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Resistance welding — Procedure for projection welding of uncoated and coated low carbon steels using embossed projection(s)

Soudage par résistance — Procédure pour le soudage par bossage(s) embouti(s) 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 16432 was prepared by the International Institute of Welding, recognized as an international standardizing body in the field of welding in accordance with Council Resolution 42/1999.

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 projection welding of uncoated and coated low carbon steels using embossed projection(s)

1 Scope

This International Standard specifies requirements for embossed-resistance-projection welding in the fabrication of assemblies of uncoated and metallic coated low carbon steel comprising two thicknesses 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 appropriate welding equipment and projection welding conditions for various coated steels are given in Annexes A to C. 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 8167, *Projections for resistance welding*

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 14272, *Specimen dimensions and procedure for cross tension testing resistance spot and embossed projection welds*

ISO 14273, *Specimen dimensions and procedure for shear testing resistance spot, seam and embossed projection welds*

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*

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
edge distance
minimum distance from the nearest edge of the component to the centre of the weld

3.2
embossed projection
projection in a sheet used for welding and produced by mechanical force using a punch to displace a predetermined amount of material into a cavity

NOTE See ISO 8167 for use on different sheet thicknesses.

3.3
projection base diameter
diameter of an embossed projection measured at the original surface of the stamped sheet

NOTE See ISO 8167.

3.4
weld pitch
distance between centres of adjacent projections

4 Symbols

Symbol	Term	Unit
d	weld diameter	mm
d_b	nominal-projection base diameter	mm
P_s	shear strength of weld	kN
R_m	ultimate tensile strength of steel	MPa
t	sheet thickness	mm

5 Materials

5.1 Form

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

5.2 Steel grades

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

5.3 Surface conditions

Prior to welding, all surfaces of components to be projection 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 projection welded, although the welding parameters outlined in Annex B may require appropriate adjustment. Generally, more care needs to be taken in selecting welding conditions, particularly with multiple projections. Materials with thicker coatings are more difficult to weld.

6 Component design and manufacture

6.1 Component design

6.1.1 General

The components/joints shall be designed and manufactured to provide adequate matching flange conditions, free from potentially harmful physical deformations to accommodate the projections used in the welding process. The design shall allow unimpeded collapse of the projections during welding, and provide proper access for the electrodes and any necessary tooling. The procedure shall include provision for reviewing the design as a result of tests, to ensure that compliance with this International Standard is achieved. Single or multiple projection arrays may be specified, provided the appropriate welding practices can be maintained.

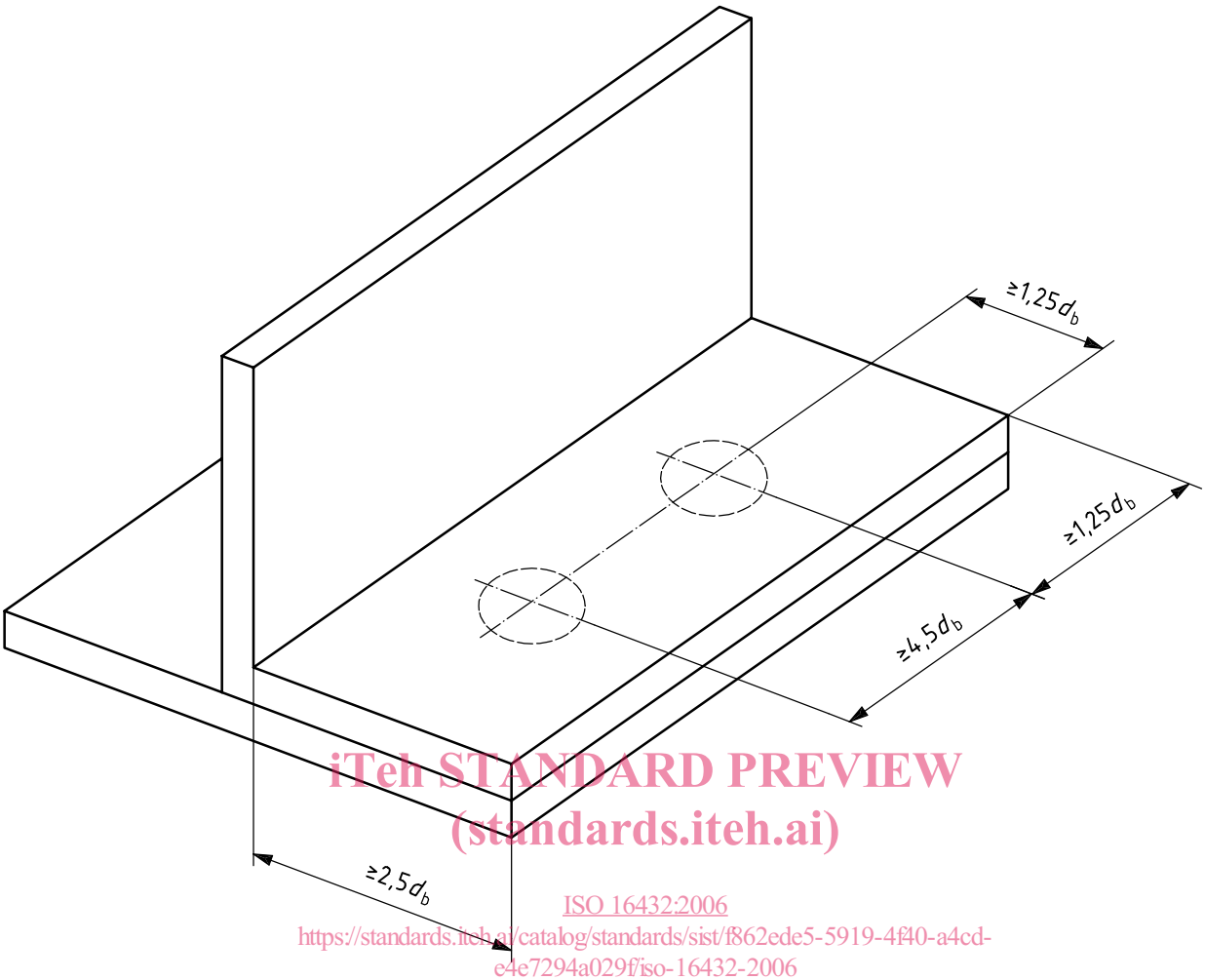
The design of the assembly to be projection welded shall take into account the process requirements specified in Clause 7. The shape of both components shall be such that there is proper contact between the projections and the surface to be welded, to allow unimpeded collapse in response to the welding process.

