INTERNATIONAL STANDARD

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Specification and qualification of welding procedures for metallic materials — Welding procedure test —

Part 12: Spot, seam and projection welding

Descriptif et qualification d'un mode opératoire de soudage pour les matériaux métalliques — Épreuve de qualification d'un mode opératoire de soudage —

Partie 12: Soudage par points, à la molette et par bossages

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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 15614-12 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 15614 consists of the following parts, under the general title *Specification and qualification of welding procedures for metallic materials — Welding procedure test*:

— *Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

— *Part 2: Arc welding of aluminium and its alloys*

— *Part 3: Arc welding of cast irons*

— *Part 4: Finishing welding of aluminium castings*

— *Part 5: Arc welding of titanium, zirconium and their alloys*

— *Part 6: Arc welding of copper and its alloys*

— *Part 7: Corrosion resistant overlay, cladding restore and hardfacing*

— *Part 8: Welding of tubes to tube-plate joints*

— *Part 9: Arc underwater hyperbaric wet welding*

— *Part 10: Hyperbaric dry welding*

— *Part 11: Electron and laser beam welding*

— *Part 12: Spot, seam and projection welding*

— *Part 13: Resistance butt and flash welding*

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

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Foreword

This document (EN ISO 15614-12:2004) 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 February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

Normative references to International Standards are listed in normative annex ZA.

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

All new welding procedure qualifications are to be in accordance with this standard from the date of its issue.

This standard does not invalidate previous welding procedure qualifications made to former national standards or specifications provided the intent of the technical requirements is satisfied and the previous procedure qualifications are relevant to the application and production work on which they are to be employed.

Also, where additional tests have to be carried out to make the qualification technically equivalent, it is only necessary to do the additional tests on a test piece which should be made in accordance with this standard.

1 Scope

This standard specifies the tests which may be used for qualification of welding procedure specifications for spot, seam and projection welding processes.

This standard is part of a series of standards. Details of this series are given in EN ISO 15607:2003, annex A.

This standard defines the conditions for carrying out tests and the limits of validity of a qualified welding procedure for all practical welding operations covered by this standard.

The tests required to qualify the procedure for a particular component/assembly depend on the performance and quality requirements of the component/assembly and shall be established before any qualification is undertaken.

Tests shall be carried out in accordance with this standard unless more severe tests are specified by the relevant application standard or contract when these shall apply.

The acceptability of applying the principles of the standard to other resistance welding processes should be established before any qualification is undertaken.

NOTE Specific service, material or manufacturing conditions may require more comprehensive testing than is specified by this standard.

Such tests may include:

- method for fatigue testing for spot welded joints;

- specimen dimensions and procedure for impact, shear and cross tension testing resistance spot and projection welds;

- bend test;

- surface crack detection;

- ultrasonic tests, x-ray test;

- chemical analysis; corrosion tests;

- micro examination, including assessment of hot cracking behaviour;

- tests of components or complete welded assemblies.

This standard covers the following resistance welding processes, as defined in EN ISO 4063:

21 - spot welding;

211 - indirect spot welding;

212 - direct spot welding;

22 - seam welding;

221 - lap seam welding;

222 - mash seam welding;

225 - fail butt-seam welding;

226 - seam welding with strip;

23 - projection welding;

231 indirect projection welding;

232 direct projection welding.

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 1418, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.*

EN ISO 14270, *Specimen dimensions and procedure for mechanized peel testing resistance spot, seam and embossed projection welds (ISO 14270: 2000).*

EN ISO 14271, *Vickers hardness testing of resistance spot, projection and seam welds (low load and micro hardness) (ISO 14271: 2000).*

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

EN ISO 14273, *Specimen dimensions and procedure for shear testing resistance spot, seam and embossed projection welds (ISO 14273: 2000).*

EN ISO 17653, *Destructive tests on welds in metallic materials — Torsion test of resistance spot welds (ISO 17653: 2003.)*

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules (ISO 15607: 2003).*

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

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

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 15607:2003 and ISO 669:2000 apply.

4 Preliminary welding procedure specification (pWPS)

The preliminary welding procedure specification shall be prepared in accordance with EN ISO 15609-5.

5 Welding procedure test

The preparation and testing of test pieces shall be in accordance with clauses 6 and 7 of this standard.

NOTE The resistance weld setter who undertakes the welding procedure test satisfactorily in accordance with this standard is qualified for the appropriate range of qualification given in EN 1418.

6 Test piece

6.1 General

The welded assembly, to which the welding procedure will relate to in production, shall be represented by actual components or by preparing a standardized test piece in accordance with 6.2.

Test specimens shall be cut from the actual components, the test piece or welded separately according to 6.3.

Test specimens or test pieces from the same material with relevant flange widths or overlap length should be used. When applicable, shunting and inductive effects shall be taken into account.

If required by the application standard, the direction of plate rolling shall be marked on the test piece.

6.2 Shape and dimensions of test pieces and test specimens for destructive testing

6.2.1 General

The shape and dimensions of the test pieces and test specimen and the test procedures are specified in the following standards: EN ISO 14270; EN ISO 14271; EN ISO 14272; EN ISO 14273; EN ISO 17653 and ISO 10447.

6.2.2 Macrosection

The test specimens shall be prepared and etched to produce transverse and/or longitudinal sections in order to clearly show the nugget, the heat affected zone (HAZ) and, if necessary, the weld profile.

The transverse macrosection shall include the unaffected parent material.

6.3 Welding of components, test pieces or test specimens

Preparation of components, test pieces or test specimens and welding of test pieces or test specimen shall be carried out in accordance with the pWPS, and under the general conditions of production welding (parameters, equipment, etc.) which they shall represent.

