve guides, valve seats, wear plates, welding jaws, worm wheels, worms

Marine

Covers for marine hardware, marine applications, marine hardware, ship building

Ordnance

Government fittings

Note: also available in heat-treated condition

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in³ at 68 °F
C95500	50	0.272

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (500 kg load)	Remarks
ksi	MPa	ksi	MPa	%	typical BHN	
95	655	42	290	10	208	

Mechanical properties according to ASTM B505/B505M-23

Physical properties

	US customary	Metric
Melting point – liquidus	1930 °F	1054 °C
Melting point – solidus	1900 °F	1038 °C
Density	0.272 lb/in³ at 68 °F	7.53 gm/cm³ at 20 °C
Specific gravity	7.53	7.53
Electrical conductivity	8% IACS at 68 °F	0.049 MegaSiemens/cm at 20 °C
Thermal conductivity	24.2 Btu/sq ft/ft hr/ °F at 68 °F	41.9 W/m at 20 °C
Coefficient of thermal expansion 68-572	9 · 10^{-6} per °F (68-572 °F)	15.5 · 10^{-6} per °C (20-300 °C)
Specific heat capacity	0.1 Btu/lb/ °F at 68 °F	419 J/kg at 20 °C
Modulas of elasticity in tension	16000 ksi	110000 MPa
Magnetic permeability*	1.32	1.32
Magnetic permeability**	1.2	1.2
Poisson's Ratio	0.32	0.32

Physical properties provided by CDA

**As cast, field strength 16 kA/m **TQ 50 temper, field strength 16 kA/m*

Fabrication properties

Technique	Suitability
Soldering	Good
Brazing	Fair
Oxyacetylene welding	Not recommended
Gas shielded arc welding	Good
Coated metal arc welding	Good
Machinability rating	50

Fabrication properties provided by CDA

Casting characteristics

Casting attribute	Level
Casting yield	Low
Drossing	High
Effect of section size	Low
Fluidity	Medium
Gassing	Medium
Patternmakers shrinkage (inches per foot)	3/16
Shrinkage in solidification	High

Casting characteristics provided by CDA

C95900

Standard-stocked product	Continuous cast	GreenAlloys™

Product description	Aluminum bronze
Solids	1" to 5" O.D.
Tubes	Consult mill
Rectangles	Up to 7"
Standard lengths	144"
Shape/form	Semi-finished, mill stock or near-net shapes, anode, bar stock, billet/bloom, squares, hex, plate, profile or structural shape, flats/ rectangular bar
Compliance	C95900 is compliant with key legislation including (1) Federal Safe Drinking Water Act - SDWA, (2) S. 3874 Federal Reduction of Lead in Drinking Water Act, (3) California AB1953, and (4) Vermont Act 193

Typical uses

Industrial

Die components, gears, gibs, worm drives

Similiar or equivalent specification

CDA	ASTM	SAE	AMS	Federal	Military	Other
C95900	B505 B505M					

Chemical composition

Cu (%)	Fe (%)	Ni (%)[1]	Al (%)	Mn (%)
remain.	3.00-5.00	0.50	12.00-13.50	1.50

Chemical composition according to ASTM B505/B505M-23

[1]Ni value includes Co.
Note: Cu + sum of named elements, 99.5% min. Single values represent maximums.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68 °F
C95900	10	0.255

Mechanical properties

Tensile strength, min		Yield strength, at 0.5% extension under load, min		Elongation, in 2 in. or 50 mm, min	Brinell hardness (3000 kg load)	Remarks
ksi	MPa	ksi	MPa	%	minimum BHN	
					241	

Mechanical properties according to ASTM B505/B505M-23

Notes:

Notes:

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