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Resistance welding — Procedure for seam welding of uncoated and coated low carbon steels

Soudage par résistance — Mode opératoire pour le soudage à la molette des aciers à bas carbone revêtus et non revêtus

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 16433 was prepared by the International Institute of Welding, recognized as an international standardizing body in the field of welding in accordance with Council Resolution.

Introduction

Requests for official interpretations of provisions in this standard should be made in writing and sent to the ISO Central Secretariat who will forward them to the IIW Secretariat for an official response.

Resistance welding — Procedure for seam welding of uncoated and coated low carbon steels

1 Scope

This International Standard specifies requirements for resistance seam welding in the fabrication of assemblies of uncoated and metallic coated low carbon steel comprising two sheets of metal, where the maximum single sheet thickness of components to be welded is within the range 0,4 mm to 3 mm for the following materials:

— uncoated steels;

— hot-dip zinc or iron-zinc alloy (galvannealed) coated steel;

— electrolytic zinc, zinc-iron, or zinc-nickel coated steel;

— aluminium coated steel;

— zinc-aluminium coated steel.

Organic-coated or primer-coated steels are not covered by this International Standard. Guidelines for the design of appropriate seam welding equipment and welding conditions are given in Annexes A and B. These are for guidance only and may need to be adapted to suit the specified service conditions of the fabrication, prevailing production conditions, type of welding equipment, mechanical and electrical characteristics of the welding machine, electrode configuration, and material. These requirements shall be taken from the relevant welding procedure specification for the application or procedure, where these exist.

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.

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

ISO 5182:1991, *Welding — Materials for resistance welding electrodes and ancillary equipment*

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

ISO 14270, *Specimen dimensions and procedure for mechanized peel testing resistance spot, seam and embossed projection welds*

ISO 14327, *Resistance welding — Procedures for determining the weldability lobe for resistance spot, projection and seam welding*

ISO 14329, *Resistance welding — Destructive tests of welds — Failure types and geometric measurements for resistance spot, seam and projection welds*

ISO 15609-5, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding*

ISO 15614-12, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 12: Spot, seam and projection welding*

ISO 17654, *Destructive tests on welds in metallic materials — Resistant welding — Pressure test on resistance seam welds*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 669 and ISO 14329 and the following apply.

3.1
continuous-current seam welding
use of a continuous-current waveform to make a weld

NOTE A continuous weld nugget is formed along the weld seam.

3.2
interrupted-current seam welding
use of a current program comprising two or more pulses of current (commonly known as “on-time”) separated by a pre-set cool time (commonly known as “off-time”)

NOTE A weld nugget is produced during each pulse.

3.3
tread width
width of the electrode face which is in contact with the work piece

NOTE Sometimes this is called electrode face width.

4 Materials

4.1 Form

The steel shall be flat rolled, in coils or cut to length, and shall be free of all harmful imperfections.

4.2 Steel grades

A partial list of steel grades to which this International Standard is applicable is given in Annex C.

4.3 Surface conditions

Prior to welding, all surfaces of components to be seam welded shall be free of contaminants such as grease, scale, corrosion products, paint, dirt or excessive pitting. This condition shall be maintained until the welding process is completed. Uncoated hot-rolled steel shall be in the pickled condition.

Certain surface treatments, such as the application of paint primers, rust preventions, and oils may be applied before welding, provided that the coating is uniform in thickness and it has been demonstrated that consistent welds, conforming to this International Standard, can be obtained. Excessive use of surface pre-treatments may adversely affect electrode life and should therefore be avoided.

Coated steels can be supplied with a chromate or phosphate passivation treatment. Phosphated mild steel may be used in certain applications. These materials can be resistance seam welded, although the welding parameters outlined in Annex B may require appropriate adjustment. Generally, only thin phosphate pre-treatment of steel is acceptable prior to seam welding.

5 Component design and manufacture

5.1 Component design

Components shall be designed and manufactured to provide adequate flange widths, free from potentially harmful physical deformations and internal stresses, and which can accommodate the weld seam. The flange width should also provide proper access for the electrodes and any necessary tooling. Account shall be taken of the degree of mechanization for guiding the components along the weld path/track during the welding process. The procedure shall include provision for reviewing the design as a result of tests, whether compliance with this International Standard is achievable or not.