If tack welds are used in the case of seam welds, they should be included in the final test piece.

Welding and testing of the test pieces shall be witnessed by an examiner or examining body and the details of this shall be established before any qualification is undertaken.

7 Examination and testing

7.1 Extent of testing

The testing includes both non-destructive testing (NDT) and/or destructive testing.

The selection of test types and the number of test specimens depends on the performance and quality requirements of the component/assembly and shall be established before any qualification is undertaken, examples are given in Table 1.

When the standard deviation for test results in shear and cross tension tests is not necessary, the reduced number of specimens shall be established before any qualification is undertaken.

Table 1 — Examples for testing spot, seam and projection welding joints

Test piece/specimen	Test type	Number of samples
One spot or projection specimen	Visual examination	all
	Shear test	11
	Cross tension [a]	11
	Macrosection [b]	2
	Hardness test	if requested
	Torsion test [c]	11
	Peel test	11
	Chisel test	11
Two spot or projection specimen [d]	Visual examination	all
	Shear test [e]	11
	Cross tension test [a]	11
	Macrosection [b]	2
	Hardness test [f]	if requested
	Peel test	11
	Chisel test	11
Multispot test or projection specimen [g]	Visual examination	all
	Shear test [h]	11
	Peel test	11
	Macrosection [b]	2
	Hardness test [f]	if requested
	Chisel test	11
Overlapped seamweld specimen (test piece)	Visual examination	all
	Peel test	11
	Shear test [i]	11
	Pillow test [j]	3
	Helium leakage test [k]	3
	Macrosection [l]	2
	Hardness test	if requested

continued

Table 1 *(concluded)*

Test piece/specimen	Test type	Number of samples
Seam welding with strip, mash seam welding	Visual examination	all
	Shear test [m]	11
	Bend test [n]	2
	Peel test [o]	9
	Pillow test [j]	3
	Helium leakage test [k]	3
	Macrosection [l]	2
	Hardness test	if requested

[a] Substitute test for the shear test with predominant cross tension loading.
[b] Two macrosections displaced by 90° and arranged perpendicular to the plane of the plate; elongated projections shall be located in the major axes.
[c] Substitute test for the shear/cross tension test, if specimen preparation conforming to standards is not possible, or in the case of predominant torsion loading.
[d] Only with push-pull welding and indirect welding.
[e] The two-spot weld specimen shall be cut into single spot weld specimens for the shear test. Deviations of the specimen width from the standard specimen result from the spot weld pitch.
[f] Two spot welds.
[g] The multi-spot weld specimen shall be welded and tested with the same spot weld pitch, edge distance and row spacing as on the component in production.
[h] In the case of spot weld rows proceed in the same way as in two-spot weld testing.
[i] Substitute test for the peel test in case of predominant shear loading.
[j] Only if leak-tightness is required (pressure test).
[k] Only if high leak-tightness is required.
[l] 1 transverse section and 1 longitudinal section.
[m] At right angle to the weld, if applicable.
[n] Each side (top and bottom side).
[o] Only mash seam weld: each 3 specimens from the start, middle and end of seam weld.

7.2 Location and cutting of test specimens

Test specimens shall be taken after visual testing or after an alternative non-destructive testing.

The location of test specimens shall be in accordance with 6.2.

It is permitted to take the test specimens from locations avoiding areas showing acceptable imperfections.

7.3 Visual testing

The spot welds and roller seam welds shall be tested - as far as access is possible - using a magnifier (six- to ten-fold magnification), a mirror or an endoscope in order to identify the following features on the outside: surface cracks, metal expulsion, spatters, deposit of electrode material, electrode indentation depth and sheet separation.

7.4 Re-testing

If the component or the test piece fails to comply with any of the requirements for visual examination or other non-destructive examination, one further component or test piece shall be subjected to the same examination. If this additional component or test piece does not comply with the same requirements, the pWPS needs to be modified. The modified pWPS shall be approved according to the requirements of this standard.

If any test specimen fails to comply with the relevant requirements of 6.2 due to geometric weld imperfections (e. g. location, shape), further test specimens shall be obtained for each one that failed. These can be taken

from the same test piece if there is sufficient material available or from a new test piece, and shall be subjected to the same test.

If any of these additional test specimens does not comply with the relevant requirements, the pWPS needs to be modified. The modified pWPS shall be approved according to the requirements of this standard.

8 Range of qualification

8.1 General

All the conditions of validity stated below shall be met independently of each other.

Changes outside of the ranges specified shall require a new welding procedure test.

8.2 Related to the manufacturer

A qualification of a WPS obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of that manufacturer.

Welding is under the same technical and quality control when the manufacturer who qualified the WPS retains complete responsibility for all welding carried out to it.

8.3 Related to the material

All tests shall be carried out with materials used in production (thickness, chemical analysis, mechanical properties). Any modification shall be established before any qualification is undertaken.

8.4 Common to all welding procedures

8.4.1 Welding process

The qualification only applies to the welding procedure used in the welding procedure test.

Where welding equipment is provided with remote control for more than one welding program used at a work station as part of a sequential operation, the WPS should include details of all welding programs used.

In automatic or robotic operating with more than one weld program, the WPS should include details of all welding programs used, each of which requires qualification.

8.4.2 Type of current

The weld procedure is qualified using the type of current (alternating, direct or pulsed), frequency and polarity used for the welding procedure test.

8.4.3 Welding cycle

The weld procedure is qualified using the welding cycle used for the welding procedure test.

8.4.4 Postweld heat treatment in the welding equipment

Any heat treatment provided for shall be taken in account in the welding procedure test.