Our Copper for your Life

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Aurubis has been producing continuous cast shapes, earning itself an outstanding reputation.

- is the maximum weight of individual shapes produced by casting.
- is the diameter of our smallest shapes.
- is the length of copper foil that can be produced from a single cake.
- is the number of different products that are manufactured in our continuous casting plants.

30,000 kg
89 mm
300,000 m
6
500

Facts & Figures

AURUBIS SHAPES
Facts & Figures
AURUBIS SHAPES

6 • is the number of decades Aurubis has been producing continuous cast shapes, earning itself an outstanding reputation.

30,000 kg • is the maximum weight of individual shapes produced by casting.

89 mm • is the diameter of our smallest shapes.

300,000 m • is the length of copper foil that can be produced from a single cake.

500 • is the number of different products that are manufactured in our continuous casting plants.

We shape the world of copper

Its distinctive properties have made copper indispensable as a modern-day material, not only for traditional applications but also as a significant component of state-of-the-art technologies. Whenever very high electrical and thermal conductivity are required, along with the best possible forming properties, copper is the material of choice. At the same time, this “red gold” also offers excellent resistance to corrosion and can be recycled particularly well. The “red gold” has come a long way from its historical origins as a raw material used to produce everyday items – even if it is hardly visible to observers in most cases.

Aurubis combines copper production with copper processing to create copper products and custom-made special solutions. The company was incorporated as a stock corporation back in 1866 and has managed to position itself successfully since then. With some 6,500 employees at sites in Europe, the USA and China as well as sales offices worldwide, the Aurubis Group is one of the leading integrated copper groups. In the field of copper recycling, Aurubis is a worldwide leader. Aurubis stands for innovation, a competitive technological edge and exemplary environmental conservation, as well as customer benefits and high returns.
The right shapes for decades

AURUBIS SHAPES provide a sound basis for manufacturing strip, sheet and foil for all applications. At Aurubis you will also find the right starting material for sophisticated industrial tube, complex profiles and large forgings. Our products are manufactured in grades and diameters that are perfectly tuned to specific applications and manufacturing techniques.

PRODUCTION
After pyrometallurgical smelting followed by an electrolytic refining process, the copper is ready for further use in its purest form, as a so-called cathode. These cathodes, which have a copper content of more than 99.99%, are first molten down in a carefully monitored process and then cast continuously as an endless bar. Depending on the requirements, alloying elements are added to adjust the desired chemical composition. Once it has reached the desired length, the shape is cut off by a flying saw and moves on to the inspection and quality assurance process.

Our production facilities are specially designed to allow us to produce continuous cast shapes weighing up to 30 t each, which maximizes the efficiency of the subsequent processing steps carried out by our customers. Our goal when developing materials is to find tailored solutions that are ideally adjusted to the material and processing requirements at hand.

PRODUCTION PROCESS FOR AURUBIS SHAPES

AURUBIS SHAPES provide a sound basis for manufacturing strip, sheet and foil for all applications. At Aurubis you will also find the right starting material for sophisticated industrial tube, complex profiles and large forgings. Our products are manufactured in grades and diameters that are perfectly tuned to specific applications and manufacturing techniques.
APPLICATIONS
AURUBIS SHAPES are the ideal starting point for manufacturing high-quality forgings, strip, foil, sheet, tube and profiles made of copper. Their uniformly high quality and precisely adjusted chemical composition mean that our shapes are much sought after for demanding applications in particular. The range of grades reaches from application-oriented SN copper with a high purity of 99.999 % Cu to high-performance alloys with a precisely tuned set of properties.

Typical end uses for the further processing of our shapes include cable strip with high demands regarding welding suitability and surface, casting molds, leadframes and industrial pipes for HVAC systems. Customer requirements and specifications are particularly important to us, so as to facilitate further processing and ensure the best possible functionality.

Whether in telecommunications engineering, mechanical engineering, automotive engineering or aviation: Aurubis’ shapes have acquired an excellent reputation in virtually every field over the past six decades.

For numerous applications, copper is initially processed into specific shapes once it has been refined. Our continuous cast shapes, referred to as AURUBIS SHAPES, are the ideal starting material for further processing by rolling, extruding, forging and other techniques, which in itself reflects some of copper’s unique properties.
### Supplies Security with the Highest Quality

**Aurubis shapes** benefit from the advantages of an integrated copper group with its own cathode production. A secure supply of high-quality grade A cathodes guarantees you as a customer the highest product quality and supply security for a variety of materials.

