Unlocking the Power of ASTM B505 C90700 Bronze: The Go-To Alloy for Bearings, Bushings, and Worm Gears

When engineers and designers seek a material that combines excellent wear resistance, good strength, and reliable performance under load, ASTM B505 C90700 often rises to the top of the list. This tin bronze alloy, also known by its UNS (Unified Numbering System) designation C90700, is a workhorse in various industrial applications. Let's break down what makes it so special.

Continuous cast	Alloy
Product description	Tin bronze, ASTM B505 C90700 Closest alloys EN 1982 CC483K CuSn12-C
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

What is ASTM B505 C90700?

ASTM B505 is a standard specification covering continuously cast copper alloy products. The C90700 designation refers to a specific tin bronze, sometimes colloquially known as "SAE 65" (though SAE specifications can evolve, C90700 is a more precise identifier). The key characteristic of this alloy is its relatively high tin content, which is crucial for its performance attributes.

Closest International Equivalents:
For those working with international standards, it's helpful to know its close cousins:
EN 1982 CC483K
CuSn12-C (The "CuSn12" indicates approximately 12% tin, and "-C" often denotes continuous casting in EN standards)
These equivalencies are important for global sourcing and ensuring material specifications align across different regions.

Similiar or equivalent specification

CDA	ASTM	SAE	AMS	Federal	Military	Other
C90700	B505 B505M	65 J461 J462				Tin bronze, 65

Chemical composition

Cu (%)[1]	Pb (%)	Sn (%)	Zn (%)	Fe (%)	P (%)	Ni (%)[1,2]	Al (%)	S (%)	Sb (%)	Si (%)
88.00-90.00	0.50	10.00-12.00	0.50	0.15	1.50	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]Ni value includes Co.
Note: Cu + sum of named elements, 99.4% min. Single values represent maximums.

Compared to a simple copper-zinc brass, the high tin content in C90700 transforms the material. Tin forms solid solutions with copper, significantly increasing hardness and strength. The phosphorus, even in small amounts but up to 1.5% here, is critical. It not only cleanses the molten metal of oxides but also forms hard copper phosphide particles within the microstructure. This combination of a strong bronze matrix and dispersed hard particles gives C90700 its exceptional resistance to wear and galling, especially crucial for bearing and gear applications. If this were a high-lead bronze, machinability would be even better, but wear resistance and strength would be lower. C90700 strikes a balance, favoring wear properties.

Machinability

Copper alloy UNS no.	Machinability rating	Density (lb/in^3 at 68˚F)
C90700	20	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	
40	276	25	172	10	102	

Mechanical properties according to ASTM B505/B505M-23

Physical properties

	US customary	Metric
Melting point – liquidus	1830˚F	999˚C
Melting point – solidus	1528˚F	831˚C
Density	0.317 lb/in^3 at 68˚F	8.77 gm/cm^3 at 20˚C
Specific gravity	8.77	8.77
Electrical conductivity	10% IACS at 68˚F	0.056 MegaSiemens/cm at 20˚C
Thermal conductivity	40.8 Btu/sq ft/ft hr/˚F at 68˚F	70.6 W/m at 20˚C
Coefficient of thermal expansion 68-392	10.2 · 10^{-6} per˚F (68-392˚F)	18.4 · 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	15000 ksi	103400 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	20

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	High
Gassing	Medium-high
Patternmakers shrinkage (inches per foot)	3/16
Shrinkage in solidification	Low

Casting characteristics provided by CDA

Applications: Where C90700 Shines

The combination of C90700's chemical and mechanical properties makes it ideal for a range of demanding industrial uses.

