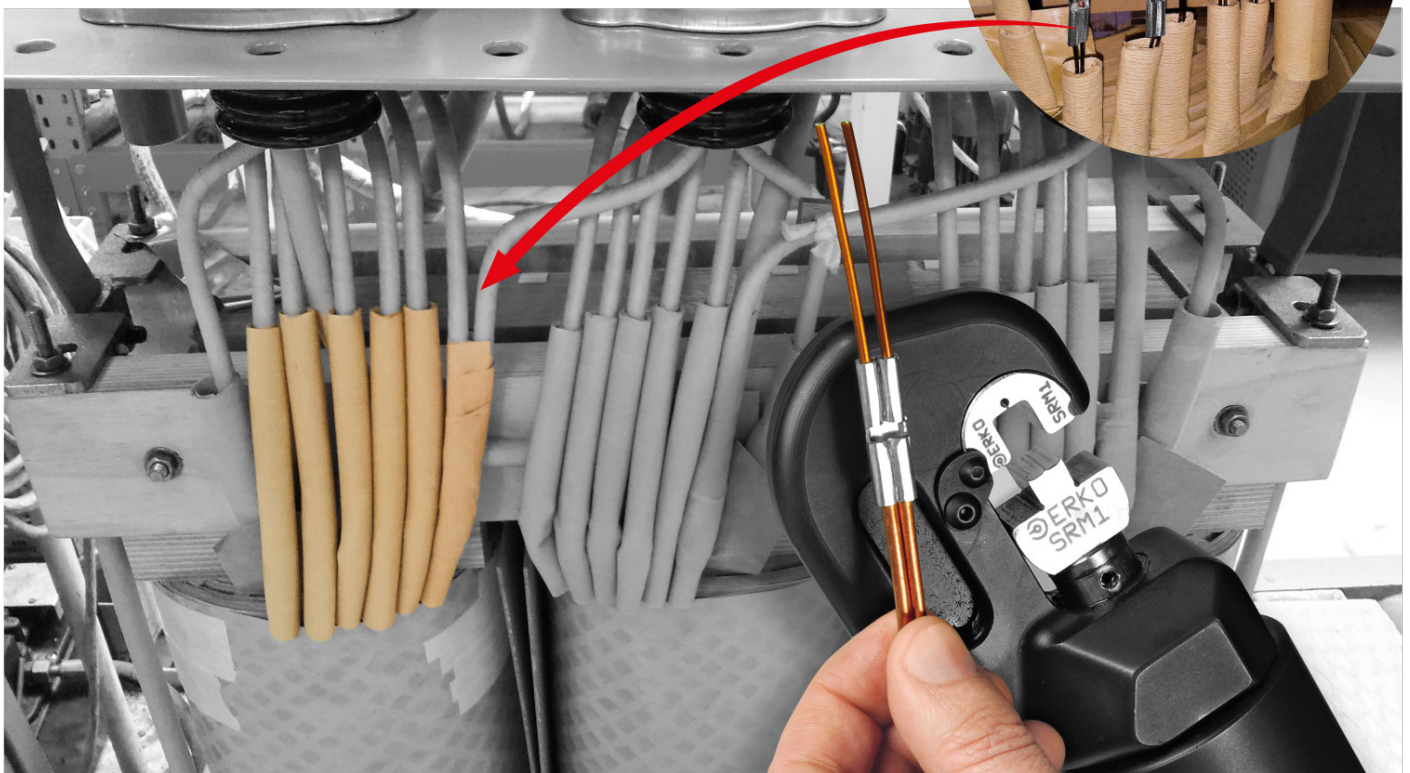
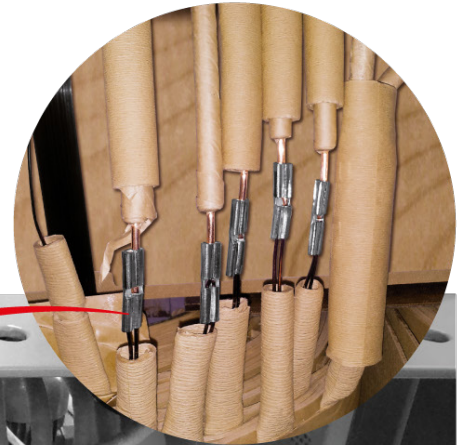


Innovation on a Global Scale: Technology for Connecting Aluminium and Copper Enamelled Wires in Transformers

by **Dorota Dittrich**
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Without transformers, the distance between power plants and all kinds of their recipients would have to be much larger. No wonder there is a constant strive to improve transformers' efficiency and to facilitate their usage.

