
CEP
FREIBERG
Copper-Based High-Temperature Materials
Creating
powerful
materials.

Looks like copper, but offers much more: CEP DISCUP®,
a copper-based high-temperature material from CEP Freiberg

AT FIRST GLANCE: FAMILIAR.
AT SECOND GLANCE: INCOMPARABLE.

CEP DISCUP® copper-based high-temperature materials from CEP Freiberg look like copper and – like copper – they conduct electricity and heat very well. But that´s where the comparisons end: CEP DISCUP® materials are produced by powder metallurgy, and offer properties that conventional metals cannot match.

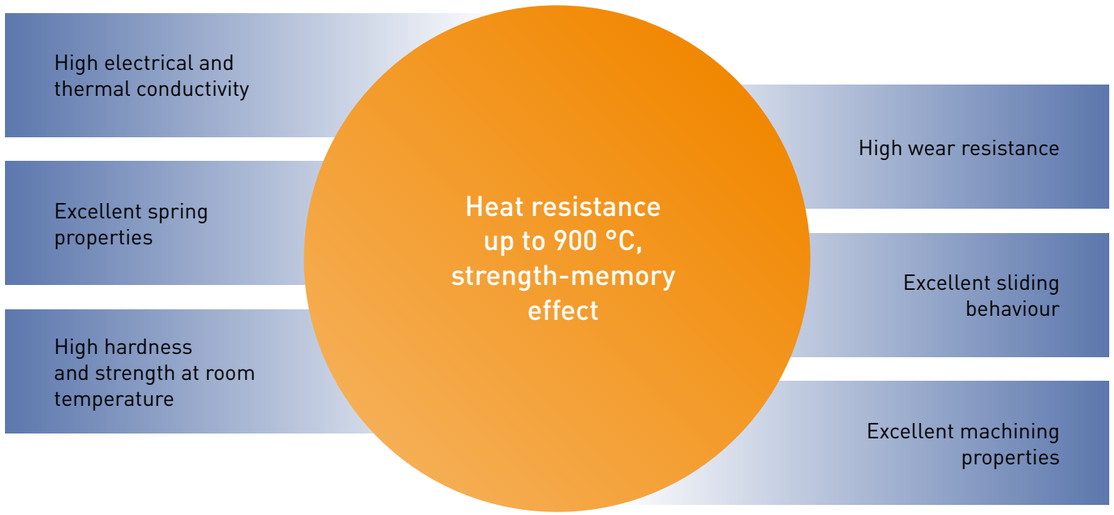
Their mechanical strength is far higher than that of copper, matching even the hardness values of unalloyed steel. At their core, however, is the remarkable combination of conductivity and temperature resistance: their so-called CT property. Copper-based high-temperature materials are not only excellent conductors, they can also tolerate high temperatures without losing their strength – and they do so better than most steels.

What is even more remarkable is that, even after exposure to temperatures above the critical 900 °C-level, the materials recover their strength again after cooling down – the strength-memory effect. No conventional metal can compare in this respect. In addition, copper-based high-temperature materials exhibit high wear resistance and elastic properties.

In terms of production technology, the materials lend themselves to a wide range of processing and machining operations. They are eminently suitable for cold and hot forming, machining, polishing, and brazing.

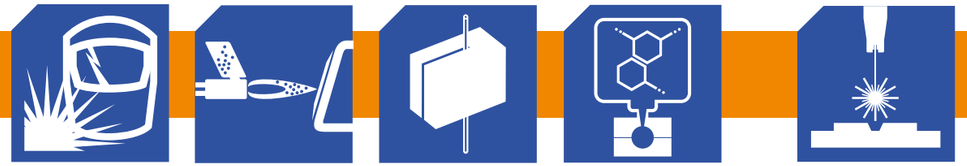
They thus open up new vistas of potential application. Where designers have had to make compromises in the past in order to produce certain components – often in terms of functionality or cost – they can now achieve their design objectives in the simplest possible way, and even more cost-effectively.

Properties of copper-based high-temperature materials



MAKE SOMETHING OF IT.