6.1.2 Placement of projections

The placement of embossed projections from the edge of a component is a function of the projection base diameter (d_b), and hence the sheet thickness (t). The edge distance shall not be less than 1,25 d_b as shown in Figure 1.

It should be noted that short edge distances may adversely affect weld quality. In this case, the nominal weld size may need to be specified below the value given in 8.2.1 and allowance for a lower weld strength shall be made in the design (see 8.2.3).

The weld pitch (see Figure 1), shall not be less than 4,5 d_b, and preferably larger. To avoid imbalance of weld sizes in a multiple array, large pitch variations shall be avoided. The linear pitch should be maintained within ± 10 %, provided the interweld distance does not fall below the specified minimum value.



Key

d_b Nominal-projection base diameter

Figure 1 — Recommended edge conditions and weld pitch

6.2 Projection dimensions

6.2.1 General

Round embossed projections shall be in accordance with ISO 8167. Where a number of projection welds (an array) are welded in one operation, the height of each individual projection of this group on the component shall not vary by more than ± 5 % and the spacing should provide for an even current distribution for the whole group or array.

Elongated projections may replace standard round projections. In this case, the minor axis shall be equal to the diameter of the round projection specified for the sheet thickness specified in ISO 8167. The size and shape of the projection shall be designed to give the required weld area or strength.

The projection strength should be capable of supporting the applied load without excessive cold collapse; i.e. the maximum permissible reduction in projection height shall not exceed 20 %.

6.2.2 Dissimilar sheet thickness

When welding sheets of dissimilar thickness, the dimensions of the projections shall be specified for the thinner of the two sheets. The projection(s) should be made in the thicker sheet.

6.2.3 Multi-weld arrays

In applications where more than one projection weld is used to join two sheet metal components in one plane, all components shall be welded simultaneously to avoid mechanical constraints that can occur if each weld is made sequentially. Sequentially produced projection welds between two components are not covered by this International Standard. Exceptions to this rule may only be made if the geometry of the components dictates this need, or the projections are not in the same plane. In all cases, the resulting arrays shall meet the other requirements of this International Standard .

The design criteria governing size, pitch and edge distances are given in 6.1.2 and 7.3.1.

6.3 Ancillary manufacturing considerations

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

7 Welding equipment

7.1 Welding machine

A machine of suitable electrical and mechanical performance for single- or multiple-projection welding should be specified in the welding procedure specification (WPS) (see ISO 15609-5). This should take into account the application requirements, such as electrode force application, pressure or current programs, current distribution over the effective welding area (platen), thermal duty cycle of machine and any necessary tooling (see 7.3.4 and 7.3.5), etc.

The welding procedure specification should specify the serial or plant numbers of the machine and its control time/programmer, the services required and all fixed settings and feedback control parameters for each application.

7.2 Electrode assembly (tooling)

The electrode holders and conductors shall be made with sufficient strength, section, conductivity, and rigidity to carry the welding current and support the electrode force without overheating or deforming.

The only part in contact with the work piece forming the weld circuit shall be either the electrode(s) or the insert(s) as recommended in ISO 5182:1991, Annex A.

7.3 Design of electrode assembly

7.3.1 Contact face

The shape of the surface of the electrode, or its insert, shall be such that intimate physical and electrical contact is ensured over the entire effective welding area on both sides of the components being assembled.

When using circular electrodes, with or without inserts, to produce welds using standard projections, their face diameter shall not be less than 3 d_b. The distance between the centre of the projection and the edge of the contact face (of the electrode) shall not be less than 1,25 d_b (where possible, it should be considerably greater). In addition, where rectangular electrode faces are used with either round or elongated projections, the distance between the edge of the electrode face and the projection shall not be closer than 1,25 d_b.

7.3.2 Electrode inserts

When inserts are used, there shall be adequate mechanical support to withstand the applied electrode force. Electrical and thermal conduction shall be ensured throughout their working life, minimizing contact