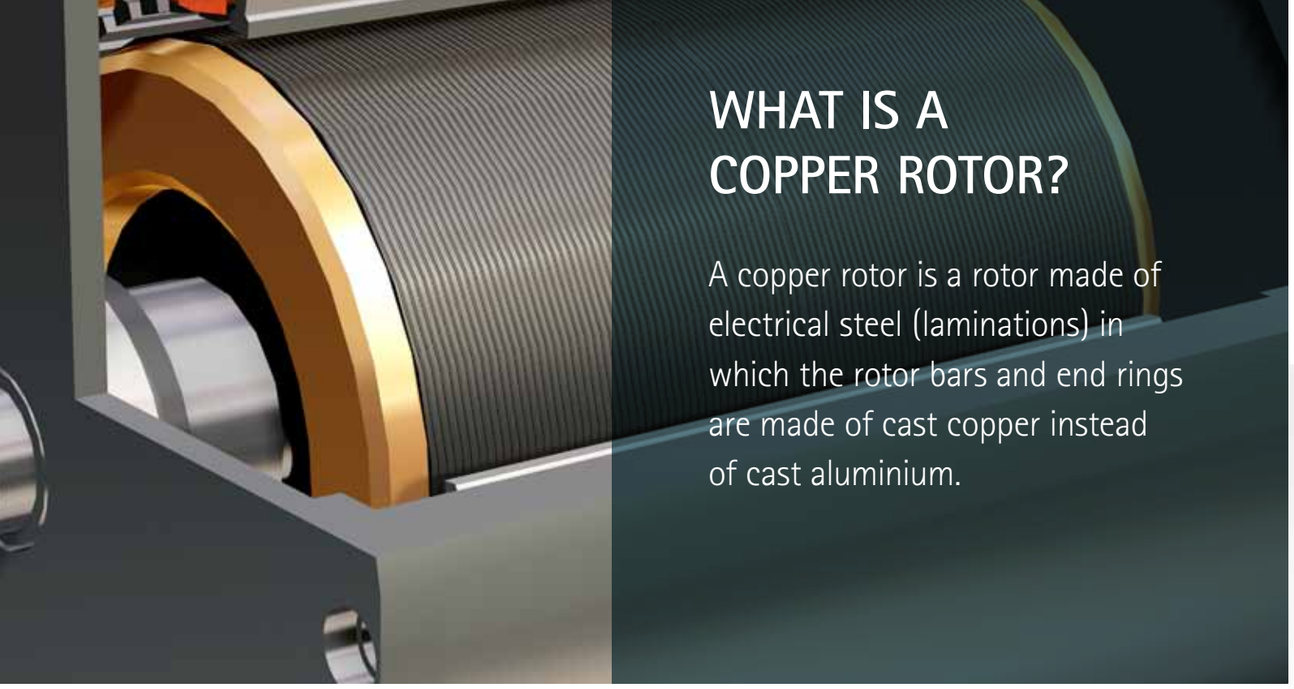
Copper Rotors for Induction Motors

New Technologies Make Commercial Scale Copper Rotor Die-Casting Viable

European Copper Institute
Copper Alliance



WHAT IS A COPPER ROTOR?

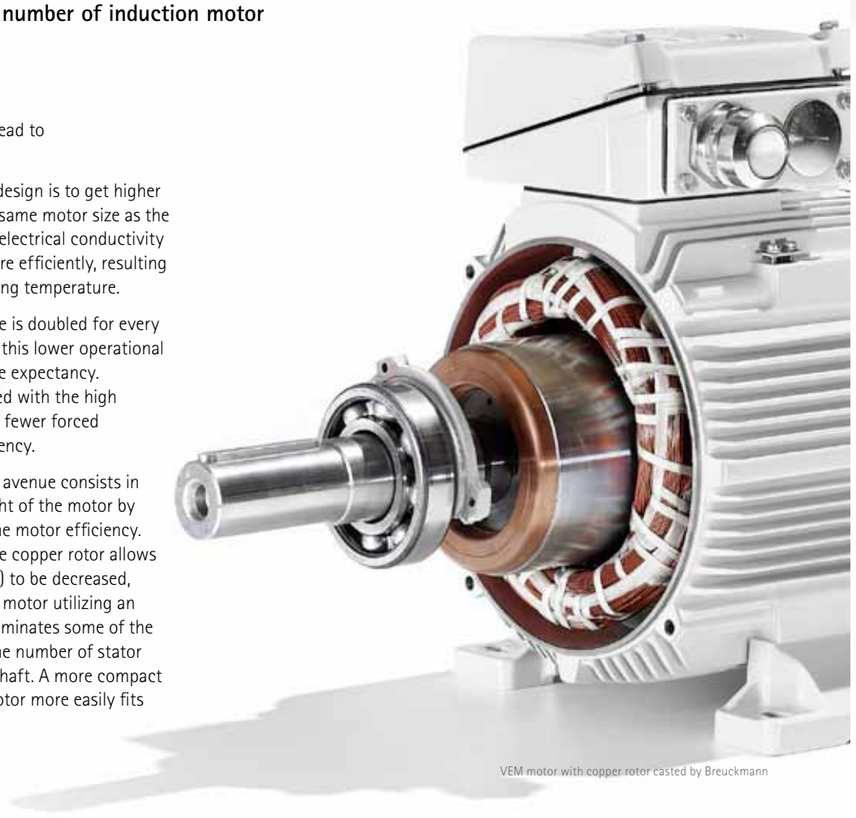
A copper rotor is a rotor made of electrical steel (laminations) in which the rotor bars and end rings are made of cast copper instead of cast aluminium.

