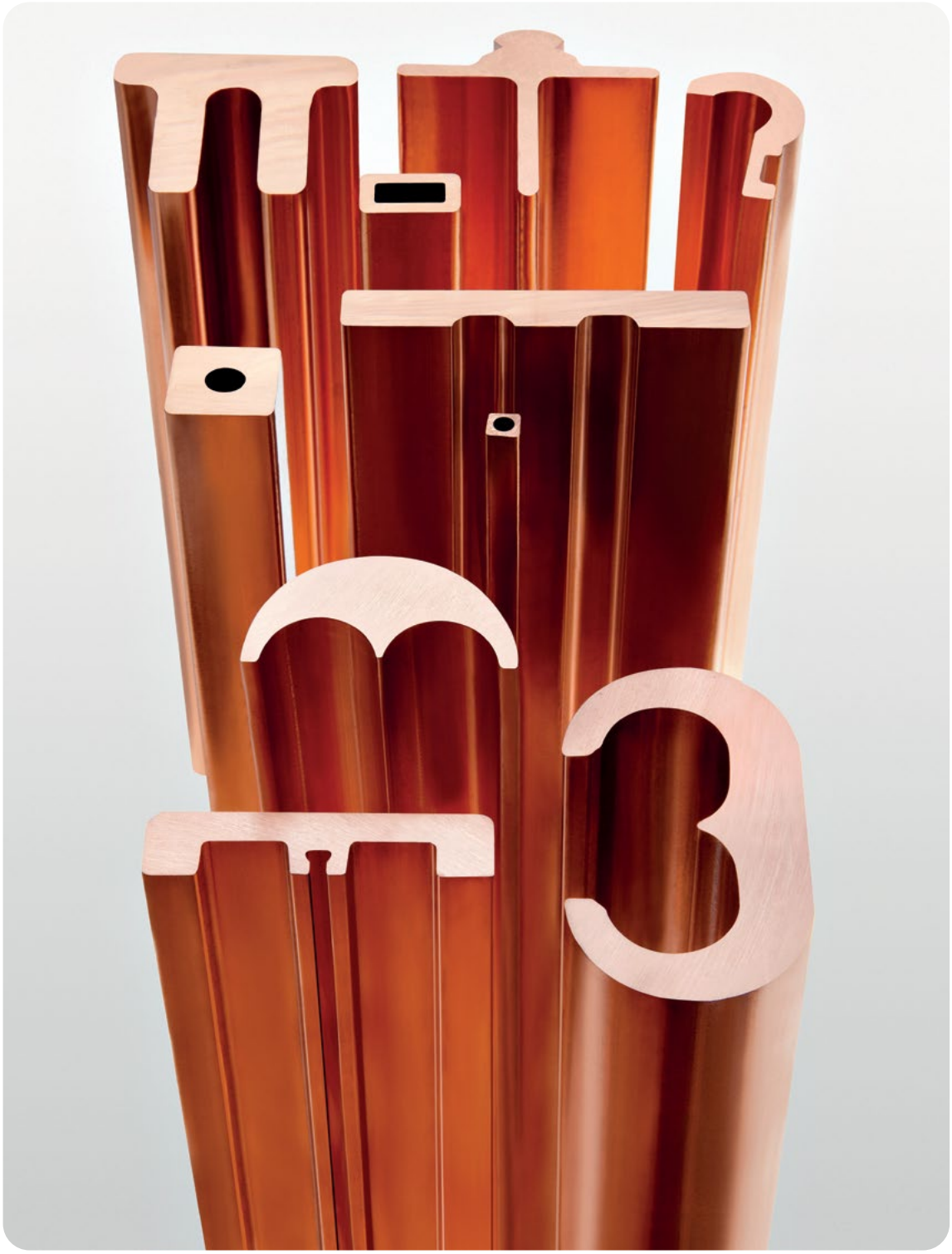


Oxygen-free Copper

Luvata's highly malleable and consistent oxygen free copper offers superior electrical and thermal conductivity.