If it was not for transformers, the electricity distribution would not be as efficient as it appears to be today. There is a reason for calling them the heart of a power system. Without

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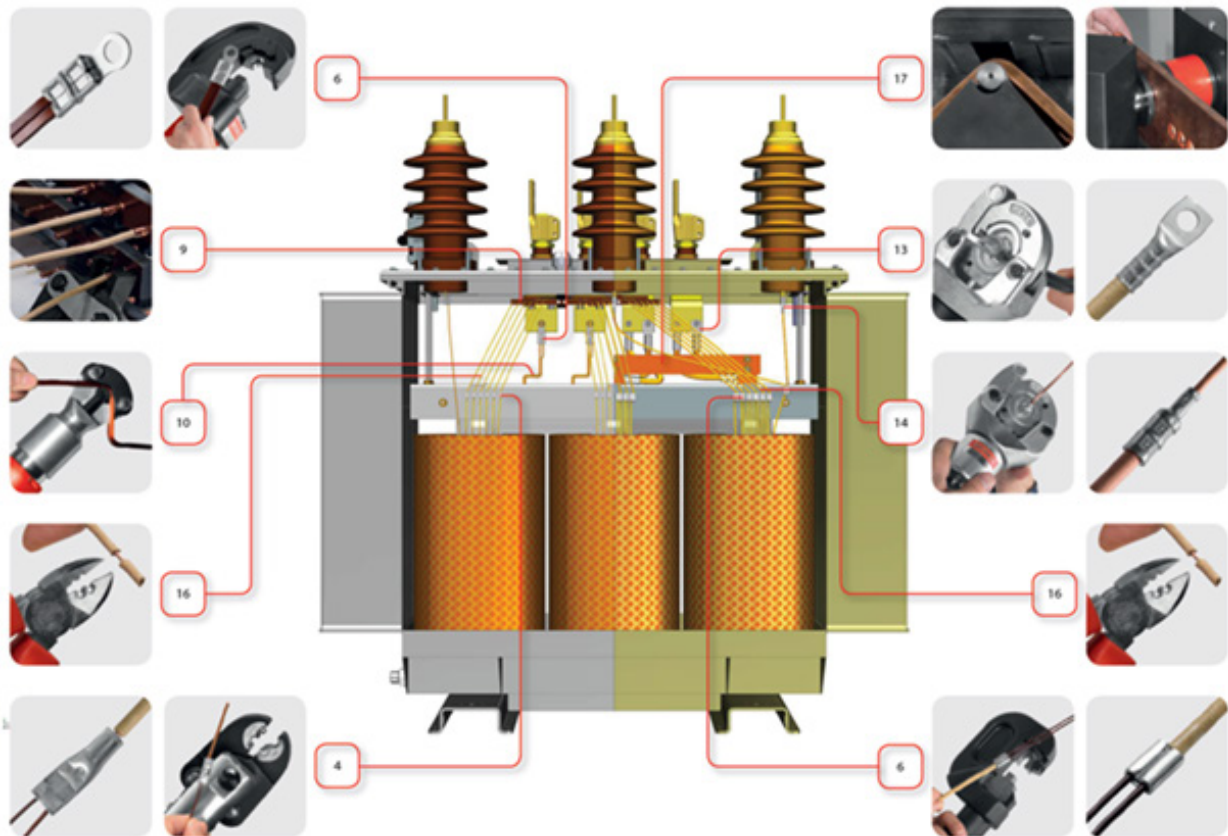
In response to the constantly growing needs of the modern market, an innovative connection system for aluminium and copper wires in transformers has been designed.

The technology is dedicated to connecting both round and profile enamelled copper and aluminium winding wires in motors and oil transformers. The designed connectors

and terminals are applicable in all branches of the economy, in which enamelled wires are used - e.g., in industrial power engineering, electric motors, automotive industry, railway industry and shipbuilding.

A wide range of available types of connectors allows to connect any cable within the scope of the technology connectors' application. All enamelled copper or aluminium, profile or round wires can be connected.

Examples of places of application of the connectors in a transformer



A single connector enables connecting wires of different cross-sections, shapes, and materials. A wide range of available types of connectors allows to connect any cable within the scope of the technology connectors' application. All enamelled copper or aluminium, profile or round wires can be connected. With observance of the relevant rules, the connectors can be also applied for connecting single-strand and multi-strand wires without insulation.

Technology innovation

Thanks to this technology, the process of removing enamel insulation from the wires has been eliminated as the connectors break through the enamel and into the core of the connected wires. That enables obtaining a permanent electrical and mechanical connection. The gradation of the teeth placed on the surface of the connector ensures lack of weakening of the core of the cable. As a result, the created connection is protected against oxidation, breakage and formation of

notches, which guarantees its trouble-free working time for years.