<table>
<thead>
<tr>
<th>Code Number</th>
<th>Code Number</th>
<th>UNS No.</th>
<th>Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aurubis name</strong></td>
<td><strong>DIN EN 1976:2013</strong></td>
<td><strong>Number</strong></td>
<td><strong>UNS No.</strong></td>
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<tr>
<td>NOS8</td>
<td>Cu-ETP</td>
<td>CR004A</td>
<td>C11000</td>
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<td>NOSV</td>
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<td>C11000</td>
</tr>
<tr>
<td>NG35 (NOS8 + Ag)</td>
<td>CuAg0.04</td>
<td>CR011A</td>
<td>C11400</td>
</tr>
<tr>
<td>NG10 (NOS8 + Ag)</td>
<td>CuAg0.1</td>
<td>CR013A</td>
<td>C11600</td>
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</table>

### Copper in % min.

<table>
<thead>
<tr>
<th>Copper in % min.</th>
<th>Oxygen in % max.</th>
<th>Silver in % max.</th>
<th>Phosphorus in % max.</th>
<th>Conductivity in MS/m</th>
<th>Recrystallization temperature in °C</th>
<th>Hydrogen-resistant</th>
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</thead>
<tbody>
<tr>
<td>99.90 (Cu+Ag)</td>
<td>0.04</td>
<td>-</td>
<td>-</td>
<td>≥58.0</td>
<td>≥100</td>
<td>ca. 180</td>
</tr>
<tr>
<td>99.99 (Cu+Ag+P)</td>
<td>0.04</td>
<td>0.003</td>
<td>-</td>
<td>≥58.6</td>
<td>≥101</td>
<td>ca. 170</td>
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<tr>
<td>99.99 (Cu+Ag+P)</td>
<td>0.04</td>
<td>0.003</td>
<td>-</td>
<td>≥58.6</td>
<td>≥101</td>
<td>ca. 210</td>
</tr>
<tr>
<td>99.99 (Cu+Ag+P)</td>
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<td>0.003</td>
<td>-</td>
<td>≥58.6</td>
<td>≥101</td>
<td>ca. 320</td>
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### OXYGEN-FREE COPPER

<table>
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<tr>
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<td>C10100</td>
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<tr>
<td>OF02</td>
<td>Cu-OF</td>
<td>CR008A</td>
<td>C10200</td>
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<td>OS35 (OF02 + Ag)</td>
<td>CuAg0.04 (OF)</td>
<td>CR017A</td>
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<tr>
<td>OS10 (OF02 + Ag)</td>
<td>CuAg0.1 (OF)</td>
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### OXYGEN-BEARING COPPER

<table>
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<td>C10300**</td>
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<td>BEAL</td>
<td>Cu-HCP</td>
<td>CR021A</td>
<td>C10300**</td>
</tr>
<tr>
<td>BE57</td>
<td>Cu-HCP</td>
<td>CR021A</td>
<td>C10300**</td>
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<tr>
<td>BE58</td>
<td>Cu-PHCE</td>
<td>CR020A</td>
<td>C10300**</td>
</tr>
<tr>
<td>BG35 (BE57 + Ag)</td>
<td>CuAg0.04P</td>
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</tr>
<tr>
<td>BG10 (BE57 + Ag)</td>
<td>CuAg0.1P</td>
<td>CR016A</td>
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### PHOSPHORUS DEOXIDIZED COPPER

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<td>DHP</td>
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<tr>
<td>P3-6</td>
<td>Cu-DXP</td>
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</tr>
<tr>
<td>P4-6</td>
<td>Cu-DXP</td>
<td>CR025A</td>
<td>C12220</td>
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### PHOSPHORUS-BEARING COPPER

<table>
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<th>Norm</th>
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<tr>
<td>DHP</td>
<td>Cu-DHP</td>
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<tr>
<td>P3-6</td>
<td>Cu-DXP</td>
<td>-</td>
<td>-</td>
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<td>P4-6</td>
<td>Cu-DXP</td>
<td>CR025A</td>
<td>C12220</td>
</tr>
</tbody>
</table>

**Note:**
- RRR: residual resistivity ratio, ratio of electrical resistivity at 293 K to electrical resistivity at 4.2 K
- **: deviates from standard
- ***: reference value

