INTERNATIONAL STANDARD

ISO 11970

First edition
2001-01-15

Specification and approval of welding procedures for production welding of steel castings

Descriptif et qualification d'un mode opératoire de soudage pour le soudage de production sur aciers moulés

Reference number
ISO 11970:2001(E)

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Printed in Switzerland

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11970 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 11, *Steel castings*.

Annex B forms a normative part of this International Standard. Annex A is for information only.

Introduction

All welding procedure approvals for production welding of steel castings shall be in accordance with this International Standard from the date of its issue.

Previous procedure approvals that conform to the range of approval of clause 8 are valid under this International Standard.

Where additional tests have to be carried out to complete the approval it is only necessary to perform the additional tests to the requirements of clauses 6 and 7.

Specification and approval of welding procedures for production welding of steel castings

1 Scope

This International Standard specifies how a welding procedure specification (WPS) for production welding of steel castings is approved,

It defines the conditions for the execution of welding procedure approval tests and the limits of validity of an approved welding procedure for all practical welding operations within the range of essential variables.

Tests shall be carried out in accordance with this International Standard unless additional tests are specified by the purchaser or by agreement between the contracting parties.

This International Standard applies to the arc welding of steel castings. The principles of this International Standard may be applied to other fusion welding processes subject to agreement between the contracting parties.

In the case of specific service, material or manufacturing conditions, more comprehensive tests may be specified by the purchaser, than are specified by this International Standard, in order to gain more information, e.g. longitudinal weld tensile tests, bend tests, chemical analyses, ferrite determination in austenitic stainless steels, elongation, Charpy “V” impact tests, radiography, etc.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 148:1983, *Steel — Charpy impact test (V-notch)*.

ISO 857-1:1998, *Welding and allied processes — Vocabulary —Part 1: Metal welding processes.*

ISO 4969:1980, *Steel — Macroscopic examination by etching with strong mineral acids*.

ISO 4986:1992, *Steel castings — Magnetic particle inspection.*

ISO 4987:1992. *Steel castings — Penetrant inspection*.

ISO 4992:—[1)], *Steel castings — Ultrasonic inspection*.

ISO 4993:1987, *Steel castings — Radiographic inspection*.

1) To be published.

ISO 5817:—[2], *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections.*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method*.

ISO 6892:1998, *Metallic Materials — Tensile testing at ambient temperature*.

ISO 6947:1990, *Welds — Working positions — Definition of angles of slope and rotation*.

ISO 9606-1:1994, *Approval testing of welders — Fusion welding — Part 1: Steels.*

ISO 9692-1:—[3], *Welding and allied processes — Recommendations for joint preparation — Part 1: Manual metal-arc welding, gas-shielded metal-arc welding and gas welding of steels.*

ISO 9956-1:1995, *Specification and approval of welding procedures for metallic materials — Part 1: General rules for fusion welding.*

ISO 9956-2:1995, *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding.*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 857-1 and ISO 9956-1 as well as the following apply.

3.1
production welding
any welding carried out during manufacturing before final delivery to the purchaser including joint welding of castings and finishing welding

3.1.1
joint welding
welding used to weld cast components together or weld cast components to wrought steels in order to obtain an integral unit

3.1.2
finishing welding
welding carried out in order to ensure the agreed quality of the casting

3.2
repair welding
any welding carried out after delivery to the end user, i.e. after the casting has been in service

4 Preliminary welding procedure specification (pWPS)

A preliminary welding procedure specification shall be prepared. It shall specify the range of all the relevant parameters according to ISO 9956-2.

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2) To be published. (Revision of ISO 5817:1992)

3) To be published. (Partial revision of ISO 9692:1992)

5 Welding procedure test

The making and testing of test pieces representing the type and the position of welding used in production shall be in accordance with clauses 6 and 7.

The welder who undertakes the welding procedure test satisfactorily in accordance with this International Standard is approved for the appropriate range of approval according to ISO 9606-1. Additional welders shall be qualified in accordance with 7.6.

6 Test piece

6.1 General

The test piece shall be in accordance with that shown in Figure 1.

6.2 Shape and dimensions of test piece

Additional test pieces, or longer test pieces than the minimum size may be prepared in order to allow for extra and/or retesting specimens (in accordance with 7.5).

