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Welding and allied processes — Guidelines for the use of the welding parameters related to the welding energy for qualification and specification of welding procedures

DIS stage – Draft

Soudage et techniques connexes - Lignes directrices pour l'utilisation des paramètres de soudage liés à l'apport de chaleur pour la qualification et le descriptif d'un mode opératoire de soudage

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Foreword

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.htmlwww.iso.org/members.html.

Welding and allied processes – Guidelines for the use of the welding parameters related to the ~~arc~~welding energy for qualification and specification of welding procedures

1 Scope

This document ~~presents the~~gives guidelines for reporting the welding parameters related to the arc energy of a welding procedure qualification record (WPQR) and transferring this data to a welding procedure specification (WPS) for production welding for all arc welding processes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO ~~17662~~13916, *Welding — ~~Calibration, verification~~Measurement of preheating temperature, interpass temperature and ~~validation of equipment used for welding, including ancillary activities~~preheat maintenance temperature*

ISO/TS 18491, *Welding and allied processes — Guidelines for measurement of arc energies*

ISO/TR 25901-1, *Welding and allied processes — Vocabulary — Part 1: General terms*

ISO/TR 25901-3, *Welding and allied processes — Vocabulary — Part 3: Welding processes*

ISO/TR 25901-4, *Welding and allied processes — Vocabulary — Part 4: Arc welding*

IEC 60974-14, *Arc welding equipment — Part 14: Calibration, validation and consistency testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 18491, ISO/TR 25901-1, ISO/TR 25901-3, ISO/TR 25901-4 and the following apply.

ISO and IEC maintain ~~terminological~~terminology databases for use in standardization at the following addresses:

— ~~—~~ISO Online browsing platform: available at ~~https://www.iso.org/obp~~https://www.iso.org/obp

— ~~—~~IEC Electropedia: available at ~~http://www.electropedia.org/~~https://www.electropedia.org/

3.1 ~~3.1~~

documentation value

arithmetic mean value over the main process phase

4 Symbols and abbreviated terms

For the purposes of this document, the general symbols and abbreviations given in ~~Table 1 shall~~Table 1 apply.

Table 1 — Symbols and abbreviated terms

Abbreviations and symbols	Term	Unit
E	Arc energy of a run	kJ/mm
E_{low}	Lowest arc energy in WPQR	kJ/mm
E_{high}	Highest arc energy in WPQR	kJ/mm
E_{avg}	Average arc energy of a run for a weld area	kJ/mm
E_{min}	Minimum qualified arc energy	kJ/mm
E_{max}	Maximum qualified arc energy	kJ/mm
I_{avg}	Average arc welding current of a run	A
I_{min}	Minimum welding current limit in a WPS	A
I_{max}	Maximum welding current limit in a WPS	A
U_{avg}	Average arc voltage of a run	V
U_{min}	Minimum arc voltage limit in a WPS	V
U_{max}	Maximum arc voltage limit in a WPS	V
ΔU	Practical arc voltage range - process dependent	V
V_{avg}	Average welding speed of a run	mm/s
V_{min}	Minimum welding speed of a run	mm/s
V_{max}	Maximum welding speed of a run	mm/s
W	Width of run	mm

5 General

The ~~standards under~~specifications given in ISO 15607 reflect minimum requirements for the use of the arc energies, but it is possible that these requirements ~~may~~are not ~~be~~ suitable under all conditions.

Not all materials are sensitive to a large variation in heat input under normal service conditions. It is therefore not realistic to prescribe a strict regime of maintaining the heat input for these materials.

In certain situations, for example, when the mechanical or corrosion properties of base materials and the weld metal can be strongly degraded by the use of the wide range of arc energy rules as given in ISO 15607, it can be appropriate to implement additional provisions that may lead to restrictions.

This is only possible if the WPQR contains sufficiently detailed information, as specified in this document.

Other documents may set rules for welding procedure qualification, while this technical specification gives guidance on how this can be carried out.

6 Risk levels

The risk levels indicate how the arc energy shall be handled in order to guarantee the mechanical and/or corrosion properties as much as possible.

Especially when there are hardness requirements or notch toughness requirements it is wise to choose the right risk level according to ~~Table 2.~~Table 2.

The risk level should be agreed in advance in an application standard, contract or specification.

If no risk level is specified, then the high-risk level is applicable.

Table 2 — Description of risk levels

Risk level	Description of risk level
Low[a]	The material properties needed by the application standard, contract or specification are not affected or slightly affected by the heat input.
Medium[b]	The material properties needed by the application standard contract or specification are affected by the heat input.
High[c]	The material properties needed by the application standard contract or specification are significantly affected by the heat input.

a Example: Group 1.1 steel with low material thickness
b Example: Group 1.2 steel with high material thickness when there is a risk of excessive hardness
c Example: Group 10 steel when high resistance to corrosion is needed

7 Measuring welding parameters during WPQR welding

7.1 Calibration, validation of measurement of the measuring equipment

All measuring devices shall be calibrated or validated to recognized international or national standards e.g. ISO 17662, IEC 60974-14.

7.2 Determination of runs to be measured

It ~~may~~can happen that there are extreme large differences in the highest and lowest arc energy measured in a WPQR, these values ±25 % then become the range for the WPS. ~~This may~~It is possible that this is not ~~be~~ acceptable for some applications as ~~that may~~it does not guarantee the mechanical and corrosion properties in production.

Each run shall be measured separately.

7.3 Length of ~~the~~ run in pipe and plate

The length of the run is defined in the ISO/TS 18491. The differences in combination of the wall thickness and diameter can lead to large differences in the arc energy used for root run, filling run and capping run.

The length of the runs shall be calculated separately for each weld layer.

7.4 Weaving width in relation with arc energy

~~**7.4.1 Weaving width in relation with arc energy**~~

When a test piece is welded using weaving and the run exceed 25 mm wide (w, see ~~Figure 1~~Figure 1 and ~~Figure 2),~~Figure 2), the qualified heat input shall be determined as follows~~:~~.

a) When using a heat input formula, by using the linear travel speed of the electrode as it moves transversely along the weld path as the welding speed.

b) When using run length or deposit length-per-unit-length of electrode, by using the approximate average width of the run multiplied by two times the number of weaving frequency per unit length of the run as the deposit length.

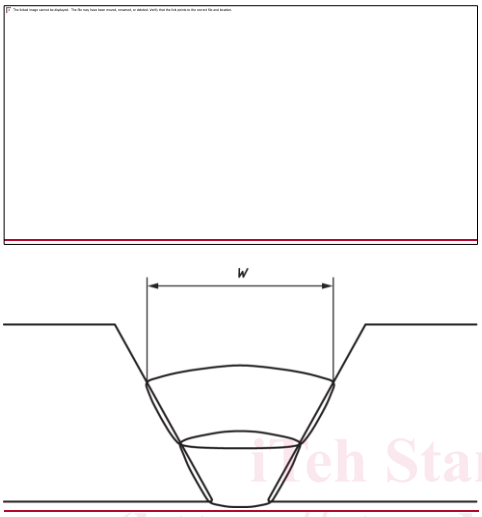

Figure 1 — Width of the run for butt joints