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**A variety of …**

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**Oxygen-bearing Copper**

- Copper in % min.: 99.90 (Cu+Ag) 99.99 (Cu+Ag+P)
- Silver in % max.: 0.04 - 0.003
- Phosphorus in % max.: -
- Conductivity in MS/m: ≥58.0
- Recrystallization temperature in °C: ca. 180
- Hydrogen-resistant: no

**Oxygen-free Copper**

- Copper in % min.: 99.99
- Silver in % max.: 0.003
- Phosphorus in % max.: 0.003
- Conductivity in MS/m: ≥58.6
- Recrystallization temperature in °C: ca. 200
- Hydrogen-resistant: yes

**Phosphorus Deoxidized Copper**

- Copper in % min.: 99.99
- Silver in % max.: 0.03
- Phosphorus in % max.: 0.003
- Conductivity in MS/m: ≥58.0
- Recrystallization temperature in °C: ca. 230
- Hydrogen-resistant: yes

**Phosphorus-bearing Copper**

- Copper in % min.: 99.90
- Silver in % max.: 0.005
- Phosphorus in % max.: 0.015
- Conductivity in MS/m: (54.0 – 57.0) (93.1 – 98.3)
- Recrystallization temperature in °C: ca. 280
- Hydrogen-resistant: yes

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**Grades**

- DIN EN 1976:2013
- UNS No.
- ASTM

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**Summary**

- Copper in % min.: 99.90 - 99.99
- Silver in % max.: 0.04 - 0.003
- Phosphorus in % max.: -
- Conductivity in MS/m: ≥58.0 - 58.6
- Recrystallization temperature in °C: ca. 170 - 280
- Hydrogen-resistant: yes - no

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**Additional Notes**

- RRR: residual resistivity ratio, ratio of electrical resistivity at 293 K to electrical resistivity at 4.2 K
- **: deviates from standard
- ***: reference value

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**Table Entry**

- A variety of materials
- SUPPLY SECURITY WITH THE HIGHEST QUALITY
- AURUBIS SHAPES benefit from the advantages of an integrated copper group with its own cathode production.
- A secure supply of high-quality grade A cathodes guarantees you as a customer the highest product quality and supply security for a variety of materials.
Materials ...

**OXYGEN-BEARING GRADES (Cu-ETP)**
These copper grades display a very high conductivity of more than 100 % IACS. Their forming and recrystallization properties are very good. However, because of the typical oxygen content of 100 to 300 ppm, Cu-ETP is not resistant to hydrogen embrittlement. Oxygen-bearing copper is primarily used in electronics and electrical engineering:

- Cable strip, leadframes, industrial strip, transformer strip
- Busbars
- Commutator segments, matrix material for superconductors

**OXYGEN-FREE GRADES (Cu-OFE)**
Oxygen-free copper grades are cast in a special process. Apart from their good conductivity, they are also hydrogen-resistant and display good forming properties. Typical applications include:

- Conductors for electronic and electrical applications
- Waveguides
- Cavity resonators
- Switches, contacts, base and terminal pins
- Cablestrip for underwater cables
- Vacuum seals and anodes for vacuum tubes
- Matrix materials for superconductors
- Components for radar equipment

**PHOSPHORUS-BEARING GRADES (Cu-DLP, Cu-DHP, Cu-DXP)**
These copper grades contain residual phosphorus, which makes the material hydrogen-resistant even during annealing. They have excellent formability and are therefore preferred in the following areas:

- Industrial tubes for HVAC applications
- Conduits
- Facades and roofing in construction and architecture
- Surface technologies
- Electrodes, solder

The silver-alloyed materials in groups Cu-ETP, -PHC, -HCP and OF have both a higher recrystallization temperature and an improved creep resistance.

**PHOSPHORUS-DEOXIDIZED GRADES (Cu-PHC, Cu-HCP)**
These copper grades are deoxidized by means of careful doping using phosphorus, making them hydrogen-resistant while at the same time having very high electrical and thermal conductivity. In addition, they have good welding properties and robust processing properties. The preferred areas of use are in electrical, electronic and mechanical engineering as strip, sheets or castings. They have excellent formability and are therefore preferred in the following areas:

- Conduits
- Cavity resonators
- Surface technologies
- Electrodes, solder

**PHOSPHORUS-FREE GRADES (Cu-PHP, Cu-HPC)**
These copper grades are phosphorus-free and have high electrical and thermal conductivity. They are cast in a special process.

