TIN-LEAD BRONZES (Anti-friction)

These are copper alloys with up to 34% Pb, 14% Sn, 4% Zn, and 2.5% Ni, featuring a highly complex metallurgical structure influenced by their chemical composition, melting process, casting, cooling, and other factors. Their load-bearing capacity varies with the copper, tin, and nickel content.

The Pb, which is insoluble in Cu and its alloys, can be mixed with it through agitation in the liquid state and, with the presence of nickel (Ni has a greater affinity for Cu, reducing the Sn retained in the first crystallization phase α and allowing more Sn into the second phase δ, forming smaller nucleation centers and interdendritic spaces, resulting in finer grains), is finely dispersed, solidifying at the end (327°C) in the form of irregular, isolated fine globules between the grain boundaries of the cast piece. Thus, the harder elements Cu and Sn, which make up the eutectoid phase δ, bear the load, while Pb forms the soft matrix of α crystals, providing plasticity.

Tin bronzes with low lead content (where Pb mainly improves machinability and does not significantly affect mechanical properties) essentially have the same applications as tin bronzes. Increasing the lead content to 7% improves conformability and anti-seizure properties at the expense of mechanical strength and impact resistance.

ALLOY: VP - 932 = UNS C93200 = SAE 660

Bronze with excellent mechanical strength and low friction coefficient, capable of withstanding heavy-duty work, wear, pressure, moderate impacts, fatigue, vibrations, and sudden starts. An excellent material for situations of borderline or uncertain lubrication, with moderate corrosion resistance to seawater, sulfuric acid (at limited concentrations), hydrochloric acid, and fatty acids; acidic mine water, mineral water, and sulfite liquors in paper mills.

As a bushing and sliding plate, it operates under moderate to high loads and speeds (500 to 1000 rpm), with medium-hard shafts (quenched and tempered) and normal lubrication.

Chemical Composition:

%Cu	% Sn	%Pb	%Zn	%Fe	% Ni
81 - 85	6,3 - 7,5	6 - 8	1 - 4	0,2 max	1 max.

Mechanical and Physical Properties:

- **Tensile Strength,** *Kg/mm²*..... 21,1 - 24,6
- **Yield Strength,** *Kg/mm²*..... 9,8 - 14,1
- **Elongation,** *%*..... 20 - 10
- **Hardness,** *HB (10 mm / 500 Kg)*..... 60 - 70
- **Thermal Conductivity,** *W / m °C (20 °C)*..... 58,2
- **Coefficient of thermal Expansion,** *10^{-6} / °C (20 - 300 °C)*..... 18,3
- **Electrical Conductivity,** *% IACS (20 °C)*..... 12
- **Operating Temperature,** *°C*..... -233 - 260
- **Operating Load or Pressure,** *Kg/mm²*..... 2,5 - 3,6 (medium)

Technical manufacturing standards:

- Chemical Composition and Mechanical Properties: UNS C 93200 = SAE 660 = DIN 1705 RG7.
- Centrifugal Casting : ASTM B271 / B271M
- Sand Mold Casting : ASTM B584 / SAE J462.
- Continuous Casting : ASTM B505 / 505M.

Main Uses and Application:

This alloy has the broadest range of applications: Bushings, seats for cylinder head, connecting rod cap, and crankshaft of agricultural machinery, motor starters, textile machinery, and the automotive industry ● Bearings, bodies, and impellers for fuel pumps ● Tensioner bushings, reducers, tees, and accessories for deep well pumps ● Hot rolling mills, forging presses for billets, injection molding machines.

✱ ***Referential Specifications for Chemical Composition, Mechanical, and Physical Properties based on the Unified Numbering System (UNS-C) of the Copper Development Association (CDA) for cast and forged copper alloys; subject to written confirmation by VULCANO METALS***