The design of the assembly to be seam welded shall take into account the process requirements specified in Clause 6, and the process variation appropriate to the application. The shape of both components shall be such that there is proper contact over the entire weld path.

The weld size (seam width) and the distance (edge distance) from the centre of the weld to the nearest edge of the components shall comply with the process requirements given in Clause 6.

NOTE Reducing the edge distance below the recommended values can affect weld quality and reduce the operating tolerances. In this case, the nominal weld size may need to be specified below the value given in 9.2.1, and allowance for a lower weld strength made in the design.

The pitch between two parallel seam welds, i.e., the centre-to-centre distance of the seam welds, shall not be less than 16 × sheet thickness (t) and preferably larger. When seam welding sheets up to, and including, t = 1,5 mm, the inter-weld pitch shall therefore approximate to 3 W_e (W_e = tread width). To stabilize any shunting effects, this pitch shall be maintained within $t \pm 10$ % over the entire length of the joint.

In cases where smaller weld pitches are necessary, the weld current in subsequent seam welds should be increased to compensate for the shunting effect.

5.2 Component manufacture

The components to be welded shall be free from distortions, burrs, wrinkles, internal stresses and other defects, which would in any way interfere with proper physical and electrical contact at the electrode or component interfaces during the welding process.

6 Process requirements

6.1 Seam welding with wide wheels

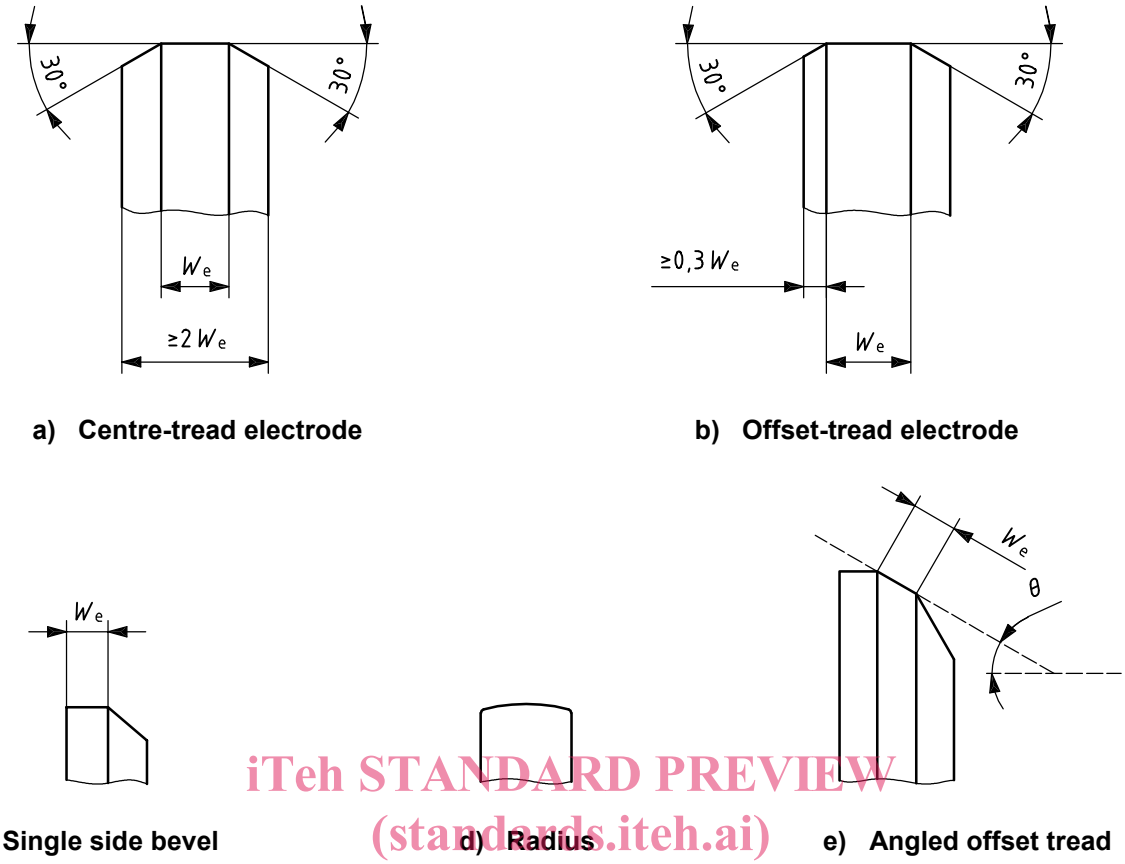
If "W_e" is the electrode-wheel tread width (see Figure 1), the centre of the electrode-wheel tread shall not be placed less than 1,25 W_e from the nearest edge of the component.

