INTERNATIONAL STANDARD

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Approval testing of welders — Fusion welding —

Part 3:
Copper and copper alloys

Épreuve de qualification des soudeurs — Soudage par fusion —
Partie 3: Cuivre et ses alliages

Reference number
ISO 9606-3:1999(E)

Foreword

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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 member bodies for voting. Publication as an International Standard requires approval by at least 75 % of member bodies casting a vote.

International Standard ISO 9606-3 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 44, *Welding and allied processes*, Subcommittee SC 11, *Approval requirements for welding and allied processes personnel*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

ISO 9606 consists of the following parts, under the general title *Approval testing of welders — Fusion welding*:

— *Part 1: Steels*

— *Part 2: Aluminium and aluminium alloys*

— *Part 3: Copper and copper alloys*

— *Part 4: Nickel and nickel alloys*

— *Part 5: Titanium and titanium alloys*

— *Part 6: Magnesium and magnesium allloys*

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Annexes A and ZA of this part of ISO 9606 are for information only.

For the purposes of this part of ISO 9606, the CEN annex regarding fulfilment of European Council Directives has been removed.

Contents

Foreword

The text of EN ISO 9606-3:1999 has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, 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of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZB, which is an integral part of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This standard covers the principles to be observed in the approval testing of welder performance for the fusion welding of copper and copper alloys.

The term "copper" stands for copper and weldable copper alloys.

The ability of the welder to follow verbal or written instructions and testing of his skill are important factors in ensuring the quality of the welded product.

Testing of skill to this standard depends on welding methods in which uniform rules and test conditions are complied with, and standard test pieces are used.

The test weld can be used to approve a welding procedure and a welder provided that all the relevant requirements, e.g. test piece dimensions, are satisfied (see relevant part of EN 288-2).

1 Scope

This standard specifies essential requirements, ranges of approval, test conditions, acceptance requirements and certification for the approval testing of welder performance for the welding of copper.

This standard applies to the approval testing of welders for the fusion welding of copper.

This standard is intended to provide the basis for the mutual recognition by examining bodies for approval relating to welders' competence in the various fields of application. Tests will be carried out in accordance with this standard unless more severe tests are specified by the relevant application standard when these are applied.

During the approval test the welder should be required to show adequate practical experience and job knowledge (test non mandatory) of the welding processes, materials and safety requirements for which he is to be approved; information on these aspects is given in Annex A.

This standard is applicable when the welder's approval testing is required by the purchaser, by inspection authorities or by other organizations.

The welding processes referred to in this standard include those fusion welding processes which are designated as manual or partly mechanized welding. It does not cover fully mechanized and automatic processes (see 5.2).

This standard covers approval testing of welders for work on semi-finished and finished products made from wrought, forged or cast material types listed in 5.4.

The certificate of approval testing is issued under the sole responsibility of the examiner or examining body.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 287-1 : 1992	Approval testing of welders – Fusion welding – Part 1: Steels
EN 287-2 : 1992	Approval testing of welders – Fusion welding – Part 2: Aluminium and aluminium alloys
EN 288-2 : 1992	Specification and approval of welding procedures for metallic materials – Part 2: Welding procedure specification for arc welding
EN 571-1	Non destructive testing – Penetrant testing – Part 1: General principles
EN 895	Destructive tests on welds in metallic materials – Transverse tensile test

EN 910	Destructive tests on welds in metallic materials – Bend tests
EN 970	Non-destructive examination of fusion welds – Visual examination
EN 1289	Non-destructive examination of welds – Penetrant testing of welds – Acceptance levels
EN 1320	Destructive tests on welds in metallic materials – Fracture test
EN 1321	Destructive tests on welds in metallic materials – Macroscopic and microscopic examination of welds
EN 1435	Non-destructive examination of welds – Radiographic examination of welded joints
EN 24063 : 1992	Welding, brazing, soldering and braze welding of metals – Nomenclature of processes and reference numbers for symbolic representation on drawings (ISO 4063 : 1990)
EN 26520 : 1991	Classification of imperfections in metallic fusion welds, with explanations (ISO 6520 : 1982)
EN 30042 : 1994	Arc-welded joints in aluminium and its weldable alloys – Guidance on quality levels for imperfections (ISO 10042 : 1992)
EN ISO 6947 : 1997	Welds – Working positions – Definitions of angles of slope and rotation (ISO 6947 : 1993)
CR 12187	Welding – Guidelines for a grouping system of materials for welding purposes
ISO 857 : 1990	Welding, brazing and soldering processes – Vocabulary

3 Definitions

For the purposes of this standard, the definitions given in EN 287-1 apply.

