VULCANO® METALS

SPINODAL BRONZE

Spinodal hardening bronzes are primarily Cu-Ni-Sn alloys with manganese additions. The hardening mechanism is related to a miscibility gap in the solid solution and does not involve precipitation. This spinodal hardening mechanism generates chemical segregation within the **α** crystal matrix on a very fine scale, requiring an electron microscope to distinguish its metallographic effects. The soft and ductile spinodal structure is achieved through a high-temperature solution treatment followed by quenching.

The material can be cold worked or machined in this condition and then subjected to a low-temperature spinodal decomposition treatment (aging) to increase the alloy's hardness and strength. Since no crystallographic changes occur, they retain excellent dimensional stability during hardening.

ALLOY: VN - 969 = UNS C96900

This single-phase alloy, with exceptional mechanical properties and a very low coefficient of friction, is capable of operating under severe load conditions at both low and high speeds. It outperforms manganese, aluminum, and beryllium bronzes as bearings and wear plates because it lacks the abrasive precipitates or crystalline phases found in the latter.

The ultra-microscopic strength of spinodal bronze results from the orderly diffusion of Ni and Sn atoms in waves or layers (rather than precipitates) measuring 50–100 Å in length during the solution treatment, quenching, and subsequent low-temperature hardening for a predetermined time. This process forms a completely homogeneous solid solution of two chemically different phases but with identical crystalline structures.

Chemical Composition:

%Cu	% Sn	% Ni	%Mn	%Zn	%Fe	%Mg	%Nb	Pb
Rem	7,5 - 8,5	14,5 -15,5	0,05 - 0,3	0,5 max	0,5 max.	0,15 max.	0,1 max	0,02 max.

Mechanical and Physical Properties:

- **Tensile Strength,** *Kg/mm²*.......... 70,3 - 77,3
- **Yield Strength,** *Kg/mm²*.......... 67,1 - 73,8
- **Elongation,** *%*.......... 6 - 3
- **Hardness,** *HB (10 mm / 500 Kg)*.......... 258 - 286
- **Thermal Conductivity,** *W / m °C (20 °C)*.......... 39
- **Coefficient of thermal Expansion,** *10^{-6} / °C (20 - 300 °C)*.......... 16,4
- **Electrical Conductivity,** *% IACS (20 °C)*.......... 7,8
- **Operating Temperature,** *°C*.......... -233 - 260
- **Operating Load or Pressure,** *Kg/mm²*.......... 193,3 - 291,8

Technical manufacturing standards:

- Chemical Composition and Mechanical Properties: UNS C 96900
- Centrifugal Casting : ASTM B271 / B271M
- Sand Mold Casting : ASTM B584
- Continuous Casting : ASTM B505 / 505M

Main Uses and Application:

Heads for hydraulic pump cylinders (without the need for cylinder bushings) ● Bearings for the rolling train of very heavy machinery ● Spindle bearings and raceways ● Couplings for pumping rods and components for the oil and gas industry ● Wear plates for stamping presses and many other applications.

✱ *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*

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