Conductive, heat-resistant and wear-resistant components

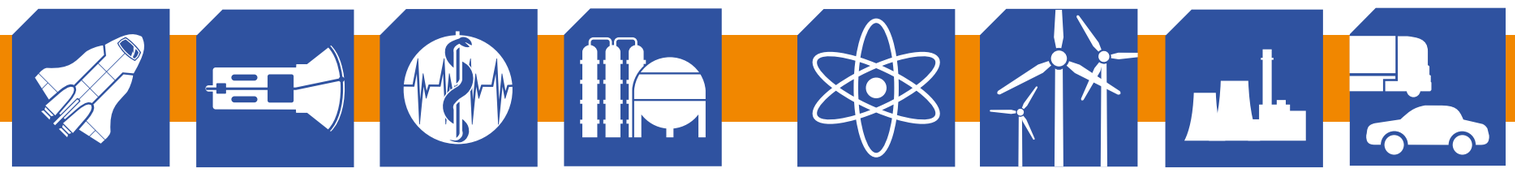


Welding and cutting technology | Flame spraying technology | Spark erosion technology | Plastics engineering | Laser micromachining

High-strength, wear-resistant and antimagnetic structural components

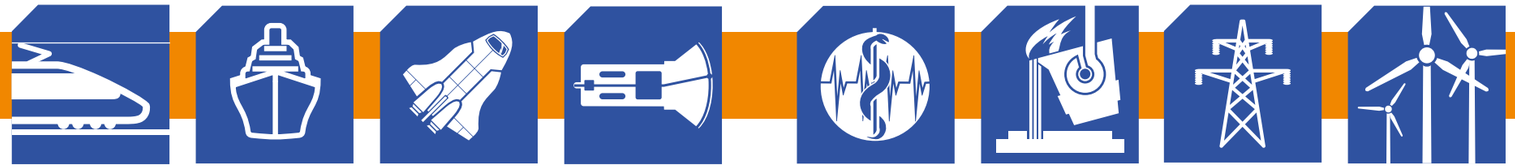
Aerospace technology | Electron beam technology | Medical engineering | Precision engineering | Mechanical and plant engineering

Conductive, heat-resistant, wear-resistant, and radiation-resistant structural components



Aerospace technology | Electron beam technology | Medical engineering | Oil and gas engineering | Nuclear engineering | Wind power technology | Power plant engineering | Automotive engineering

Heat-resistant and wear-resistant electrical contacts or cable connectors

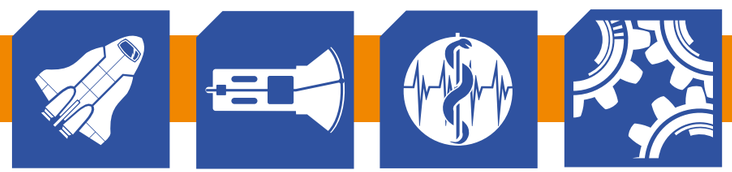


Railway engineering | Naval engineering | Aerospace technology | Electron beam technology | Medical engineering | Metallurgical engineering | Electrical engineering | Wind power technology

Heat-resistant and wear-resistant conducting wire (e.g., military-grade applications)

Naval engineering | Aerospace technology | Electron beam technology | Medical engineering | Metallurgical engineering | Electrical engineering | Power plant engineering | Wind power technology

Heat-resistant and radiation-resistant components of electronic systems



Aerospace technology | Electron beam technology | Medical engineering | Mechanical and plant engineering

With their unique combination of properties, copper-based high-temperature materials like CEP DISCUP® are suitable for challenging applications in a wide variety of technological sectors.

They are the perfect solution whenever engineers require materials that satisfy the „trichotomy" of strength, conductivity, and resistance to high temperatures. For such applications, the materials from CEP Freiberg are second to none.