LUVATA
Partnerships with a Promise



The Purest Commercial Copper Grade

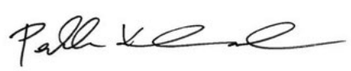
The purity of oxygen-free copper makes it exceptionally conductive. This quality, along with its malleability and metallurgical consistency, makes it ideal for the most precise industrial and scientific applications. It can be found in superconducting wires, circuit boards, vacuum interrupters, X-ray tubes, laser mirrors and scientific instruments, where precision is critical, and the copper needs to be of a consistently high quality.

Purity is only part of the story
It is the purity of oxygen-free copper that makes it superior to other commercial copper alloys, but the people behind the product are equally important. Whether it is a case of needing high electrical conductivity, a material that resists deformation in the manufacturing process, or secure joining by brazing, our people have the experience and insight to know when and how oxygen-free copper can be used to its best advantage. We believe in forging strong, long-term relationships and engaging fully with our customers' businesses, helping them solve problems, innovate and design tailor-made solutions

Our in-house casting allows us to fully control the production process and the quality of our end products. We have just invested in a state-of-the-art hot extrusion line in Finland including the latest in material handling robotics and automation, allowing for even greater product customization.

"As we all strive towards a greener, more digitized future, oxygen-free copper will play an increasingly important role. It is used in scientific applications such as fusion research for renewable energy, and can be found in the superconductors at the CERN particle accelerator. It is also central to the green transition, through the production of renewable electricity and the development of e-mobility solutions. In fact, we see unlimited potential for the future of oxygen-free copper in building a more sustainable future, including solving challenges that haven't even been thought of yet.

We are serious about sustainability. Every strategic decision we make takes into account our environmental impact, and we have pledged to become carbon neutral by 2045. We believe oxygen-free copper as fundamental to our vision of a future which benefits people, society and the Earth."



President & CEO
Pekka Kleemola

Luvata OF-OK® Copper

Luvata Oxygen-Free Copper was specifically developed for electrical, electronic and heat transfer applications. It is an extremely pure copper alloy, with a maximum oxygen content of 5 ppm (0.0005%) and has a unique combination of high-performance properties.

Consistency
High quality raw materials, melting and casting in electric furnaces, and a strictly controlled manufacturing process, guarantee the material is consistent from batch to batch.

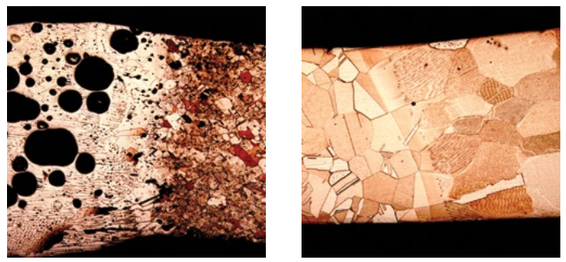
Consistency means less time consumed for machine set-up and less waste. By using silver bearing oxygen-free copper (alloying copper with a small amount of silver) its softening temperature can be increased significantly without compromising its high conductivity or formability. Silver bearing Luvata OF-OK® (Ag) is perfectly suited to commutators, generator rotor bars and welding components.

Electrical and Thermal conductivity
As a result of its purity, Luvata OF-OK® copper has high electrical conductivity (typically 100 – 102% IACS) and high thermal conductivity (390 W/Km). The higher conductivity values compared with other materials mean that equipment made of Luvata OF-OK® copper operates more efficiently and at lower temperatures, which increases their service life and reliability.

Immunity to Hydrogen embrittlement
At high temperature, hydrogen ions can diffuse into copper and form water with the oxygen atoms in the copper. The resulting water vapor has a high enough pressure to form pores in the copper known as hydrogen embrittlement. It can occur when brazing or welding copper components in a moist environment or within a reducing atmosphere containing hydrogen. In commercial copper grades which usually contain 200-600 ppm (0.02-0.06%) of oxygen, the result is a completely brittle metal. In Luvata OF-OK® copper, we guarantee a maximum of 5 ppm (0.0005%) oxygen content, which makes it immune to hydrogen embrittlement and ensures safe joining with all brazing and welding methods.

