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Resistance welding — Weldability —

Part 2: Alternative procedures for the assessment of sheet steels for spot welding

Soudage par résistance — Soudabilité —

Partie 2: Méthodes alternatives d'évaluation des tôles d'acier pour le soudage par points

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18278-2 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 18278 consists of the following parts, under the general title *Resistance welding — Weldability*:

— *Part 1: Assessment of weldability for resistance spot, seam and projection welding of metallic materials*

— *Part 2: Alternative procedures for the assessment of sheet steels for spot welding*

Contents

Foreword

This document (EN ISO 18278-2:2004) has been prepared by Technical Committee CEN/TC 121 “Welding”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 44 “Welding and allied processes”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

This standard consists of the following parts:

— Part 1: Assessment of weldability for resistance spot, seam and projection welding of metallic materials;

— Part 2: Alternative procedures for the assessment of sheet steels for spot welding.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This document describes alternative procedures for assessing the weldability of sheet steels by determining the welding range and electrode life for resistance spot welding.

It supplements generic standards for the assessment of the weldability lobe (EN ISO 14327) and electrode life at constant machine settings (EN ISO 8166). These procedures can be used to evaluate the following:

a) the effect of electrode material, shape, dimensions and electrode cooling when welding a particular material;

b) the effect of material type and thickness being welded;

c) the effect of welding conditions;

d) the effect of welding equipment type.

1 Scope

This document specifies a laboratory test procedure for the determination of the acceptable welding current range and the assessment of electrode life using a multi-spot test with specific conditions.

This document is applicable for the assessment of the weldability of uncoated and coated sheet steels of thicknesses up to 3 mm.

The test procedure specified in this document and the results obtained, apply only for the introduction of a new type or batch of material.

Procedures for determining the generic weldability lobe at a constant weld time or electrode force are given in EN ISO 14327.

The electrode life at constant machine settings is given in EN ISO 8166.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 22768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (ISO 2768-1:1989).*

EN 22768-2, *General tolerances — Part 2: Geometrical tolerances for features without individual tolerance indications (ISO 2768-2:1989).*

EN 25821, *Resistance spot welding electrode caps (ISO 5821:1979).*

EN ISO 5183-1, *Resistance welding equipment — Electrode adaptors, male taper 1:10 — Part 1: Conical fixing, taper 1:10 (ISO 5183-1:1998).*

EN ISO 6520-2, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 2: Welding with pressure (ISO 6520-2:2001).*

EN ISO 8166, *Resistance welding — Procedure for the evaluation of the life of spot welding electrodes using constant machines settings (ISO 8166:2003).*

EN ISO 14272, *Specimen dimensions and procedure for cross tension testing resistance spot and embossed projection welds (ISO 14272:2000).*

EN ISO 14327, *Resistance welding — Procedures for determining the weldability lobe for resistance spot, projection and seam welding (ISO 14327:2004).*

EN ISO 14329:2003, *Resistance welding — Destructive tests of welds — Failure types and geometric measurements for resistance spot, seam and projection welds (ISO 14329:2003).*

EN ISO 18278-1:2004, *Resistance welding — Weldability — Part 1: Assessment of weldability for resistance spot, seam and projection welding of metallic materials (ISO 18278-1:2004).*

ISO 669:2000, *Resistance welding — Resistance welding equipment — Mechanical and electrical requirements.*

ISO 5182, *Welding — Materials for resistance welding electrodes and ancillary equipment.*

ISO 10447, *Welding — Peel and chisel testing of resistance spot, projection and seam welds.*

ISO/DIS 14373, *Resistance welding — Procedure for spot welding of uncoated and coated low carbon steels.*

ISO/DIS 17657-1, *Resistance welding — Welding current measurement for resistance welding — Part 1: Guideline for measurement.*

ISO/DIS 17657-2, *Resistance welding — Welding current measurement for resistance welding — Part 2: Welding current meter with current sensing coil.*

ISO/DIS 17657-3, *Resistance welding — Welding current measurement for resistance welding — Part 3: Current sensing coil.*

ISO/DIS 17657-4, *Resistance welding — Welding current measurement for resistance welding — Part 4: Calibration system.*

ISO/DIS 17657-5, *Resistance welding — Welding current measurement for resistance welding — Part 5: Verification of welding current measuring system.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 669:2000, EN ISO 14329:2003 and EN ISO 18278-1:2004 and the following apply.

3.1
acceptable welding current range
range of R.M.S. values of welding current between lower and upper limits which allows an acceptable weld diameter

3.2
R.M.S. value
R.M.S. value of an alternating voltage is the square root of the mean value of the square of the voltage values during a complete cycle

4 Purpose

This procedure allows the determination of the lower and upper limits of the welding current under specific welding configuration in order to assess the life of the electrode for a given welding current chosen within the acceptable welding current range, without any redressing of the electrode tips.