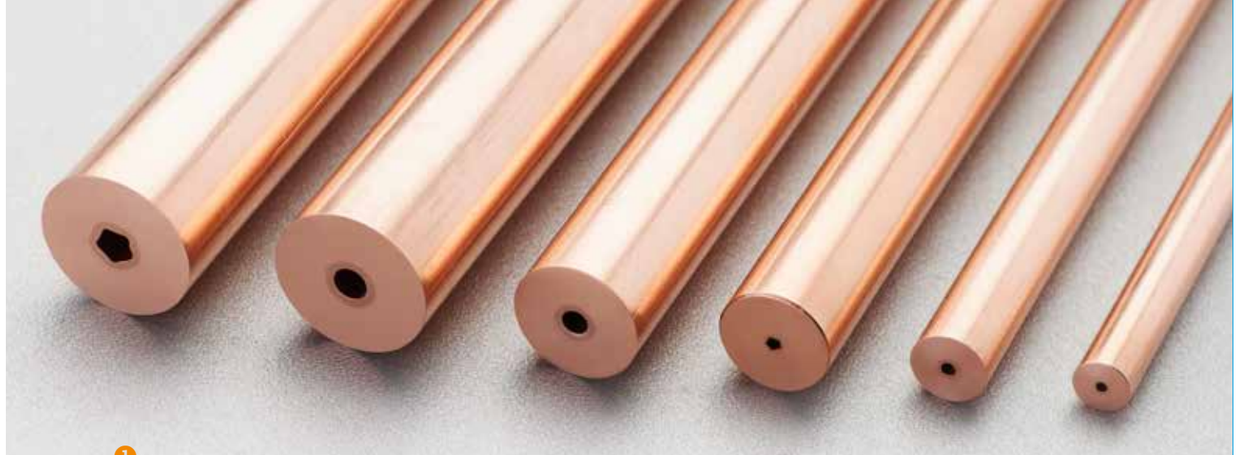
Often, however, their other properties – such as outstanding wear resistance, or their excellent sliding behavior – can play a decisive role, either on their own or in combination with the CT effect described above. This overview shows just some of their potential fields of application.

SEMI-FINISHED OR FINISHED PRODUCTS.

CEP DISCUP® copper-based high-temperature materials are offered as bar material, and are produced by indirect extrusion. The bars are normally supplied with a circular cross-section. However, other cross-sections are also available on request. Large volumes of semi-finished products can be produced by hot isostatic pressing (HIP).

CEP DISCUP®+Cu is the name of a composite tube semi-finished product: highly conductive pure copper on the outside, with heat- and wear-resistant copper-based high-temperature materials on the inside. The tubes are available with round or pentagonal internal geometries. They are the perfect feedstock for long-lifetime **composite contact tips** for MIG, MAG, and submerged arc welding. CEP Freiberg also supplies ready-to-use contact tips to suit the systems of many welding technology suppliers.

Contact tips made of CEP DISCUP®+Cu composite tube from CEP Freiberg



Examples of other semi-finished and finished products

1. CEP DISCUP®+Cu composite tube
2. Bar stock made of CEP DISCUP®
3. Large-diameter roller seam electrode produced by HIP
4. Patented TIG welding collets made of composite tube
5. Electrode caps for spot welding from bar material

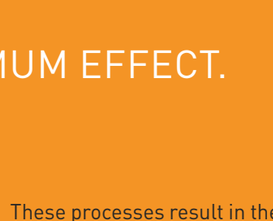
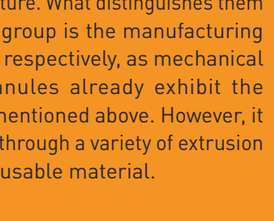
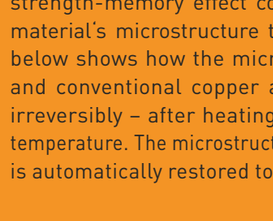
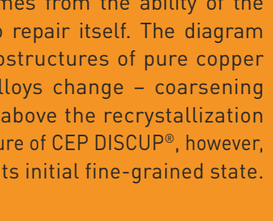
MINISCULE ADDITIONS. MAXIMUM EFFECT.

CEP Freiberg's copper-based high-temperature materials are ODS coppers. ODS materials are powder-metallurgical materials that obtain their strength from small, non-metallic precipitates in their microstructure. What distinguishes them from other members of this group is the manufacturing process: Reaction milling, or respectively, as mechanical alloying. The resulting granules already exhibit the special material properties mentioned above. However, it is the subsequent moulding – through a variety of extrusion processes – that produces a usable material.

These processes result in the material's strength-memory effect, i. e., the restoration of the material's strength properties after exposure to high temperatures. The strength-memory effect comes from the ability of the material's microstructure to repair itself. The diagram below shows how the microstructures of pure copper and conventional copper alloys change – coarsening irreversibly – after heating above the recrystallization temperature. The microstructure of CEP DISCUP®, however, is automatically restored to its initial fine-grained state.

