THE THERMOELECTRIC METHOD OF TEMPERATURE MEASUREMENT OF THE WELD BEAD

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Abstract: *In this article we present a method of temperature measurement of a weld bead melting bath using laser welding with or without filler material. This method can be used for electric or classic welding, with filler material. According to this method, to measure the temperature of the weld bead, we use electromotive voltage generated by a thermocouple made between the welding base metal and the weld bead. As we describe the method, we also present in detail the phases and the succession of operations to achieve the characteristic of calibration of the thermocouple used to determine the weld bead temperature.*

Keywords: *welding, thermocouples, laser.*

INTRODUCTION

The weld bead temperature, especially in the melting bath zone, can determine after getting cold, the state of the area that was thermically influenced, exercing influence on the mechanical resistance of the area in discussion. The weld bead temperature also influences the oxidation and the segregation of the alloyage elements in the welded alloy. In order to determine the weld bead temperature, we use, at present, optoelectronic pyrometers and thermovision cameras [1], [2], and also other complex methods. Besides the high costs, these measurement methods have low measurement accuracy. At the same time, the classic method of measurement with thermocouple [3], [4], is not possible because of the high temperature that could cause its melting. We hereby present the result of the long researches we have made in order to find a concrete alternative of temperature measurement of the weld bead using laser welding with or without filler material, [5], [6], [7], method that can also be used for electric welding with filler material.

EXPERIMENTAL BASIS

The basis of the measurement method is the use of the total thermoelectric voltage generated by a chain of metals and alloys participating at the welding process. The base metal and the filler metal (in case of welding with filler material)are part of this chain, but also the two points of welding that connect the platinum conductors with the temperature measuring apparatus, *Fig.1*. The two welding points are made: one on the base material and one at the end of the weld bead using a laser with or without filler material. The three zones form a thermocouple measurement system of which thermoelectric voltage, electronic extrapolated on a calibration line, automatically gives the real temperature of the thermal plasma in the welding area.

The mathematical dependance between the thermoelectric voltage and the plasma temperature is expressed by:

$$U = K \cdot T \qquad [mV] \tag{1}$$

where K represents the constant given by the slope line from the linear characteristic area and represents the angle's tangent value α created between the line and the abscissa:

$$K = tg\alpha = \frac{\Delta T}{\Delta U} \quad [^oC/V] \tag{2}$$