6.3 Welding of test piece

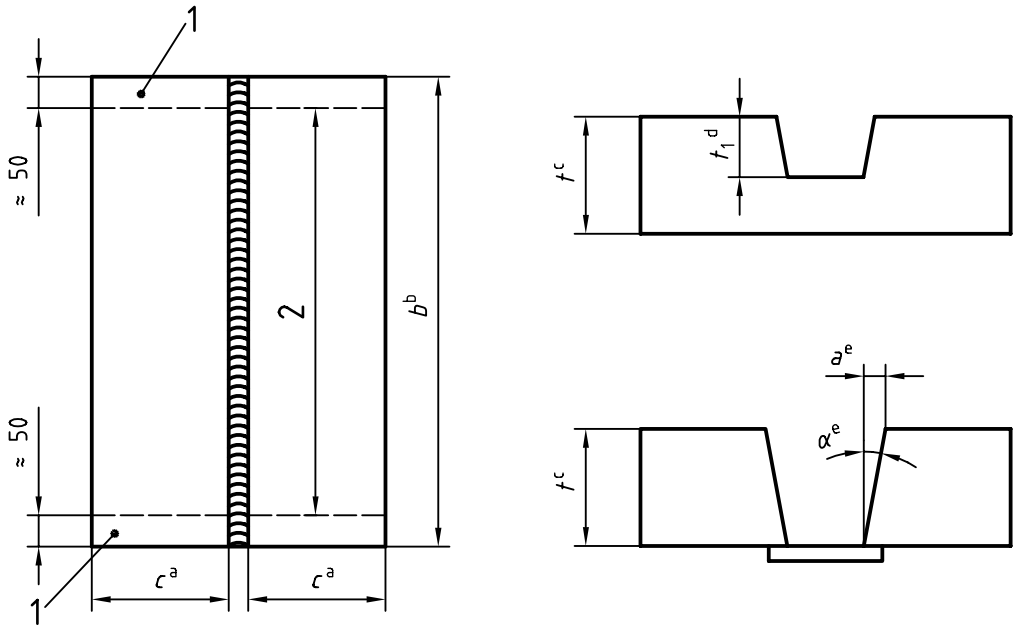
The preparation and welding of the test piece shall be carried out in accordance with the relevant pWPS. Angular tolerances may be agreed between the contracting parties or by the relevant application standard.

The dimensions and shape of the groove shall be in accordance with ISO 9692-1.

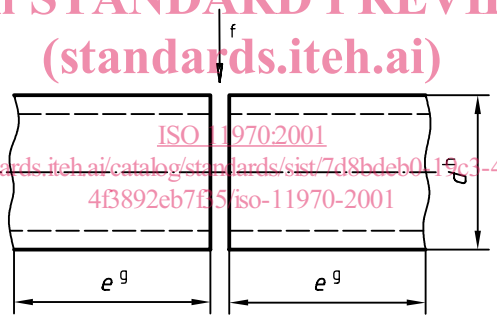
If tack welds are to be fused into the final joint they shall be included in the test piece.

Unless otherwise specified in the purchase order or contract review, welding and testing of the test piece(s) shall be witnessed by an examiner (or test body). When the examiner (or test body) is not specified in the purchase order the manufacturer may appoint a suitable examiner.

Dimensions in millimetres



a) Plate



b) Tube

Key

1 Discard

2 Inspection length

NOTE The dimensions shown are for information only and may be adjusted to meet production and testing requirements.

a $c = 3t \geqslant 150$ mm.

b $b = 6t \geqslant 350$ mm.

c $t \geqslant 15$ mm.

d $t_1 \geqslant 0{,}5t$.

e $a = 5$ mm to 15 mm or $\alpha = 5°$ to 20°.

f Edge preparation and fit-up as detailed in the preliminary Welding Procedure Specification (pWPS).

g $e \geqslant 150$ mm.

h d = outside diameter.

Figure 1 — Test piece

7 Examination and testing

7.1 Extent of testing

The examination and testing includes both non-destructive examination (NDE) and destructive testing (DT) which shall be in accordance with the requirements of Table 1.

Table 1 — Examination and testing of the test pieces

Type of test	Extent
Visual	100 %
Radiographic[a] or ultrasonic [b]	100 %
Surface crack detection [c]	100 %
Transverse tensile test	1 specimen
Impact test [d]	2 sets
Hardness test	if required by the purchase order or by the relevant application standard
Macro-examination	if required by the purchase order or by the relevant application standard
Micro-examination	if required by the purchase order or by the relevant application standard
Bend tests	if required by the purchase order or by the relevant application standard
Corrosion tests	if required by the purchase order or by the relevant application standard
Additional tests	if required by the purchase order or by the relevant application standard

a Radiographic testing shall be carried out in accordance with ISO 4993.

b Ultrasonic testing shall be carried out in accordance with ISO 4992.

c Magnetic particle testing in accordance with ISO 4986 or dye penetrant in accordance with ISO 4987.

d Impact V-notch tests are only required when the parent metal requires impact testing The same number of tests are required in the weld metal and HAZ.

All tests shall be carried out after any required post weld heat treatment.

7.2 Location and cutting of test pieces

Location and cutting of test pieces shall be in accordance with Figure 2.

Test pieces shall be taken after non-destructive examination (NDE) has given satisfactory results.

7.3 Non-destructive examination

The quality requirements of the HAZ shall be in accordance with the requirements for the parent metal.

The acceptance requirements of the weld deposit shall comply with level C of ISO 5817:1982 except for excess weld metal and excessive convexity for which level D shall apply. Standards for acceptance criteria relating to NDE methods shall be used for the evaluation of imperfections.