



# KUKK

Coil production with fine wires for  
medical technology



In coil manufacturing for medical technology, the trend towards miniaturisation is currently driving technological progress. This development was triggered by the fact that more and more medical technology devices are being inserted into the body, whether via catheters, permanent and temporary implants, or minimally invasive applications. In the context of digitalisation, new monitoring possibilities are emerging, for example through health apps. To monitor a patient, or more precisely their data, sensors are needed that are either attached to the body or instruments, e.g. syringes, must be equipped with them.

But why does this directly result in miniaturisation for the developer of medical technology devices? It originates from various requirements: reaching otherwise inaccessible parts of the body, minimising interference with normal bodily functions, reduced energy consumption or extended service life of implanted components.

Concerning coil manufacturing this means installation space is shrinking and output power is increasing. Of course, the challenges are not limited to the winding of the coil, which ultimately also must be connected to a printed circuit board or a connector. It is also important that the coil can communicate with the system.

So-called miniature coils or micro coils offer the solution. Today, inductors with different core materials such as iron or metal powder or nano-crystalline cores are available, which fulfil all key requirements of contemporary applications: Small size and weight as well as higher performance and switching frequencies and optimised temperature behaviour.

This e-paper presents innovative technologies in coil manufacturing for medical technology, in particular the latest advances in the winding of ultra-fine wires. The next part deals with the options that these advances in coil production open for the developer of medical equipment. Because today, even in series production, key cases can be solved that were unthinkable in medical technology just a few years ago.



### **Miniature coils for medical technology require special winding equipment**

Producing coils with ultra-fine wires at a reasonable cost requires a production environment of the highest standard. Only the most innovative coil manufacturers can keep up with this. The mere winding of wires that are barely visible to the human eye is a major challenge. This requires a coil manufacturer who not only has the specific equipment, but ideally has also built up a great deal of know-how in this area over the years. In addition to the windings, the required final shape of the miniature coil is often a sticking point. A long list of physical and environmental factors limits the alternatives. Finally, there are also very strict tolerance requirements. Thus it's pretty obvious that production facilities must be available that are absolutely precise and in most cases also tailor-made for the respective customer. A complete documentation of the production processes is essential. Micro coils require not only very special equipment, but also specially trained staff. In the production of coils with ultra-fine wire, work must be extremely precise, as the diameter of the ultra-thin wire means that much of the work takes place in the micrometre range. It is therefore not surprising that only a few coil manufacturers are able to produce such miniature coils - including the globally operating KUK Group.

## Connection and its challenges

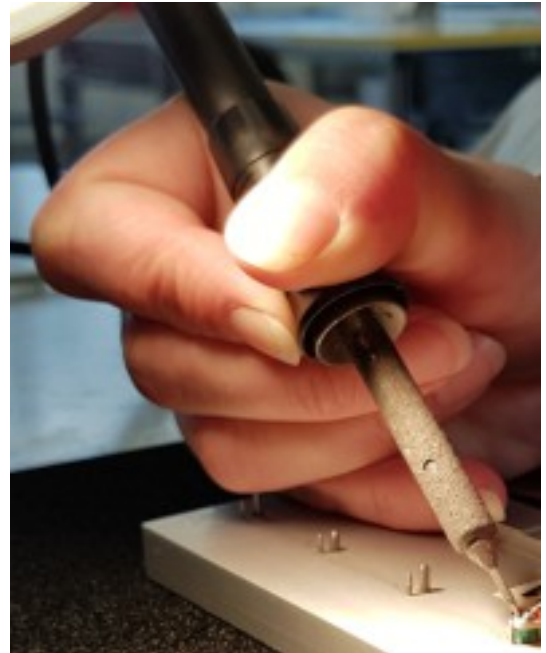
Miniature coils for medical technology applications are not only complex in terms of coil manufacturing per se: since micro coils are ultimately only one component in a larger assembly, the connection process with the other components poses an additional challenge. Traditional processes, such as conventional soldering, require specific knowledge and experienced personnel for micro coils.

