Overview: What is Beryllium Copper C17300?

C17300 beryllium copper Cube2Pb--C17300 (CDA 173)

Beryllium copper C17300 is a high-performance copper-based alloy belonging to the precipitation hardening type. Its most notable feature is the addition of a small amount of lead, which makes it the best-cutting-grade among all beryllium copper alloys.

You can simply think of it as "a high-strength beryllium copper with easy cutting properties". It retains the high strength, high hardness, good electrical conductivity and corrosion resistance of beryllium copper while significantly improving the convenience of machining, making it particularly suitable for manufacturing complex-shaped parts that require precise machining.

Chemical Composition

The composition of C17300 is the decisive factor for its performance, and the main difference from C17200 lies in the content of lead.

Element	Content range (weight %)	Function
Be	1.80 - 2.00	The core reinforcing element is formed into precipitates through heat treatment, providing extremely high strength and hardness.
Co + Ni	0.20 - 0.60 (Co+Ni)	Refining the grains serves as an auxiliary element for beryllium, enhancing the heat treatment effect and performance.
Pb	0.20 - 0.60	Key difference! As an internal lubricant, it significantly improves cutting performance.
Cu	Balance	The base metal offers excellent electrical conductivity, thermal conductivity and corrosion resistance.
Other impurities	≤ 0.5	The control is strictly maintained at an extremely low level to ensure stable performance.

Main international standard systems and their corresponding designations

C17300 has its own standard designations in different countries and regions around the world, but there is usually a clear correspondence between these standards, ensuring the equivalence of the materials.

Standard System/Region	Equivalent Grade	Typical Standard Number	Core Content & Specifications

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USA(UNS/ASTM)	C17300	ASTM B197 (Bar and Wire Products) ASTM B194 (Plate, Strip, and Sheet)	The source standard. Specifies chemical composition, mechanical properties (tensile strength, yield strength, hardness, elongation in different heat-treated states), conductivity, dimensional tolerances, and test methods.
International Organization for Standardization (ISO)	CuBe2Pb	ISO 1187 (Wrought copper and copper alloys — Chemical composition and forms)	A globally universal standard. Defines the chemical composition range of the alloy and serves as a key reference for countries developing their own standards. ISO standards focus more on compositional classification, with specific performance requirements often supplemented by product standards.
Europe (EN/DIN)	CW112C	EN 12166 (Copper and copper alloys — General purpose rods) EN 1652 (Copper and copper alloys — General purpose plates, sheets, strips)	The dominant standard in the European market. CW112C is the grade corresponding to C17300 in the European Standard (EN). EN standards are very detailed, not only including composition but also strictly specifying properties and tolerances for different supply conditions (e.g., “soft” for cold working and “hard” for final products).
Japan (JIS)	C1720Pb	JIS H3110 (Phosphor bronze, beryllium copper, and copper alloy sheets, strips and plates for springs) JIS H3130 (Copper alloy sheets, strips	An important standard in the Asian market. C1720Pb is the corresponding grade in the Japanese Industrial Standards (JIS). JIS standards are particularly strict on the performance requirements of materials in applications like elastic

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		and plates for springs)	components such as springs.
China (GB)	QBe2-Pb	GB/T 5231 (Designation and chemical composition of wrought copper and copper alloys)	The Chinese national standard. QBe2-Pb is the corresponding grade in the Chinese standard. The GB standard mainly specifies chemical composition and classification, while specific mechanical properties and delivery conditions are often referenced to other industry standards or agreements.

Summary: If a German engineer specifies CW112C on a drawing and an American engineer specifies C17300, the materials they procure are essentially equivalent, thanks to the correspondence of the international standard systems mentioned above.

Core Properties of C17300 beryllium copper

The properties of C17300 can be divided into two main categories: mechanical properties and physical properties.

1. Mechanical Properties

- **Extremely High Strength and Hardness:** Through solution annealing and age precipitation hardening, its tensile strength can easily exceed 1400 MPa (200 ksi), and hardness can reach HRC 40-45, or even higher. This makes it comparable to many alloy steels.
- **Excellent Wear Resistance:** High hardness provides outstanding wear resistance, making it suitable for manufacturing wear parts like bearings and gears.
- **Good Fatigue Strength:** It maintains a long service life under repeated stress.
- **Excellent Elasticity:** After age hardening, it exhibits good elasticity and elastic limit, making it an ideal material for high-end springs and elastic components.