Applications
Luvata OF-OK® is the ideal material for a large number of applications:

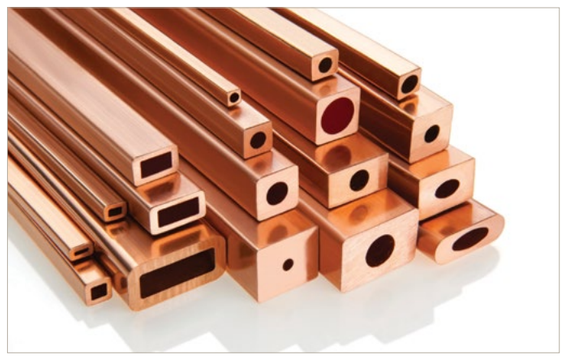
- Rotor bars and stator winding for power generators
- Components for electrical equipment
- Coils for electrical magnets and induction furnaces
- Connectors
- Heat sinks for semiconductor bases



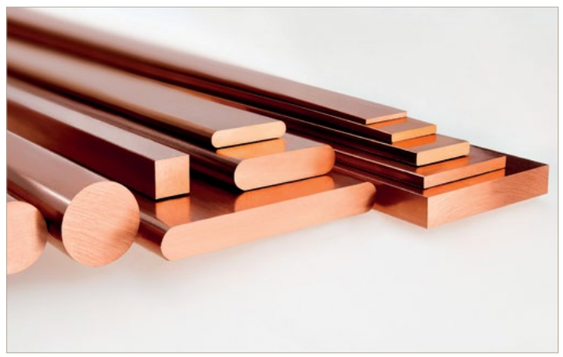
Hydrogen embrittlement in TIG welded, ETP (left) versus Luvata's TIG welding seam in oxygen-free OF-OK® copper (right)



XFEL corrector quadrupole



Luvata hollow conductors, OF-OK® and OFE-OK®



Luvata rods, bars and busbars, OF-OK® and OFE-OK®

Luvata OFE-OK® Certified Grade Copper

Luvata's OFE-OK® oxygen-free electronic grade copper is tested at every stage of the manufacturing process, from selecting the raw material to signing the inspection certification. That is why we call it Certified Grade Copper.

A higher grade material for specialist applications
For the most demanding electronic, cryogenic and optical applications, a higher grade oxygen-free copper is needed. Luvata OFE-OK® copper is a high-purity copper grade with total impurities of less than 40 ppm (0.0040%), with no single impurity exceeding 25 ppm (0.0025%). OFE-OK® copper is manufactured, controlled and inspected separately from standard Luvata OF-OK® copper. For the certified grade, only specially selected cathode copper is used and every ingot is inspected to ensure compliance with ASTM F68 Oxygen-Free Copper in Wrought Forms for Electron Devices specification and other international specifications for OFE copper.

Vacuum Applications
Luvata OFE-OK® Certified Grade Copper has an extremely low content of highly volatile low melting elements such as Phosphorus (P), Lead (Pb), Sulphur (S), Zinc (Zn), Cadmium (Cd) and Mercury (Hg). In a number of vacuum applications in the electronic industry, glass is directly bonded to copper, requiring an adherent oxide film on the copper surface. This oxide film can be rendered non-adherent and brittle if phosphorus, which is often used as oxidant, is present. To prevent this, Luvata OFE-OK® contains less than 3 ppm (0.0003%) of phosphorus, allowing for a direct bond to glass and ceramic materials. The low volatility and limited phosphorus content in Luvata OFE-OK® ensure the smooth functioning and long service life for vacuum components such as vacuum interrupters, X-ray tubes and radio transmitters.

Integrity
Luvata OFE-OK® is tested during all steps of the manufacturing process; casting, extrusion, drawing and at the end of the process to ensure the integrity of the material. Even small impurities or defects from extrusion may cause scattering of the beam from the optical component and cause rejection after a great deal of time and effort has been spent. Using OFE-OK® ensures the highest possible yield in the process. All Luvata OFE-OK® copper carries a test certificate guaranteeing the impurities are below the specified limits, electrical conductivity is at least 101.5% IACS and the material integrity complies with the requirements of the most demanding applications.