4 Symbols and abbreviations

4.1 General

Where the full wording is not used, the following symbols and abbreviations shall be used when completing the test certificate in accordance with Annex A of EN 287-2 : 1992.

4.2 Test piece

a nominal throat thickness ;
BW butt weld ;
D outside diameter of pipe ;
FW fillet weld ;
P plate ;
t plate or pipe wall thickness ;
T pipe ;
z leg length of fillet weld.

4.3 Consumables

nm no filler metal ;
wm with filler metal.

4.4 Miscellaneous

bs welding from both sides ;
gg back grinding or back milling of welds ;
mb welding with backing material;

nb welding without backing ;
ng no back grinding or back milling ;
ss single-side welding

5 Essential variables for approval testing

5.1 General

The criteria specified in this clause shall be examined in order to identify the ability of the welder in these areas. Each criterion is considered to be a significant factor in the approval testing.

The welder's approval test shall be carried out on test pieces and is independent of the type of construction.

5.2 Welding processes

Welding processes are defined in ISO 857 and reference numbers of welding processes for symbolic representation are listed in EN 24063.

This standard covers the following welding processes:

111 metal-arc welding with covered electrodes;
131 metal-arc inert gas welding (MIG welding);
141 tungsten inert gas arc welding (TIG welding);
15 plasma arc welding;
311 oxy-acetylene welding;

other fusion welding processes by agreement.

5.3 Joint types (butt and fillet welds)

Test pieces shall be produced for butt weld (BW) and fillet weld (FW) in plates (P) or pipes[1]) (T) for approval tests in accordance with 7.2.

5.4 Material groups

5.4.1 General

In order to minimize unnecessary multiplication of technically identical tests, copper with similar metallurgical and welding characteristics are grouped for the purpose of a welder's approval (see 5.4.2).

In general, a welder's approval test shall involve depositing weld metal having a chemical composition compatible with any copper in the parent metal group(s).

The welding of any one material in a group confers approval on the welder for the welding of all other materials within the same group.

When welding parent metals from two different groups which do not give approval to each other according to table 4 (see 6.4), an approval for the combination as a separate group is required.

When the filler metal is dissimilar to the parent metal group, an approval for that combination of parent metal group and filler metal is needed, except when permitted by table 4.

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[1]) The word "pipe" alone or in combination, is used to mean "pipe", "tube" or "hollow section".

5.4.2 Copper groups of parent metal

5.4.2.1 General

Copper casting alloys are included in the following groups but the filler metal shall be compatible with the filler metal used for the wrought materials in the same group.

Material groups according to CR 12187

5.4.2.2 Group W 31: Pure copper

5.4.2.3 Group W 32: Copper-zinc alloys

5.4.2.4 Group W 33: Copper-tin alloys

5.4.2.5 Group W 34: Copper-nickel alloys

5.4.2.6 Group W 35: Copper-aluminium alloys

5.4.2.7 Group W 36: Copper-nickel-zinc alloys

5.5 Consumables

In the approval test, the filler metal and the shielding gas, including plasma gas, shall be compatible with the parent metal and the process used in accordance with the relevant pWPS or WPS (see EN 288-2).

5.6 Dimensions

The approval test should be based on the thickness of the material (i.e. plate thickness or wall thickness of pipe) and pipe diameters which the welder will use in production. A test is listed for each of the ranges of plate thickness and pipe wall thickness or pipe diameter as specified in tables 1 and 2.

It is not intended that thicknesses or diameters should be measured precisely but rather the general philosophy behind the values given in tables 1 and 2 should be applied.

Table 1: Test piece (plate or pipe) and range of approval

Test piece thickness t mm	Range approval
t	$0,5\ t \leq t \leq 1,5\ t$ [1)]
1) For oxy-acetylene welding (311) the test shall be carried out on the minimum and on the maximum production thickness: $t \approx t$	

Table 2: Test piece diameter and range of approval

Test piece diameter D mm	Range approval
$D \leq 25$	D to $2D$
$D > 25$	$\geq 0,5\ D$ (25 mm min.)