2. Physical Properties

- **High Electrical Conductivity:** While not as high as pure copper, it is outstanding among high-strength alloys. Conductivity is typically between 22% - 28% IACS (International Annealed Copper Standard). **Note:** Due to the addition of lead, its conductivity is slightly lower than that of C17200.
- **Excellent Corrosion Resistance:** It has outstanding corrosion resistance in atmospheric, freshwater, and seawater environments.
- **Non-Magnetic:** It does not become magnetized in strong magnetic fields, making it very friendly for electronic equipment.
- **Non-Sparking:** It does not produce sparks when struck or rubbed, making it a key material for manufacturing explosion-proof tools and equipment.

Core Advantage: Excellent Machinability

This is the primary reason for choosing C17300 over C17200.

- **Machinability Rating:** If the machinability of free-cutting brass C36000 is rated at 100%, C17200 is only about 20%, while C17300 can reach 50% - 80%, depending on the heat treatment condition.
- **Machining Advantages:**
  - Low cutting force, resulting in less tool wear.
  - Higher cutting speeds and feeds can be used, increasing production efficiency.
  - Chips are discontinuous, making them easy to clear away.
  - Good surface finish and high dimensional accuracy.

  This makes C17300 perfectly suited for high-volume, high-precision machining of complex parts using automated equipment like CNC machines.

Heat Treatment

The properties of beryllium copper are “activated” through heat treatment, and C17300 is no exception.

The typical process is as follows:

1. Solution Annealing:

The material is heated to approximately 790°C - 815°C and then rapidly water-cooled. At this point, the material becomes very soft (hardness about HRB 80-95) and ductile, making it easy for cold

forming, bending, or complex machining. This condition is called the “Solution Annealed” or “AT” condition.

2. Precipitation/Age Hardening:

The machined and formed part is heated to a lower temperature, about 315°C - 345°C, held for 2-3 hours, and then air-cooled. During this process, beryllium atoms precipitate to form fine, hard particles, causing a sharp increase in the material’s strength and hardness. This condition is called the “Age Hardened” or “HT” condition.

Typical Workflow: Machine the part in the AT condition -> Perform age hardening -> Obtain the final high-performance part.

Main Application Fields

Based on its unique combination of properties, C17300 is widely used in the following high-demand fields:

- **Plastic Molds:** For manufacturing mold cores, inserts, slides, etc., especially for molds used to produce corrosive plastics (like PVC), leveraging its high hardness, wear resistance, corrosion resistance, and ease of machining.

- **Oil and Gas:** For manufacturing valves, pump components, and safety tools (non-sparking) used in flammable and explosive environments.
- **Electronics and Electrical:** For manufacturing high-strength connectors, switch contacts, relay springs, resistance welding electrodes, etc., which require a combination of conductivity, strength, and elasticity.
- **Aerospace:** For manufacturing bearings, bushings, fasteners, and precision components for control systems.
- **Precision Instruments:** For manufacturing high-precision gears, bearings, guide parts, etc., that require wear resistance and dimensional stability.

Important Safety Warning

Beryllium dust is toxic!

When machining beryllium copper in ways that create dust, such as grinding, cutting, or polishing, strict protective measures must be taken:

- Local exhaust ventilation and dust collection systems must be equipped.
- Operators should wear approved respiratory protection.
- Avoid inhalation or skin contact with beryllium dust, as long-term inhalation can lead to serious lung diseases (berylliosis).

Summary

Beryllium Copper C17300 is a special alloy designed to resolve the conflict between “high strength” and “high-efficiency machining.”

- **Choose it when:** Your parts not only require the high strength, high hardness, and conductivity of beryllium copper but are also complex in shape and require extensive precision machining. C17300 is the perfect choice.
- **Do not choose it when:** If the part’s shape is simple, or if the ultimate electrical conductivity is required, then choosing the lead-free C17200 might be more appropriate, avoiding the slight performance trade-off and environmental considerations associated with lead.

In conclusion, C17300 is a powerful and efficient tool for engineers in the design and manufacturing of high-performance, complex-shaped precision parts.