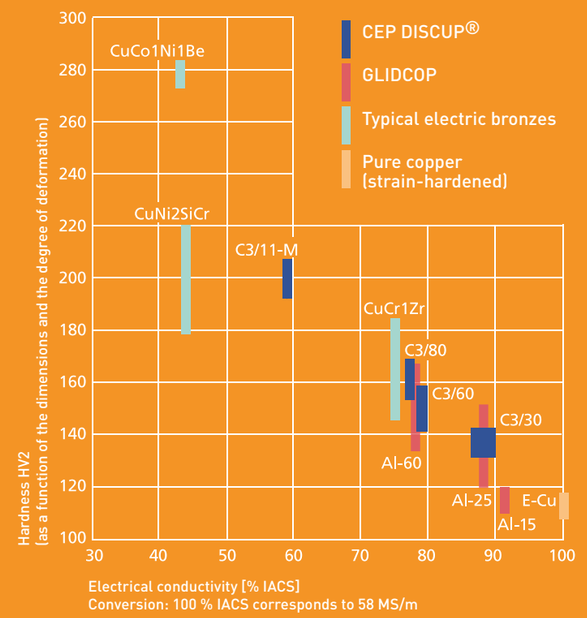
Strength-memory effect

Comparison of the microstructures of CEP DISCUP®, pure copper and CuCr1Zr before and after heat treatment

	CEP DISCUP®	Pure copper	CuCr1Zr
Initial condition (extruded)			
After annealing at 1,000 °C / 1 h			
	Fine grain No change in microstructure, strength is maintained	**Coarse grain** Recrystallization, grain coarsening, softening	**Coarse grain** Recrystallization, grain coarsening, softening

Hardness and electrical conductivity

CEP DISCUP® in comparison with other electrical engineering materials



Conductivity like copper, but with hardness and strength like steel

Properties of CEP DISCUP® in various strength categories at room temperature

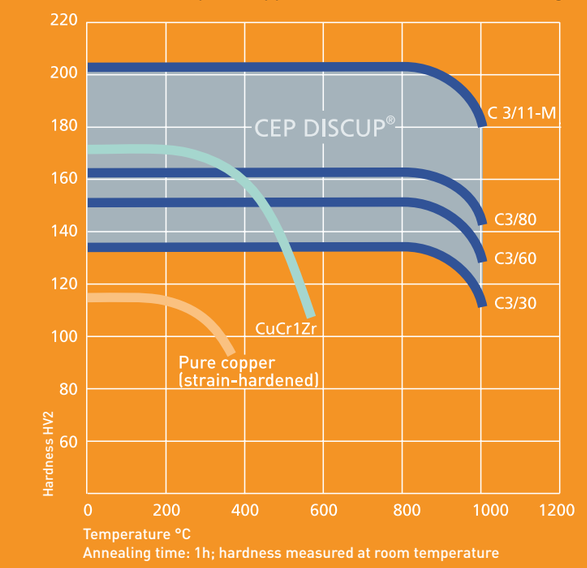
CEP DISCUP®	C3/30	C3/60	C3/80	C3/11-M
Hardness HV2	130 ± 10	152 ± 5	161 ± 6	205 ± 15
Tensile strength MPa	400	450 - 510	470 - 540	600 - 690
0.2 % Yield strength MPa	340	360 - 400	380 - 420	480 - 520
Elongation %	15 - 20	15 - 20	8 - 12	6 - 10
Electrical conductivity % IACS	87 ± 3	79 ± 3	77 ± 3	59 ± 4

The properties apply to the diameter range of 8 to 30 mm.

The data are approximate values and may vary depending on the processing method. The right to revise technical specifications is, therefore, reserved.

Electrical conductivity

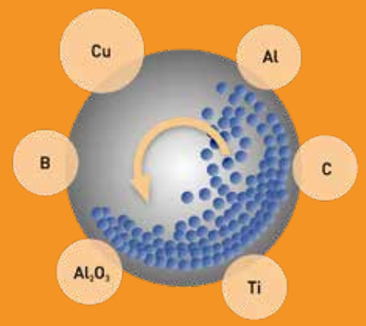
Comparison of the hardness values at room temperature of CEP DISCUP®, pure copper, and CuCr1Zr after annealing



Manufacturing process

Copper-based high-temperature materials from CEP Freiberg

1. Reaction Milling / Mechanical Alloying



2. Powder Compaction (Pre-Compaction to Green Body)
3. Extrusion
4. Depending on the Product: Drawing and Straightening
5. Mechanical Processing (optional)

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Unt_2023/06_DE

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made in germany