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I.S. EN ISO 18592:2009

Resistance welding - Destructive testing of welds - Method for the fatigue testing of multi-spot-welded specimens (ISO 18592:2009

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English Version

Resistance welding - Destructive testing of welds - Method for the fatigue testing of multi-spot-welded specimens (ISO 18592:2009)

Soudage par résistance - Essais destructifs des soudures - Méthode d'essai de fatigue des échantillons soudés par points multiples (ISO 18592:2009)

Widerstandsschweißen - Zerstörende Prüfung von Schweißverbindungen - Verfahren zur Schwingfestigkeitsprüfung von geschweißten Mehrpunktproben (ISO 18592:2009)

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Foreword

This document (EN ISO 18592:2009) has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" in collaboration with Technical Committee CEN/TC 121 “Welding”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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The text of ISO 18592:2009 has been approved by CEN as a EN ISO 18592:2009 without any modification.

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INTERNATIONAL STANDARD

ISO 18592

First edition
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Resistance welding — Destructive testing of welds — Method for the fatigue testing of multi-spot-welded specimens

Soudage par résistance — Essais destructifs des soudures — Méthode d'essai de fatigue des échantillons soudés par points multiples

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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.

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ISO 18592 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding and allied mechanical joining*.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 6 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Introduction

This International Standard has been prepared because welding engineers (and most design engineers) are not familiar with fatigue testing and the influence of factors such as load type (e.g. shear load, peel load), and failure criteria.

Tests are used to investigate the existence of specific properties and their qualitative and quantitative evaluation. Fatigue tests, in general, are used to investigate the behaviour of structures and components subjected to cyclic loads. For welded components, fatigue tests are used to determine the influence of different parameters such as joining methods, pitch, material thickness and material combinations type of load (e.g. shear load, peel load), overlap, location of weld on flange, edge distance, loading condition (e.g. quasi-static, cyclic, load ratio R), and the combination of environment and corrosion on the fatigue behaviour (life) of spot welds and/or specimens subjected to various types of loads. Fatigue tests should, if their results are to be used for design purposes, as far as possible, take into consideration such boundary conditions as encountered in a real life environment. This applies to load types, load amplitudes, and load ratios as well as load distributions and failure criteria (Reference [7]).

The test specimen selected for the fatigue test should simulate, as closely as possible, the loads and the boundary conditions as they are encountered in service. Furthermore, the failure criterion used should conform to the application in hand. Although the type of primary load is identical in some specimens, e.g. shear load in flat multi-spot specimens, shear H-specimens, KS-2 specimens, and double disc specimens, the results of fatigue tests differ significantly because of the secondary load types resulting from varying degrees of local deformation due to the differences in the local stiffness in the area of the joints. The local deformation, responsible for the magnitude of the peel component, for example, is a function of the local stiffness, increasing with a decrease in stiffness.

This International Standard offers a framework within which the different specimens, described herein, can be modified such that design specifics and production constraints, e.g. flange width and overlap, weld nugget size, pitch, bending radius, and sub-standard welds, can be given due consideration. This helps towards enhancing the significance of the results very appreciably.

Note that if welds could be subjected to identical amplitudes of shear and peel loads, their lives would differ by a factor of approximately 10^4 (References [8] to [11]). This explains the necessity to use different specimens for the simulation of different load types.

Conformance tests on *real* components serve the verification of design calculations and are necessary for the qualification of structures. It is therefore necessary to maintain their number at an absolute minimum.

Resistance welding — Destructive testing of welds — Method for the fatigue testing of multi-spot-welded specimens

1 Scope

This International Standard specifies test specimens and procedures for performing constant load amplitude fatigue tests on multi-spot-welded and multi-axial specimens in the thickness range from 0,5 mm to 5 mm at room temperature and a relative humidity of max. 80 %. The applicability of this International Standard to larger thicknesses can be limited by mechanical properties such as yield strength and formability of the specimen material. The thickness range for advanced high strength steels (AHSS) is generally below 3,0 mm. Greater thicknesses apply for aluminium alloys, for example.