6.2 Seam welding with thin wheels

The centre of the electrode-wheel tread shall be placed such that the distance between the centre of the weld and the nearest edge of the component shall be not less than $5\sqrt{t}$, where t = sheet thickness, in mm.

The electrode force shall always be applied normal to the component surface with both wheels running on parallel axes.

NOTE Toe-in may be applied as necessary.



a) Centre-tread electrode

b) Offset-tread electrode

c) Single side bevel

d) Radius

e) Angled offset tread

Figure 1 — Typical electrode shapes

6.3 Mash seam welding

Depending upon the application and the thickness required at the joint, the selected width of the overlap shall be between t and $3t$ of the sheet being welded, and this shall be maintained over the entire length of the joint to within ± 10 % or ± 0,05 mm, whichever is the greater. Large overlaps may result in a partial mash.

6.4 Wire seam welding

The contour of the wire and the electrodes shall be that specified by the machine supplier for the application.

6.5 Wire electrode seam welding

Depending upon the application, the edge distance, or overlap, shall comply with the specification issued by the machine supplier.

6.6 Foil seam welding

The edge condition and the foil used shall be that specified by the machine supplier for the application.

7 Welding equipment

7.1 Welding machine

When specifying the process details for an application, the type of machine (e.g., portable, manual/mechanized, pedestal, automated), its power source (e.g., dc, ac standard, or elevated frequency) and cooling requirements shall be stated and a specific machine/controls/ancillary equipment/tooling to be used for this application shall be identified. It is recommended that, if possible, the secondary current be prevented from passing through the bearings supporting the electrode wheels and transmitting the electrode force in the specified machine.

Machine/controls serial or plant numbers, electrode/tooling drawing, as well as settings and services requirements should be recorded in the Welding Procedure Specification (WPS) (see ISO 15609-5).

7.2 Electrodes (wheels, mandrels, pads, backing bars)

Seam welding electrodes may be driven using different systems. The most popular systems are described in ISO 669.

7.2.1 Electrode materials

Electrode wheels, mandrels, and backing bars shall be made of suitable copper alloys with high thermal and electrical conductivity, and be provided with an adequate cooling system, and shall comply with, and be used in accordance with, the relevant requirements of ISO 5182.

7.2.2 Electrode dimensions

The welding electrodes shall be of sufficient cross-sectional area and strength to carry the welding current and support the electrode force without overheating, deformation, or excessive deflection under the specified production conditions.

7.2.2.1 Seam welding with wide wheels

Typical wheel-tread geometries are of the form shown in Figure 1. Where two wheels are used, the tread width, W_e, of both, or of the small tread width side shall approximate to the following formula:

$$W_e = 5\sqrt{t} \tag{1}$$

where

W_e is the tread width, expressed in millimetres (mm);

t is the thickness of the sheet in contact with the wheel, expressed in millimetres (mm).

If one wheel is used in association with a mandrel, pad or backing bar, the tread width of the wheel shall also approximate to formula (1).

The thickness of the wheel shall not be less than twice the tread width, i.e., > 2 W_e [see Figure 1a)].

In general, the tread of the electrode wheels shall be normal to the electrode force transmitted to the components during welding but, where access is restricted, inclined electrode wheels (see Figure 2) may be employed, provided the specified weld strength can be demonstrated. Unless precluded by the shape of the component, both the drive shafts should have the same inclination to the surface of the weld and the combined convergence shall not exceed 30° (see Figure 2), if electrode wear as a consequence of wheel misalignment is to be minimized. The welded assembly shall conform to the relevant drawings and, unless otherwise specified, a sheet separation gap shall be tolerated, provided the test requirements of 9.2 are met.