WHY COPPER?

Copper is an excellent material to use for rotors because of its high conductivity. Copper's conductivity is rated at 57 MS/m, which is significantly higher than that of aluminium (37 MS/m). This makes copper the material of choice for a number of induction motor applications worldwide.

The use of copper in place of aluminium can lead to significant benefits:

- **Higher efficiency** – A first possibility of design is to get higher efficiency, while using approximately the same motor size as the aluminium rotor version. Copper's higher electrical conductivity allows the rotor to conduct electricity more efficiently, resulting in lower resistive losses and lower operating temperature.
- **Extended life expectancy** – As motor life is doubled for every 10°C reduction in operating temperature, this lower operational temperature results in extended motor life expectancy. The lower operating temperature combined with the high thermal conductivity of copper allows for fewer forced cooling units. This further improves efficiency.
- **Smaller size and cost** – A second design avenue consists in the reduction of the overall size and weight of the motor by using a copper rotor, while maintaining the motor efficiency. This is because the higher efficiency of the copper rotor allows the overall length of the rotor (and motor) to be decreased, while still matching the performance of a motor utilizing an aluminium rotor. Shortening the motor eliminates some of the rotor and stator laminations; decreases the number of stator windings; and reduces the length of the shaft. A more compact and lighter machine is possible, and the rotor more easily fits into a monoblock motor system.



VEM motor with copper rotor casted by Breuckmann

WHY NOT COPPER?

Copper melts at 1083°C, compared to 660°C for aluminium. The higher melting point of copper has historically led to die-casting problems. In fact, the die-casting of (pure) copper was technically difficult or virtually impossible for a long time. This meant that copper had not been greatly utilized for industrial rotor production. However, all these problems now belong to the past, thanks to the availability of new processes.

INNOVATIONS STIMULATE MARKET GROWTH

New technological breakthroughs

Several breakthroughs in copper die-casting have removed the previous problems. The technology has been fine-tuned to make it economically viable. A number of companies in Europe, US and Asia are now up and running with copper die-casting production facilities.

Mass production is now possible and commercially viable. Around 2 million copper die-cast units are already in use worldwide. As a result, the market for copper die-cast rotors is expected to grow significantly.

Current applications proven; new ones under development

Initial interesting applications include industrial high efficiency low voltage induction motors (100 W – 100 kW) and traction applications. More applications in niche sectors are following closely behind. These include corrosive atmospheres, special cooling needs and cranes.

Recycling: Technologically and economically feasible

Beyond manual processes for separation of copper from iron, a number of automated sorting techniques are tested and proved, such as X-ray fluorescence. As well, new tools are under development, such as laser induced breakdown spectroscopy (LIBS).

Copper rotors contain typically around 25% copper in weight (the rest is steel). 9/10 of the scrap value corresponds to copper. There is then a strong economic rationale to recycle copper rotors.

Recycling of copper is also environmentally responsible. It leads to the emission of few, if any, harmful gases and avoids its expensive disposal in landfills. It also leads to significant energy savings. To extract copper from copper ore, the energy required is approximately 100 GJ/tonne. Recycling copper uses much less energy, about 10 GJ/tonne. This energy saving leads to the conservation of valuable reserves of fossil fuels and consequent reduction of CO_2 emissions. Finally, recycling helps as well to preserve raw material reserves.

WANT TO KNOW MORE?

Here are two websites where you can discover more about innovative copper rotor technologies and applications:

www.copper-rotor.eu

presents copper rotor technology for induction motors, focusing on industrial applications, and includes:

- An introduction to the technology.
- An economic analysis to support decision-making.
- A comprehensive view over the supply chain of this technology in Europe and other regions.
- An environmental approach: recycling avenues.