1. Bearings and Bushings:
Reason: Low coefficient of friction, excellent wear resistance (especially against steel shafts), moderate strength, good corrosion resistance.
Why C90700? The tin and phosphorus content creates a surface that can withstand sliding contact with minimal seizure or galling, even under heavy loads and relatively low speeds. It can embed small abrasive particles, protecting the mating shaft. Its corrosion resistance also prevents premature failure in less-than-ideal environments.
Heavy Loads & Low Speeds: This is a sweet spot. The material's inherent strength and wear characteristics handle the pressure, while the lower speeds reduce the extreme heat generation that might favor other bearing types.

2. Worm Gears and Worm Wheels:
Reason: High wear resistance, low coefficient of friction against steel worms, good machinability for gear cutting, moderate strength.
Why C90700? Worm gear drives involve significant sliding contact between the worm (typically steel) and the worm wheel (bronze). C90700's anti-galling and wear-resistant properties are paramount here. The dissimilar materials (steel worm, bronze wheel) are a classic pairing to prevent like-on-like material seizure. The phosphorus content is particularly beneficial, enhancing the wear resistance needed for the continuous sliding action in worm gears. Good machinability allows for the precise tooth profiles required.

3. Gear Boxes:
Reason: Wear resistance (for internal gears/bushings), moderate strength, good corrosion resistance, machinability, pressure tightness (up to 260°C / 500°F).
Why C90700? Components within gearboxes, such as thrust washers, bushings, and some types of gears, benefit from C90700's properties. Its ability to remain pressure-tight is also advantageous for sealed gearbox casings or hydraulic components.

4. Speed Reducers:
Reason: Similar to gearboxes and worm gears – wear resistance, low friction, moderate strength.
Why C90700? Speed reducers inherently involve gears and bearings operating under load, making C90700 a suitable material for these critical wear components.

5. Valve Bodies & Components:
Reason: Wear resistance (for valve seats/guides), moderate strength, pressure tightness, good corrosion resistance.
Why C90700? For certain industrial valves, especially those handling non-highly-corrosive fluids or slurries, C90700 offers a good balance of properties for valve bodies, discs, or internal trim components that experience sliding or sealing.

6. Restaurant Equipment:
Reason: Good appearance (when polished), corrosion resistance to fresh water, saline solutions, and various food-related environments, machinability, moderate strength.
Why C90700? While less common than stainless steel, certain bronze components in heavy-duty restaurant equipment (e.g., bushings in mixers, dispenser parts) can leverage C90700's durability and corrosion resistance.

Summarizing the Advantages of C90700:

Excellent Wear Resistance: Particularly against steel, due to tin and phosphorus.
Good Strength and Hardness: Suitable for moderate to heavy loads.
Low Coefficient of Friction: Ideal for sliding applications.
Good Machinability: Can be machined to precise tolerances.
Good Corrosion Resistance: Performs well in many industrial and marine environments.
Pressure Tightness: Suitable for hydraulic or sealed applications.
Anti-Galling Properties: Resists seizure when in contact with other metals.

Contrasting Logic: When Might C90700 NOT Be the First Choice?

Extreme High Speeds/Loads: For very high-speed bearings or gears under extreme shock loads, other specialized bronzes (like aluminum bronzes for strength) or different material classes might be preferred.
Highly Corrosive Environments: While C90700 has good corrosion resistance, for aggressive chemical exposure, more specialized alloys (e.g., nickel-aluminum bronzes or stainless steels) would be necessary.
Cost-Sensitive, Low-Demand Applications: For very light-duty applications where wear isn't a major issue, cheaper materials might suffice.

Conclusion

ASTM B505 C90700 / EN 1982 CC483K / CuSn12-C is a highly capable tin-phosphor bronze alloy. Its carefully balanced chemical composition, particularly its significant tin and phosphorus content, endows it with an excellent combination of wear resistance, moderate strength, good machinability, and corrosion resistance. This makes it an indispensable material for critical components like heavy-duty bearings, bushings, worm gears, and other parts subjected to sliding contact and substantial loads. When reliability and longevity in demanding mechanical applications are required, C90700 bronze consistently proves its mettle.