Cryogenic Properties
At cryogenic temperatures, the electrical and thermal properties of Luvata OFE-OK® copper are superior to any other copper grade. With the high purity of Luvata OFE-OK® combined with the special thermal treatment in the manufacturing process, the high value RRR (Residual Resistance Ratio) of Luvata OFE-OK® is guaranteed. RRR values up to 2000 are available with specific high purity copper grades.

Since RRR is very sensitive for common processing treatments, Luvata experts are pleased to advise the best thermomechanical treatment to meet the optimum RRR value in the final component. Unlike oxygen-containing copper alloys with high RRR values, Luvata OFE-OK® can readily be electron beam welded or annealed in a reducing atmosphere without the risk of hydrogen embrittlement.

On request, Luvata also provides copper materials having RRR within a specific range and alloyed copper grades with very low RRR value.



Laser mirrors



X-ray tube

Technical data

Alloys

Alloy	Luvata Alloy	Purity %	EN	ASTM
Cu-OF	OF-OK®	99.95 min	CW008A	C10200 OF
Cu-OFE	OFE-OK®	99.99 min	CW009A	C10100 OFE, ASTM F68
CuAg0.04(OF)	HK003	Cu + Ag min 99.95	CW017A	C10400 OFS
CuAg0.10(OF)	HK015	Cu + Ag min 99.95	CW019A	C10700 OFS

Size range

Rods mm	Mill Length mm	Temper
3 – 25	3500 – 4000	hard, soft annealed
25 – 60	3500 – 4000	hard, soft annealed
50 – 125	2000 – 3000	hard, soft annealed
125 – 190	1000 – 2000	extruded, forged
190 – 850	500 – 1500	cast, forged

Busbars

Width mm	Min Thickness mm
10 – 20	2
20 – 40	3
40 – 70	4
70 – 250	5

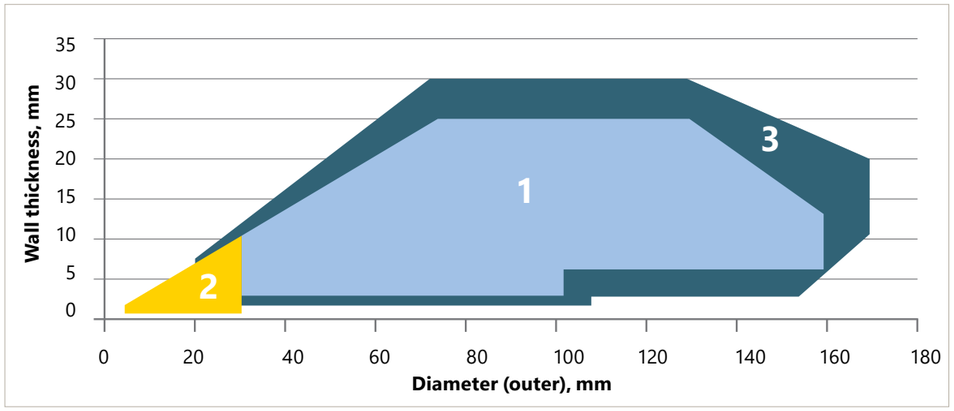
Tubes

Deliver forms:
- Straight lengths up to 12 m
- Loose coils up to 120 kg
- Mileon® continuous coils in wooden reels up to 2500 kg
- LWC (Level Wound Coil) coils
- Forged tubes up to OD 800 mm

Hollow conductors

Size range: Different shapes from 3 x 2 mm up to 100 x 100 mm.

Delivery forms:
- Straight lengths up to 16 m
- Loose coils
- Mileon® continuous coils in wooden reels up to 2500 kg
- Pancake coils
- LWC (Level Wound Coil) coils



See list of tools of profile tubes:
www.luvata.com/hollow-conductors

Region No.1 – tubes in straight length.
Region No.2 – tubes in coil.
Region No.3 – special dimensions (available upon request). Other dimensions – check availability from Luvata.

