Grooved contact wire

The widest range of alloys, properties, profiles and technical characteristics
Profiles

There are two types of profile:

- **circular**
- **oval**

Attachment grooves

There are two types of groove:

- **type A**
- **type B**

Identification grooves

To distinguish the materials used in manufacturing contact wire different types of groove are used:

- Copper: without groove
- Copper-Tin: one groove
- Copper-Silver: two grooves
- Copper-Magnesium: three grooves

---

LA FARGA
yourcoppersolutions
### Composition in %

<table>
<thead>
<tr>
<th>Elements</th>
<th>Cu</th>
<th>Bi</th>
<th>O</th>
<th>P</th>
<th>Pb</th>
<th>Other elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>max.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>99.90</td>
<td></td>
<td>0.0005</td>
<td>0.04</td>
<td>0.005</td>
<td>0.03</td>
</tr>
<tr>
<td>Cu-OF</td>
<td>99.90</td>
<td></td>
<td>-</td>
<td></td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Cu-HCP</td>
<td>99.95</td>
<td></td>
<td>0.0005</td>
<td>0.007</td>
<td>0.005</td>
<td>0.03</td>
</tr>
<tr>
<td>CuAg0.10</td>
<td></td>
<td>Rest</td>
<td>0.0005</td>
<td>0.04</td>
<td>0.08</td>
<td>0.12</td>
</tr>
<tr>
<td>CuMg0.2</td>
<td></td>
<td>Rest</td>
<td>0.1</td>
<td>0.3</td>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>CuMg0.5</td>
<td></td>
<td>Rest</td>
<td>0.4</td>
<td>0.7</td>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>CuSn0.2/0.4</td>
<td></td>
<td>Rest</td>
<td>0.15</td>
<td>0.55</td>
<td></td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Copper**

Copper is mainly used for conventional lines. It is the material possessing the best conductivity, but wears out more easily than the products made with its alloys.

**CuAg - Copper-Silver**

Silver is used as an alloy element to increase the resistance of the base material to the annealing, which enables greater thermal stability to be achieved of the products that make up the overhead power cable without sacrificing mechanical or electrical characteristics, and in consequence improve its durability.
CuSn - Copper-Tin

Materials made with Copper-Tin alloys have a very high mechanical resistance that enables high-hanging tensions to be applied, sufficient for providing greater wave propagation speeds on the overhead power cable and, as a consequence, can obtain greater train running speed.

CuMg - Copper-Magnesium

The greater the speed of the trains on the line, the greater the hanging tensions used must be and the materials must possess better mechanical characteristics.

To achieve this, on high-speed lines conductivity is sacrificed in favour of resistance to traction, which enables higher tensions, an increase in wave propagation speed of the overhead power cable and, as a consequence, the trains can run at a greater speed.

EVELHIS - Evolution in electrification: high speed

The EVELHIS™ technology developed by LFL surpasses the standards established by international regulations in materials used for high speed. It is based on copper-magnesium alloys improved to increase their technical uses.

EVELEC - Evolution in electrification

Sometimes the conventional design of the overhead power cables does not enable complex problems to be dealt with, such as accelerated wear or need for improved mechanics without excessively prejudicing electrical conductivity. In these cases the design of the specific materials for each situation is a tool of great value.

La Farga Advanced Materials has developed the new generation EVELEC™ copper, a material which based on micro-alloys, improves the wearing resistance between 30% and 50% compared to products commonly used on conventional lines.
**Comparison of the different materials**

<table>
<thead>
<tr>
<th>Properties</th>
<th>CuETP</th>
<th>CuAg0.1</th>
<th>EVELEC (*)</th>
<th>CuSn0.2</th>
<th>CuMg0.5</th>
<th>EVELHIS (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical resistance (ohm/km)</td>
<td>0.122</td>
<td>0.122</td>
<td>0.136</td>
<td>0.165</td>
<td>0.191</td>
<td>0.167</td>
</tr>
<tr>
<td>Weight/m (g/m)</td>
<td>1293-1374</td>
<td>1293-1374</td>
<td>1345</td>
<td>1298-1378</td>
<td>1293-1374</td>
<td>1345</td>
</tr>
<tr>
<td>Conductivity (% IACS)</td>
<td>97.1</td>
<td>97.1</td>
<td>84</td>
<td>72</td>
<td>62.2</td>
<td>68</td>
</tr>
<tr>
<td>Minimum failure (KN)</td>
<td>52.4</td>
<td>52.4</td>
<td>60.5</td>
<td>61.1</td>
<td>68.4</td>
<td>75.7</td>
</tr>
<tr>
<td>Minimum traction resistance (N/mm²)</td>
<td>360</td>
<td>360</td>
<td>400</td>
<td>420</td>
<td>470</td>
<td>501</td>
</tr>
<tr>
<td>Lengthening (%A200)</td>
<td>3-8</td>
<td>3-8</td>
<td>4</td>
<td>2-8</td>
<td>3-10</td>
<td>4</td>
</tr>
<tr>
<td>Rp0.2 minimum (N/mm²)</td>
<td>347</td>
<td>352</td>
<td>375</td>
<td>385</td>
<td>-</td>
<td>442</td>
</tr>
<tr>
<td>Guideline annealing temperature (°C)</td>
<td>200</td>
<td>340</td>
<td>380</td>
<td>365</td>
<td>385</td>
<td>420</td>
</tr>
</tbody>
</table>

Values according to norm EN-50149  * Values obtained according to real samples

**Mechanical and electrical properties**

### Annealing temperature:

- CuETP: 200 °C
- CuAg0.1: 340 °C
- EVELEC: 380 °C
- CuSn0.2: 365 °C
- CuMg0.5: 385 °C
- EVELHIS: 420 °C

### Resistance to traction (N/mm²) for BC 150 mm²:

- CuETP: 360 N/mm²
- CuAg0.1: 385 N/mm²
- CuSn0.2: 400 N/mm²
- CuMg0.5: 420 N/mm²
- EVELHIS: 501 N/mm²

---

**Mechanical and electrical properties of contact wire**

[Graph showing the relationship between electrical conductivity (% IACS) and resistance to traction (N/mm²)]

- IDEAL MATERIAL
- CuETP
- CuAg 0.1
- EVELEC
- CuMg 0.5
- CuSn 0.2
- EVELHIS

[Graph details include axes labeled Electrical conductivity (% IACS) and Resistance to traction (N/mm²).]