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In the process of stripping wires using traditional technology, the wire is narrowed (a notch is formed), which leads to a local reduction in cross-section and mechanical weakening of the wire. The use of the innovative



Dorota Dittrich works as a Junior Marketing Specialist for ERKO, one of the electrotechnical industry key suppliers. She graduated in linguistics in business and received her Master of Arts from The University of Warmia and Mazury in Olsztyn, Poland. She can be reached at dorota.dittrich@erko.pl

technology eliminates this problem and guarantees longer trouble-free operating time of cables and devices, in which modern connectors and terminals have been installed. The elimination of preparatory processes provides a significant competitive advantage for this technology over traditional methods of making connections on enamelled wires.

An alternative to removing enamel from the wires

The process of connecting enamelled wires using the traditional connection technology requires the usage of mechanical or chemical methods of removing the insulation from the wires. Mechanical methods include scraping the insulation, which causes dust and pollution of the working environment. Another method is burning or soldering the insulation with hard solder with the addition of silver. However, those activities pollute the environment with toxic results of the process and require the installer to have special qualifications.

The chemical method is based on dissolving the insulation in corrosive substances. Both methods are burdened with many technological and environmental flaws. Thus, to increase efficiency and durability of the connections, using this new method, the process of removing enamel from the wires has been completely eliminated.

The disadvantages of soldering and preparing the wires using the mechanical method

Stripping the wires mechanically is associated with problems with the precise removal of the insulation from profile wires. It also causes local narrowing of wires, which contributes to their electrical and mechanical weakening (especially in case of aluminium wires).

Additionally, both mechanical methods and soldering generate solid impurities (fillings, charred insulation) that get into the transformer, causing a potential source of short-circuit. What is more, in case of mechanical technology, typical dies do not always match the size of the crimped wires, which leads to the formation of flashes (sharp edges). Working with maladjusted dies makes it necessary to supplement the missing cross-section with fillings. Soldering, on the other hand, requires preliminary preparation of the surface of the wires and using expensive solder and suitable equipment. It also often damages the insulation of the wires

polluting the environment with gases generated during this process.

Special features of the innovative technology

The innovative system enables making durable connections of the highest quality, that work in transformers trouble-free for many years. The technology itself is clean and prevents contamination of transformer windings. Elimination of harmful processes of soldering and burning the insulation results in reduced pollution of the working environment.

The system guarantees increased efficiency in comparison to the technology previously used. As it is dedicated to transformer producers, the elimination of preparatory processes (including the energy consuming soldering process) ensures that the system is economical. Universal technology enables connecting wires of different cross-sections, shapes and materials

with a single connector, which leads to the possibility of reducing the stocked assortment of connectors in general.

Research and tests

Constant research is conducted to evaluate the effectiveness of the mentioned connectors and dedicated tools. To carry out the research, the so-called test chain is performed. It is created by making serial connections of equal conductor sections with the use of tested connectors. The lengths of the cable sections connecting individual connectors are strictly defined in the PN-EN 61238-1:2004 standard. During the research, the changes in connection resistance between heating cycles are registered and the temperature of all connectors and its changes in all stages and cycles is measured. In addition, the process of cyclical heating of connections made with innovative connectors is conducted. It is carried out in accordance with the requirements of the standard.

