TECHNICAL REPORT

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Welding and allied processes — Guidelines for measurement of welding energies

Soudage et techniques connexes — Lignes directrices pour le mesurage des énergies de soudage

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*.

Introduction

Welding “arc energy” or “heat input” are fundamental values used to manage the consistency of weld metal and heat-affected zone properties. ISO 15614 requires the measurement of the welding energies implemented during a welding procedure qualification, but it does not give details about the methods to be used. Likewise, during the construction of a welded assembly, inspectors should make sure that the welding energies comply with the Welding Procedure Specification (WPS). But again, the details of the methods to be used are not specified. As a consequence, there may be a lack of consistency between the methods used to measure the welding energies during welding of the test piece and the methods used during the manufacturing process. This is a potential source of error which could have implications on the safety or quality of a welded component or structure.

Moreover, the latest technological breakthroughs in microprocessors and electrical power manipulation have yielded welding power sources and control systems that are capable of generating complex waveforms. However, these control systems and waveforms increase the difficulties related to voltage and current intensity measurements, as their values are manipulated at frequencies which can reach thousands of Hertz. The measuring instruments generally used by inspectors, such as TRMS clamp meters, can no longer be relied on to correctly measure the welding energy since differences exceeding 30 % with respect to the true energy can sometimes be found.

This Technical Report provides guidance on how to accurately measure welding energy and calculate heat input, both in the case of traditional welding systems and those that employ complex waveforms.

Welding and allied processes — Guidelines for measurement of welding energies

1 Scope

This Technical Report presents the guidelines for measuring the parameters needed to calculate arc energies for arc welding processes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 17662, *Welding — Calibration, verification and validation of equipment used for welding, including ancillary activities*

ISO/TR 17671 (all parts), *Welding — Recommendations for welding of metallic materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15607 and ISO/TR 17671 (all parts) and the following apply.

3.1
arc energy
E
product of welding voltage and current divided by travel speed of welding

Note 1 to entry: The often-used term "heat input" is more correctly the arc energy modified by an arc efficiency factor.

3.2
waveform controlled welding
welding process modification of the voltage and/or current wave shape to control characteristics such as droplet shape, penetration, wetting, bead shape, or transfer mode(s)

3.3
instantaneous energy
IE
welding energy determined by summing the product of current and voltage measurements made at rapid intervals which capture brief changes in the welding waveform

3.4
instantaneous power
IP
welding power determined by averaging the product of current and voltage measurements made over time at rapid intervals which capture brief changes in the welding waveform

3.5
run out length
length of a run produced by the melting of a covered electrode

[SOURCE: ISO/TR 17671-2:2002, 3.2]