NOTE If automatic redressing or current stepping procedures are used, it is necessary to use a modified test and procedure.

5 Welding equipment

5.1 General

Welding equipment shall be capable of delivering the required welding conditions to carry out the tests as defined below.

5.2 Electrodes

The electrodes shall be of type A 2/3 material as defined in ISO 5182 unless otherwise specified.

The electrode configuration for these tests shall conform to:

— cap electrodes to be used;

— EN 25821 - G 16 × 20 - (d_1 = 16 mm - l_1 = 20 mm) for sheets with a thickness < 1,3 mm;

— EN 25821 - G 20 × 22 - (d_1 = 20 mm - l_1 = 22 mm) for sheets with a thickness ≥ 1,3 mm.

The geometry shall be checked prior to commencing the test to ensure that tolerances are within ± 0,1 mm of the range permitted for grade F of EN 22768-1 or EN 22768-2.

A typical gauge for checking electrode geometry is described in Annex A.

The adapter used shall have a cooling bore complying with:

— EN ISO 5183-1 - B 16 x 71 - A 2/3, or

— EN ISO 5183-1 - B 16 x 88 - A 2/3.

5.3 Welding current

Unless otherwise specified, welding current should be single phase AC, its R.M.S. value shall be set and recorded.

The equipment shall be set so that R.M.S. welding current is not less than 70 % of R.M.S. value at full conduction angle.

5.4 Mechanical system

The electrode force applied by the electrode head assembly shall be chosen to minimize the impact effect of the electrode meeting the sheet. For example, an electrode approach rate of 0,15 m/s is recommended. The electrode approach rate measurements shall conform to ISO 669:2000, Annex A.

5.5 Parameter measurement

5.5.1 Welding current

In order to ensure optimum reproducibility and allow comparison of the results obtained from the various tests previously carried out, the welding current shall be measured with a current measuring system which is regularly calibrated in accordance with procedures outlined in ISO/DIS 17657-1 to ISO/DIS 17657-5. The R.M.S. current value shall be measured over the entire effective welding time as defined in ISO/DIS 17657-1.

The shape of the welding current waveform shall be checked using a suitable device to determine the regularity of welding current peak values and conformity of the actual welding cycle with the programmed cycle.

5.5.2 Welding force

The welding force shall expressed in kN with an accuracy of ± 3 % measured during the setup.

5.5.3 Electrode approach rate

The electrode approach rate on the sheet shall be measured with an accuracy better than 0,02 m/s.

5.5.4 Detection of splash

Occurrence of splashed spot welds shall be determined/confirmed from visible examination or from the electrode displacement curve or the welding force, welding voltage or welding current signal. A splashed spot weld is characterized by a very sharp deviation in the trace of an electrode displacement or welding force signal.

5.5.5 Electrode flow rate cooling water

The electrode cooling water flow rate shall be measured as specified in EN ISO 8166.

5.5.6 Weld diameter measurement

After the destructive test, the maximum and minimum dimensions of the weld diameter shall be measured with a calliper gauge, according to ISO 10447 and EN ISO 14329. The weld diameter value shall be rounded to 1/10 mm.

6 Range of qualification

The range of qualification given in Table 1 shall apply unless otherwise specified.

Table 1 — Range of qualification

Thickness of the test specimen	Sheet thicknesses
0,8 mm	< 1,3 mm
2,0 mm	≥ 1,3 mm

7 Test specimen characteristics

7.1 Materials

Material conditions and properties shall be as defined the specific conditions or on the test order form.

7.2 Assemblies

Assemblies for testing shall be as defined on the test order form.

Configuration shall be representative of the component to be welded.

8 Preliminary adjustments

8.1 Electrode position check under electrode force used for the test

Only the adapters (see EN ISO 5183-1) shall be aligned. To do this, specific caps shall be used (see Figure B.1). Both axial and angular alignments shall be checked, this can be done using the carbon imprint method where a sheet of paper is sandwiched between two carbon papers inserted between the two caps then applying the electrode force.

The tolerance for linear alignment shall be ± 0,5 mm. Angular misalignment shall not exceed 5 rad.

Examples of carbon imprints obtained on the paper sheet after application of pressure are shown in Figure B.2.

8.2 Electrode conditioning

Before each test, the electrodes shall be conditioned using the following parameters:

— for welding sheet thicknesses < 1,3 mm conditions A apply;

— for welding sheet thicknesses ≥ 1,3 mm conditions B apply.