Wire Resistance Measurement of Power Cables in Stranding Machines

Why use an automatic measuring device in cable production?

Lower material requirement

In terms of saving raw materials and energy, it is not easy to appraise over-dimensioned conductor cross-sections. Whereas the consumption of raw materials is higher in such cases, the energy losses are lower. Contractual partners must calculate on the basis of weight per kilometer of cable to preclude disadvantages for any partner if cross-sections are not monitored thoroughly. However, as standard cross-sections underlie such contracts, manufacturers need to perform checks to minimize costs. Such checks must be initiated as early as possible during the production of individual wires.

When a buyer of electrical high-tension wires discovers that the cross-sections of the supplied cables exceed the specified dimensions, he has good reason to be happy. In this case he received a small bonus, as the voltage drops in his planned system of conductors will be lower than expected. However, the supplier respectively the manufacturer of the cables gets the short end of the stick here. Using conventional measuring instruments, it is difficult to precisely maintain tolerance limits, so that a safety allowance of up to 5 % must be made to prevent any drops below the specified limit which would cause the product to be rejected. With a safety allowance of 5 %, roughly 150 $ are squandered per ton of processed copper. Considering the large quantities of copper processed in a cable factory, this loss easily accumulates to 5,000 $ per month.

So far, it has been a standard procedure to cut off a meter-long sample of finished cable and measure it separately before restarting a machine. After that, the machine is adjusted and a series of measurements performed until the required value is obtained. A safety allowance of 5% is made in this process, as the tension in the individual wires increases steadily as the diameter of the wound coils decreases, thus lowering the cross-sections of the individual wires. The possibilities of dimensional checking after a machine has been restarted are very restricted. One interfering factor is that temperature of the finished cable as it leaves the compacting head not only rises, but is distributed unevenly over the cable cross-section. Variations in this temperature cause corresponding variations in the measured values.

To ideally monitor the production of single wires for high-tension cables, quality control must be performed directly in the stranding machine. burster allows line resistances to be measured to an accuracy of 0.1% inside the production of a cable length. The machine operator is able to adjust the compacting head in accordance with the measurement results, thus optimizing the cable's cross-section.

How it works out

Therefore, as described, the optimal quality control for production of singular wires and power cables is done with a test directly in the stranding machine. The components RESISTOMAT® 2304, the clamping device 2382A and a lifting table make a measurement of a sample length possible during production, however only with a temporary stop of the stranding machine. The machine guide has the option to adjust the compressor according to the measurement result in order to optimize the cable diameter.

The production process is supervised and therefore fulfils the requirements of ISO 9002 due to the integration of the measurement system straight in the stranding machine. The single measurement values can be registered on a PC or by direct print-out on a printer.

The ISO 9002 - verification level production - is advanced, of course, in relation to the ISO 9003 - verification level end product - where the testing is effected on meter probes after the production of the batch (with RESISTOMAT® 2304 and clamping device 2382L).

Technical details

Before a measurement can be done, the twisting machine must stop and the lifting platform carrying the measurement basin rises to make contact with the specimen. The exact high position is reached by limit switches. The contact to the cable happens with spring mounted potential taps at a distance of 1000 mm. During the whole measurement the cable is inside a temperature-controlled water bath. A circulation pump ensures an even distribution of temperature in the water bath and re-circulates the water flowing out through the bulkheads.

The water bath is heated and maintained by a thermostat at a set temperature as close as possible to that of the test object. So you get a short temperature equalizing time and therefore a fast and very accurate measurement value. The determination of the water temperature happens with an accurate Pt 100 sensor. This water temperature is necessary for the temperature compensation in the RESISTOMAT® which calculates the value at 20 °C.

Necessary calibration of the measuring system

burster's series 1240 of calibration resistors are designed for calibrating and testing the resistance meter. Every resistor is delivered with a Manufacturer Test Certificate. On request, resistors can be delivered with a DKD Calibration Certificate. This certificate documents compliance with national standards for displaying physical units in agreement with the international SI system.

As the temperature of the conducting cable directly influences the measurement result, the temperature of the water bath measured and displayed by the RESISTOMAT® 2304 must also be checked. A calibrated thermometer with DKD Certificate can be used for this purpose.

Assembly premises

No special terminals are required for routing the measurement current through the conducting cable. The current is routed directly through the cable via the compacting head at one end and the drawing winch at the other. The lifting platform with the measurement basin is assembled between these two machine components. Of course, one prerequisite must be fulfilled for measurements to proceed correctly: The drawing winch as well as the cable guides and winding units following it must not be electrically linked with the remaining machine components on the side of the compacting head, or the resistance of the electrical link must be high enough to render it insignificant as a shunt to the cable section which is to be measured. In other words, this resistance should be about 1000 times larger than the line resistance between the compacting head and drawing winch.

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