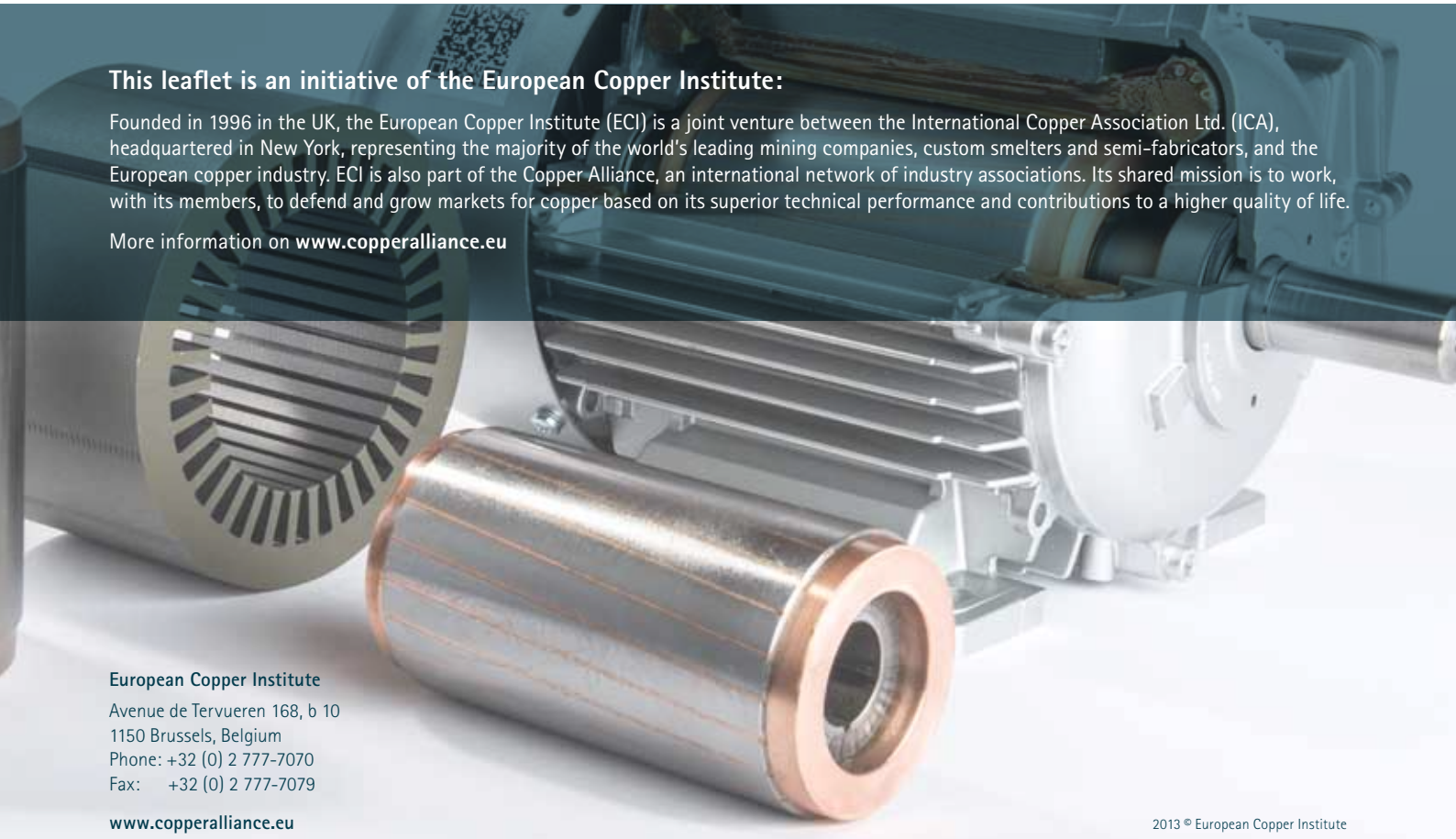
www.coppermotor.com

focuses on copper rotor induction motors for automotive applications and is packed full of manufacturing and design resources.

Contact the European Copper Institute at **eci@copperalliance.eu** to discuss how you can play a role in the further growth of the copper rotor phenomenon.

Leading European copper rotor manufacturers:

Breuckmann | ZAT | Kienle Spiess



This leaflet is an initiative of the European Copper Institute:

Founded in 1996 in the UK, the European Copper Institute (ECI) is a joint venture between the International Copper Association Ltd. (ICA), headquartered in New York, representing the majority of the world's leading mining companies, custom smelters and semi-fabricators, and the European copper industry. ECI is also part of the Copper Alliance, an international network of industry associations. Its shared mission is to work, with its members, to defend and grow markets for copper based on its superior technical performance and contributions to a higher quality of life.

More information on **www.copperalliance.eu**

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