**HIGH PERFORMANCE ALLOYS (HPA)**
Aurubis’ low-alloyed copper materials feature special mechanical and physical properties with good electrical and thermal conductivity.

These materials, which are doped with Cr and/or Zr, are precipitation hardening alloys. Compared to unalloyed copper materials, they have higher strengths and an increased wear resistance, even at higher input temperatures. Applications using these materials can be found in electrical engineering and metallurgy:

- Short-circuit rings
- Staves
- Molds
- Heat exchangers

The low-alloyed material CuFe0.1P has good cold forming properties with high electrical conductivity and a low propensity to soften. Familiar applications of CuFe0.1P include:

- Connectors in the electrical and automotive industry
- Power transistor components
- Tubes for air conditioners and heat exchangers in industrial plants

The high-strength, nickel-bearing material CuNi1Si can be hardened and is wear-resistant and durable. It is used in electrical engineering, welding technology, overhead power lines and apparatus engineering.

Connecting elements (screws/nuts)
- Slide bearings

CuSn0.15 is highly conductive with very good forming properties. This copper alloy is used in the semiconductor industry and the automotive industry:

- Leadframes
- Central automotive electrics

Additional copper materials can be requested at any time.

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<table>
<thead>
<tr>
<th>Standards</th>
<th>Chemical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
<td>Copper in %</td>
</tr>
<tr>
<td>LCR1 CuCr1</td>
<td>Residual CR</td>
</tr>
<tr>
<td>LCF1 CuCr1Zr</td>
<td>Residual Cr</td>
</tr>
<tr>
<td>LFR1 CuZr</td>
<td>Residual Zr</td>
</tr>
<tr>
<td>LNSP CuNi1Si</td>
<td>Residual Ni</td>
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<tr>
<td>LFE1 CuFe0.1P</td>
<td>Residual Fe</td>
</tr>
<tr>
<td>L515 CuSn0.15</td>
<td>Residual Sn</td>
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* deviates from standard
... and geometries

<table>
<thead>
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<th>CAKES</th>
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<td>C232</td>
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<td><strong>SQUARE BARS</strong></td>
<td><strong>Format Width in mm</strong></td>
</tr>
<tr>
<td>E100</td>
<td>103</td>
</tr>
</tbody>
</table>

| **SQUARE BARS** | **Format Width in mm** | **Thickness in mm** | **Specific weight* in kg/m** | **Lengths: 490 – 8900 mm** | **Diameter tolerances: ≤ 150 mm ± 1 mm** |
| E100 | 103 | 103 | 95 | E100 | 103 | 103 | 95 |

Certified quality

Each of the shapes manufactured undergoes intensive testing by the independent Quality Control Shapes department. All the relevant parameters of the production process are monitored with the help of computers, documented and used for the detailed assessment of the products’ quality. Independently of this, smelting samples are taken and sample sections are cut from the shapes, which are then used for destructive testing: properties such as electrical conductivity, surface, quality of the microstructure, tensile strength, chemical composition and recrystallization behavior are determined and compared with fixed target values. Beyond this, the cast surface is carefully inspected. Only if the shape meets the defined criteria in every respect is it released for dispatch. Our integrated QM system is certified in accordance with DIN ISO 9001ff and is being further optimized all the time.
Before, during and of course also after purchase, Aurubis offers its customers comprehensive commercial and technical services, geared entirely to the needs of our customers.

Outstanding service

COMMERCIAL SERVICES
» Provision of the latest copper market information
» Advice for and support with hedging
» Always available for you during the metal exchange’s opening hours
» Experienced contacts in our offices in Hamburg and Brussels
» Routine visits and customer events

TECHNICAL SERVICES
» Support from our experienced engineers
» Joint projects with our customers to optimize the overall production chain
» Joint training programs with our customers’ employees
» Laboratory with facilities for extensive physical and chemical analyses
» State-of-the-art assaying methods, such as scanning electron microscopy

LOGISTICS
» Maximum reliability of supply and flexibility thanks to integrated copper supply
» Individually arranged dispatch by road, rail or ship
» We will be happy to arrange for our products to be transported right to your production facilities
Our Copper for your Life

www.aurubis.com