5.7 Number of test pieces

Plate:One test piece per position.
Pipe: A minimum weld length of 150 mm is required, but not more than three test pieces.

5.8 Welding positions

The welding positions shall be taken from EN ISO 6947.

The test pieces shall be welded in accordance with the nominal angles of the positions according to EN ISO 6947.

6 Range of approval for the welder

6.1 General

As a general rule, the test piece approves the welder not only for the conditions used in the test, but also for all joints which are considered easier to weld. The range of approval for each type of test is given in the relevant sub-clauses and tables. In these tables the range of approval is indicated in the same horizontal line.

6.2 Welding process

Each test normally approves one process. A change of process requires a new approval test. However, it is possible for a welder to be approved for more than one welding process by a single test or by two separate approval tests to be used to cover a multi-process joint. For example in a case where approval is required for a single-side butt joint with the root to be welded by TIG (141) without backing and to be filled by MIG (131), the welder can be approved by either of the following routes:

a) a successful completion of an approval test simulating the multi-process joint, i. e. the root run welded by TIG (141) without backing, subsequent runs or layers welded by MIG (131) within the limits of the range of approval for each welding process;

b) successful completion of separate relevant approval tests one for TIG (141) without backing for the root run and a separate test for the fill by MIG (131) with backing or welded from both sides with or without back grinding or milling.

6.3 Joint types

Depending on the test piece, the range of welds for which the welder is approved is shown in table 3; the following criteria are applicable:

a) approval for butt welds in pipes, diameter > 25 mm, includes butt welds in plates;

b) approval for butt welds in plates in all relevant positions covers butt welds on pipes having an outside diameter ≥ 500 mm, except when item c) also applies;

c) approval on test butt joints in plates welded in the flat (PA) or horizontal (PC) position shall include approval for butt joints in pipes of outside diameter ≥ 150 mm welded in similar positions according to table 4;

d) butt welds approve fillet welds. In cases where the majority of production work is fillet welding, the welder shall be approved also by an appropriate fillet welding test;

e) approval for butt welds in pipes without backing includes approval for branch connections within the same range of approval as in tables 3 to 5. For a branch weld the range of approval is based on the diameter of the branch;

f) in cases where the majority of production work is predominantly branch welding or involves a complex branch connection, the welder should receive special training. In some cases a welder approval test on a branch connection can be necessary.

Table 3: Range of approval for tests on butt joints (Details of the weld type)

Details of the weld type				Range of approval					
				Butt welds in plate				Butt welds in pipe	
				welded from one side ss		welded from both sides bs		welded from one side ss	
				with baking mb	no baking nb	with grinding gg	no grinding ng	with baking mb	no baking nb
Butt weld in plate	welded from one side ss	with baking	mb	★	—	×	—	[1])	—
		no baking	nb	×	★	×	×	[1])	[1])
	welded from both sides bs	with grinding	gg	×	—	★	—	[1])	—
		no grinding	ng	×	—	×	★	[1])	—
Butt weld in pipe	welded from one side ss	with baking	mb	×	—	×	—	★	—
		no baking	nb	×	×	×	×	×	★

[1]) See 6.3b), and 6.3c)

★ indicates the weld for which the welder is approved in the approval test
× indicates those welds for which the welder is also approved
— indicates those welds for which the welder is not approved

6.4 Material groups

According to the material group of the test piece, the range of materials for which a welder is approved is shown in table 4 (see 5.4). For any copper alloy not covered by any of the copper groups the welder shall carry out an approval test, which only approves for that copper.

An approval test made on wrought material groups gives approval for cast material and a mixture of cast and wrought material in the same material group (see 5.4).

Table 4: Range of approval for parent metal

Material group of approval test piece	Range of approval					
	W 31	W 32	W 33	W 34	W 35	W 36
W 31	★	—	×	×	×	—
W 32	—	★	—	—	—	x
W 33	—	—	★	—	—	—
W 34	—	—	—	★	×	—
W 35	—	—	—	×	★	—
W 36	—	x	—	—	—	★

★ indicates the material group for which the welder is approved in the approval test
× indicates those material groups for which the welder is also approved
— indicates those material groups for which the welder is not approved

NOTE: This table applies only when parent metal indicated by ★ and filler metal are in the same group.