Especially when soldering fine wires under the influence of heat, certain side effects must be prevented. These include oxidation of the contact to the PCB (leading to inferior conductivity and lower durability), excessive stress (resulting in lower durability) or heat damage in the area of the connection (lower reliability and durability).

To avoid these risks in the production of micro coils, KUK Group has developed an innovative process over the years. It allows that no tensile impact can occur from the fine wire to the contacting wire. This minimises the risk of failure due to the stress and significantly extends the durability. This procedure makes it possible to process ultra-fine wire from 0.010 mm in a technically clean way and with acceptable effort.

In addition, KUK uses diamond bonding for connections for which a soldering process is not an option at all. Here, the finest wire is pressed onto the contact using a diamond head and heat.

These state-of-the-art methods of technology produce micro coils with a very reliable, corrosion- and stress-free connection. This simplifies the manufacturing process and thus reduces costs. Thorough testing of the technology in a variety of use cases in medical technology and beyond proves the capability for series production. At the same time, the production process complies with the regulatory requirements for medical technology, both for disposable products and lifelong applications (e.g. permanent implants). Due to the extremely sensitive application, coils for medical technology naturally require an extremely careful development phase before series production. This starts with the detailed coil design based on the specific requirements of the component. Then it is a matter of developing and assembling a customised coil production line. This must meet the specifications while maintaining strict quality and reliability standards. Coil manufacturers who - like KUK - have their own automation department can offer a customer-specific solution here.



Technically demanding connection of a miniature coil.

## Technological advantage thanks to miniature coils for medical technology

Coil manufacturing with ultra-fine wires opens a real innovation boost for medical technology. Miniature coils can be used for the following functions, for example:

- Transmission of control, monitoring and logging data to/from miniature implants.

- Transmitting power to implants that require battery charging or electrical charge input to activate and operate their systems.
- Radiation of energy for RF (radio frequency), thermal or electromagnetic radiation-based treatments
- In vivo magnetic navigation using a local or external magnetic field.

Diamond-headed thermobonding used by leading custom coil manufacturer KUK connects fine wires to other fine wires, to terminals or to printed circuit boards. Some examples:

- Copper-to-copper bonding of micro coils to circuit boards.
- Miniature thermocouple based on a copper-constantan connection of ultra-fine wires
- Connection of micro coils with a component, e.g. RFID chip



Coils with 0.010 mm wire produced by KUK Group

### Applications of miniature coils in medical technology

Medical applications that benefit from miniature coils and windings with fine wire include:

- Diagnostic applications: wireless communication with miniature implants that act as sensors, whether for physiology (blood pressure, heartbeat), blood glucose levels or blood flow (blood, respiration).
- Active implants: Monitoring/control of implanted miniature pacemakers or deep brain stimulation components in implanted devices for pain management
- Therapeutic applications: Terminal devices in electrophysiological treatments (heart, nerves, brain) or current-based ablations (microwaves and RF)
- Navigation and orientation applications: targeted drug delivery, targeted radiation catheters, stent placement, high precision ablations, implanted markers, inter-body tagging as well as endoscopic, gastroscopic, colonoscopic, laproscopic, bronchoscopic and other similar procedures

- Hearing aids: connection of the miniature coil with an operating system on a printed circuit board
- Temperature measurement applications

### The future of miniature coils in medical technology

The use of state-of-the-art fine wire technology opens limitless new possibilities for designers of medical devices. The growing need for access to tiny body parts underlines the importance of miniaturisation in medical technology. At the same time, miniature coils are expected to help reduce interference with normal body functions, lower energy consumption and extend the life of implanted components.

A miniature coil manufactured by KUK Group is applied as a key element in a highly sensitive medical technology process. It is a typical example of the technological ability to produce a miniature component with high and predictable quality at a reasonable cost. We assume that this innovative technology will continue to gain acceptance in medical technology and thus the variety of applications with miniature coils/micro coils will continue to increase.



Sensor with <3 mm length, 0.3mm outer diameter and several hundreds of turns - corresponds to less than the area of Europe on 1 euro cent coin. Manufacturer: KUK Group.

### KUK Group – miniaturized coils and electronics tailor-made for medical technology

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