Luvata - Partnerships with a Promise

Working for People, Society and the Earth
We all want to ensure a sustainable future for our planet. As a manufacturer, we know that we have both an opportunity and a responsibility to contribute positively to the changes needed to secure that future. We have stated that our vision is to be the leading provider of copper solutions that benefit people, society and the earth, and this is a serious commitment. We are active in markets such as e-mobility, healthcare, electrification and the green transition, all of which have a need for copper products. We believe that our innovations will help drive these markets forwards, making green solutions more easily accessible to all.

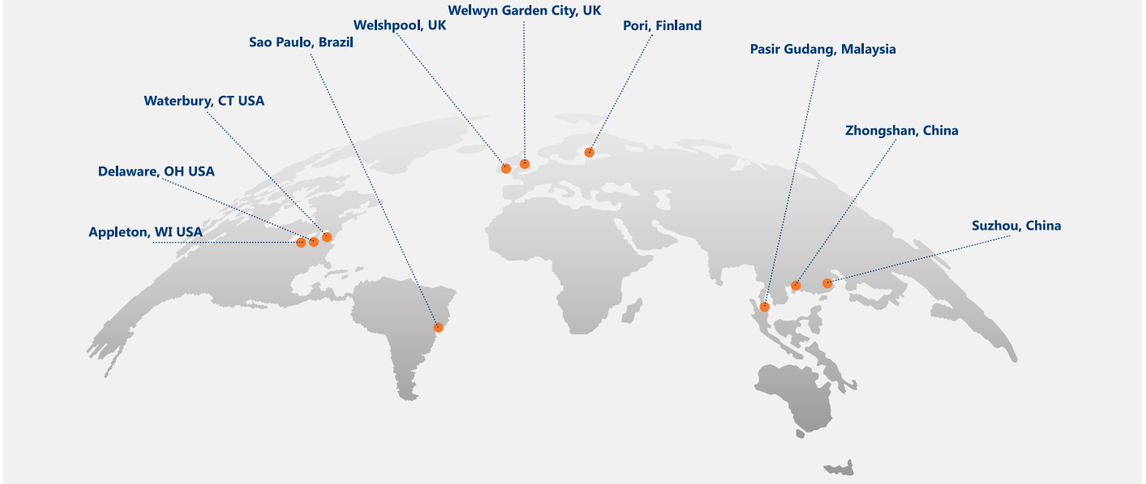
We also recognize the need for our operations to be sustainable. To this end, we are striving to reduce greenhouse gas emissions, aiming to be using 100% renewable electricity by 2035 and to be fully carbon neutral by 2045.

Helping our customers grow and thrive
We have always worked in partnership with our customers, getting to know their businesses and collaborating on custom-made solutions. We take great satisfaction in seeing our customers thrive, and knowing that we played a part in their success.

Where we believe we can make a real difference is in sharing our robust manufacturing capabilities, technology and material knowledge, and by using our unique expertise to develop technically-demanding products. Together with an emphasis on lean production, innovation and value-added solutions, we work hard to ensure that we are the partner of choice for our customers, every time.

Partnerships with a Promise
At Luvata, we deliver on our promises. We have pledged always to treat people with respect, keep an open mindset and work together with others.

Our global footprint stretches across four continents. Our diversity of locations, cultures and markets gives us access to a wealth of knowledge and expertise that continues to grow. It also means that we are local to our customers, wherever they are, so we can continue to forge the strong relationships we are known for.



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About Luvata

Luvata is a world leader in copper manufacturing and related engineering services. It brings together people, innovation and technology to create solutions in areas such as e-mobility, healthcare, and in electrification & the green transition. The company's success is driven by innovation, lean production and value-added sales, and its vision is to provide copper solutions which benefit people, society and the earth. Employing over 1,400 staff on four continents, Luvata works in partnership with customers such as ABB, CERN and Siemens. Luvata is a group company of Mitsubishi Materials Corporation.

LUVATA

Partnerships with a Promise

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