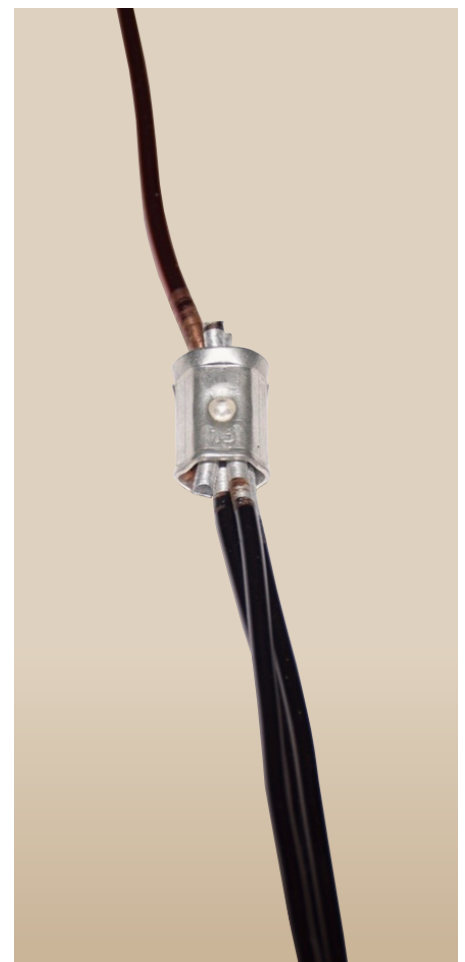
Soldering with tin solder



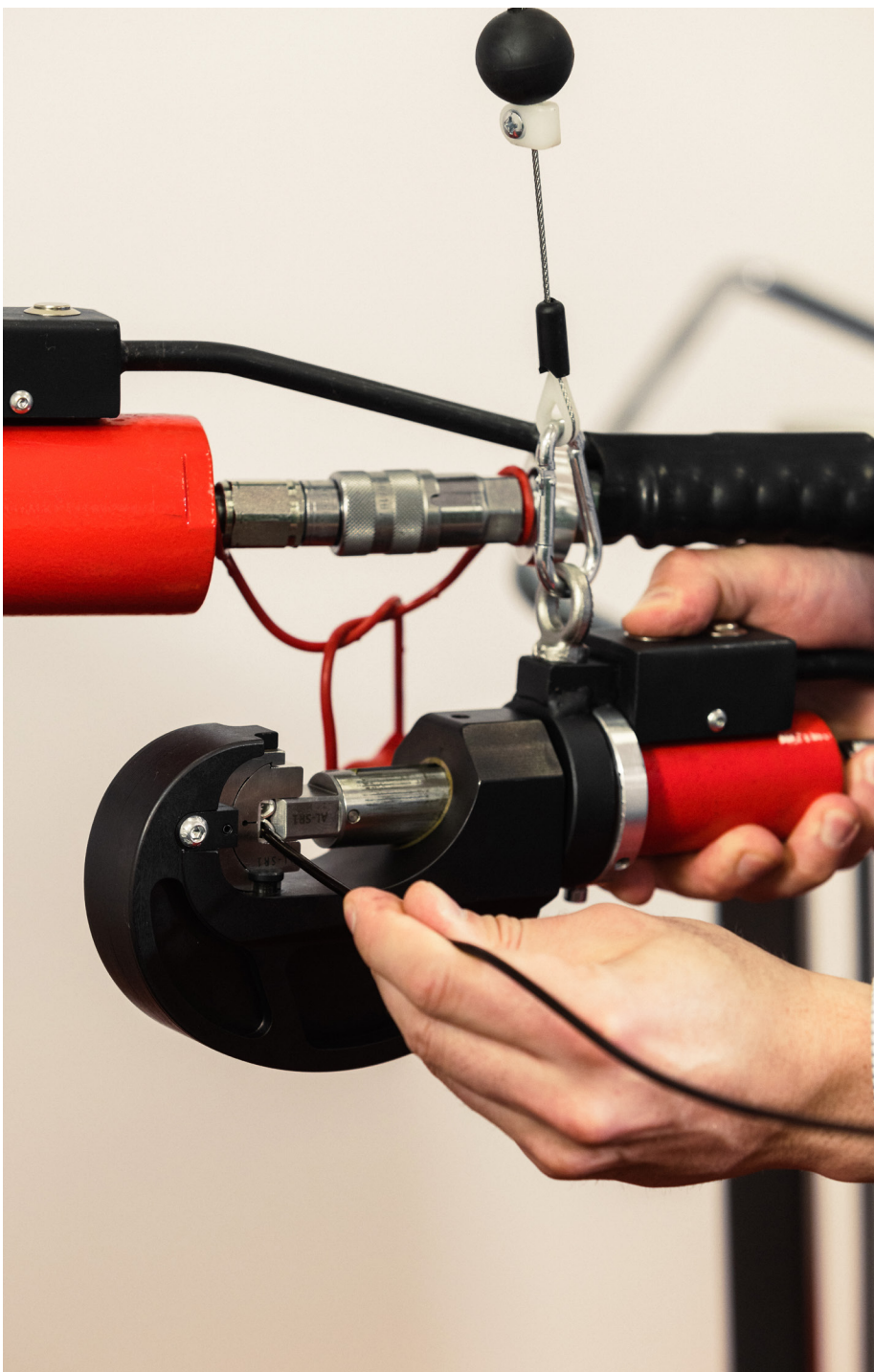
Hard Soldering



Mechanical Crimping



Research and tests



Technology that enables connecting wires in enamelled insulation without the need of taking the enamel off is an innovation on a global scale – at this point it is not even the future, but the present of power transformers.

The measurements of the mechanical properties of connections are also constantly carried out.

The tested connectors cannot introduce additional resistance to the test circuit, and their temperature in process of cyclical heating cannot exceed the temperature of the conductor on which they are installed.

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