Depending on the specimen used, it is possible from the results to evaluate the fatigue behaviour of:

a) spot welds subjected to defined uniform load distribution;

b) spot welds subjected to defined non-uniform load distribution;

c) spot welds subjected to different defined combinations of shear-, peel-and normal-tension loads; and

d) the tested specimen.

Multi-spot specimens with which the different load distributions can be realized are:

1) defined uniform load distribution:

i) H-specimens for shear- and peel-loading, (welds subjected to uniform shear or peel loading transverse to the joint line),

ii) single- and double-hat specimens subjected to four-point bending (spot welds subjected to uniform shear load in the direction of the row of welds),

iii) double-disc specimen under torsion (spot welds subjected to uniform shear load),

iv) double-disc specimen under tensile load (spot welds subjected to uniform peel load),

v) double-disc specimen under combined torsion and tensile loading,

vi) flat multi-spot specimens using defined grips;

2) defined non-uniform load distribution:

i) H-specimens with modified grips,

ii) modified H-specimens with standard grips,

iii) modified H-specimens with modified grips,

iv) flat multi-spot specimens with modified grips,

v) modified multi-spot flat specimens with standard grips,

vi) modified multi-spot flat specimens with modified grips;

3) defined combinations of shear-, peel- and normal-tension loads:

i) the KS-2 specimen,

ii) the double disc specimen;

4) spot welds subjected to undefined non-uniform load distribution — single-hat, double-hat and similar closed hollow sections under torsion, 3-point bending and/or internal pressure.

The specimens and tests referred to under 4) are not dealt with further in this International Standard, because the results obtained with these specimens are specific to the components as tested and may not be generalized or used for deriving data pertaining to the load-carrying behaviour of the welds. Results obtained with such tests are suitable for comparing the mechanical properties of the tested components with those of similar components tested in the same manner. These tests are, however, *not suitable* for evaluating or comparing the load-carrying properties of the welds.

The test results of the fatigue tests obtained with component like specimens are suitable for deriving criteria for the selection of materials and thickness combinations for structures and components subjected to cyclic loading. This statement is especially relevant for results obtained with specimens with boundary conditions, i.e. a local stiffness similar to that of the structure in question. The results of a fatigue test are suitable for *direct* application to design only when the loading conditions in service and the stiffness of the design in the joint area are identical.

NOTE Specimens are modified to take into consideration constraints or specific demands posed by design, e.g. smaller than standard overlap, smaller or larger than standard nugget diameter, and specific load distribution, thus enhancing the value of the test results for the design engineer.

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

ISO 14324, *Resistance spot welding — Destructive tests of welds — Method for the fatigue testing of spot welded joints*

ISO 15609-5:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14324 and the following apply.

3.1
repeated load
F
load varying simply and periodically between constant maximum and minimum values

NOTE Adapted from ISO 14324:2003, 3.12.

3.2
maximum load
F_{max}
highest algebraic value of the repeated load

NOTE Adapted from ISO 14324:2003, 3.9.

3.3
minimum load
F_{min}
lowest algebraic value of the repeated load

NOTE Adapted from ISO 14324:2003, 3.11.

3.4
load range
ΔF
difference between maximum and minimum loads

$$\Delta F = F_{max} - F_{min}$$

NOTE Adapted from ISO 14324:2003, 3.8.

3.5
load amplitude
F_a
half of the load range

$$F_a = 0{,}5\Delta F$$

NOTE Adapted from ISO 14324:2003, 3.6.

3.6
mean load
F_m
average of maximum and minimum loads

$$F_m = 0{,}5(F_{max} + F_{min})$$

NOTE Adapted from ISO 14324:2003, 3.10.

3.7
load ratio
R
minimum load divided by the maximum load

$$R = \frac{F_{min}}{F_{max}}$$

NOTE Adapted from ISO 14324:2003, 3.7.