Electrical contacts impact on the DC resistance measurement of metallic conductors: Application on an industrial measurement device

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In most industrial devices used for measuring electrical resistance of conductors, the supplying current is applied using clamping jaws. One of the stumbling blocks of this type of device is the existence of contact phenomenon between wires. Indeed, the contact areas between the components of the conductor present a crucial challenge when measuring conductor's resistance. The electrical characteristics of the contact between wires on the one hand, and the mechanical stresses they face on the other hand, influence the distribution of current paths within the conductor cross section.

It is well known that the contact resistance depends on the shape and dimension of contacts spots and on the magnitude of contact pressure. In this paper we suggest a series of measurements coupled with a wide range of numerical simulations to establish the relationship between the contact resistivity and conductor design parameters, under different conditions, including variable mechanical pressure and contacts shapes. The purpose is finding out how the current passes from one conductor to another. The effect of the intermediate layer in the contact region on the current density distribution has been also examined. It was deduced that an intermediate layer with conductivity lower than copper was present. Through extensive simulations and supporting measurements the effects of various design parameters on the conductor resistance were also established. It was found that the current density is not uniform through the conductor cross-section. The current density distribution is also heavily influenced by the structure of the contact interfaces and the resistance of the transient layers.

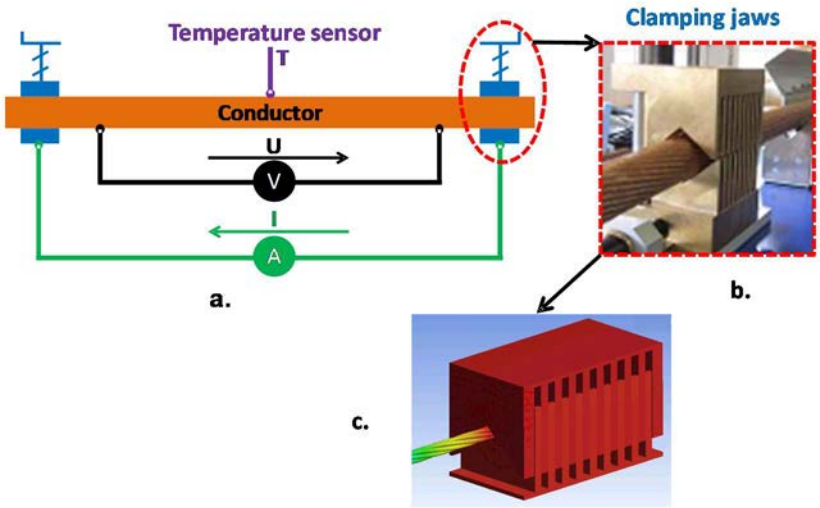

Fig. 1: Industrial conductor resistance testing method (**a**), Current injection system "Clamping jaws" (**b**) and DC finite element model (**c**)

The paper will present a method by which the contact interfaces can be identified and their electrical contact resistance can be precisely measured. The distance from the current entry point (the clamps) to the position where current density may be considered uniform along the conductor will be established (Fig. 1). This will facilitate estimating recommended positions of voltage taps from current taps. Original relationships will be proposed showing the dependency between contact resistance, conductor design parameters and mechanical contact conditions.