
British Standard Specification for Approval testing of welders working to approved welding procedures

Part 1. Fusion welding of steel

Spécification pour essai d'agrément des soudeurs qualifiés
pour les procédés de soudage agréés
Partie 1. Soudage par fusion de l'acier

Spezifikation für Schweißerprüfung mit Verfahrensprüfung
Teil 1. Schmelzschweißen von Stählen

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Compliance with a British Standard does not of itself confer immunity from legal obligations.

Foreword

This revision of this Part of BS 4871 has been prepared under the direction of the Welding Standards Committee. It incorporates alterations necessary to align the standard with BS 4870 : Part 1 : 1981 and also embodies other technical changes developed from experience gained in the use of the standard since it was first published in 1974. This Part of BS 4871 supersedes BS 4871 : Part 1 : 1974 which is withdrawn.

This revision does not invalidate welder approvals previously accepted according to the requirements of the 1974 edition of the standard, provided the details of the procedures are still relevant to the production work on which the welders are to be employed. The extent of approval given by a previous test in accordance with the 1974 edition may now be related to those ranges indicated in this revised edition. All new approval testing of welders should be made in accordance with the requirements of this revised edition.

This British Standard is one of a series of standards on the approval testing of welders and welding procedures, the latter having a bearing on the former for certain applications. This link has been used as a means of arranging the series of standards into:

- (a) approval testing of welding procedures (see BS 4870 : Part 1);
- (b) welder approval when approval of the welding procedure is required;
- (c) welder approval when approval of the welding procedure is not required (for either technical or contract reasons) (see BS 4872 : Part 1).

For the purposes of this Part of this standard, a welder working to an approved procedure or a procedure being approved is considered to be sufficiently experienced in the appropriate welding process and hence already capable of passing training tests such as those given in BS 1295.

When non-destructive testing is used for the examination of test welds, it should be appreciated that the acceptance levels given in this standard are for the purposes of the approval testing of welders and as such are not necessarily the same as those which might be specified for work on which approved welders will be employed.

Depending upon the emphasis placed on quality control in the production of welded components, the approval of welding procedures covered in this series of standards may be administered in one of several ways which should be stipulated at the enquiry and/or order stage. The alternatives currently employed are the following:

- (1) each individual contractor (or sub-contractor) may have proved by actual test pieces every weld form he wishes to use, in every thickness and material; or
- (2) each individual contractor (or sub-contractor) may have proved by actual test pieces a set of welds representative on a group basis of all the various thicknesses and materials to be used in production; or
- (3) each individual contractor (or sub-contractor) need not make procedure test pieces provided he can prove by appropriate authentic documentation of an independent nature that he has previously satisfactorily welded the type of joint and material in question.

In respect of (1) and (2) it should be appreciated that once the welding procedure tests have been approved, they need never be repeated unless there is a change in certain variables. As an extension beyond (3), it may be possible by agreement between the contracting parties for fully documented welding procedures, developed independently of the particular contractor, to be employed without the need for further approval tests.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

British Standard Specification for

Approval testing of welders working to approved welding procedures

1. Scope

This Part of this British Standard specifies requirements for the approval testing of welders to be engaged on the manual, semi-automatic or mechanized fusion welding of those ferritic steel or austenitic stainless steel fabrications for which an approved welding procedure has to be employed. This standard is not intended to apply to operators of automatic welding equipment. Cast-to-cast fabrications are not included*.

The welder who successfully completes a welding procedure test in accordance with BS 4870 : Part 1 is approved to the extent given in clauses 5 and 6 of this standard without further testing.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2. Definitions

For the purposes of this Part of BS 4871, the following definitions apply.

2.1 welding procedure. A specified course of action followed in welding including a list of materials and, where necessary, tools to be used†.

2.2 welding procedure test. The making and testing of a welded joint representative of that to be used in production in order to prove the feasibility of a welding procedure.

NOTE. This term is not usually applied to any tests that may have been made during the development of a welding procedure.

2.3 approved welding procedure. A documented welding procedure that has been approved by an inspecting authority either by means of a welding procedure test or as a result of authentic documented experience gained with the welding of joints similar to that to which the welding procedure applies.

2.4 welder approval test. A documented test, which has been approved by an inspecting authority, carried out by a welder working to an approved welding procedure.

2.5 test piece. Components welded together in accordance with a specified welding procedure, or a portion of a welded joint detached from a structure, for test†.

2.6 test specimen. A portion detached from a test piece and prepared as required for testing†.

2.7 inspecting authority. That competent independent body or association which verifies compliance with this standard.

3. Information to be given to the welder

The welder shall be provided with full written details according to clause 4 of BS 4870 : Part 1 : 1981 of the approved welding procedure (which may be modified as permitted by clause 5) which he shall follow in making his test weld (see also clause 8 of this standard).

4. Items to be recorded

The items given in appendix A shall be recorded for each welder approval test.

NOTE. Details of the welding procedure used should have been recorded previously by approval testing in accordance with BS 4870 : Part 1.

5. Changes not affecting approval

The following changes between the approved welding procedure and the procedure used for the welder approval test shall **not** entail reapproval of the welder.

NOTE. Clause 5 of BS 4870 : Part 1 : 1981 states the changes affecting an approved welding procedure, but for welder approval purposes more latitude is permitted as only the welder's ability is being tested.

(a) A change in parent metal (but see item (d)) within one of the following ranges of steels‡ (see also table 1).

(1) Carbon steels and low alloy steels with less than 6 % total alloy.

NOTE. This range corresponds to groups A1, A2, B, C, D, E1, E2, F, G and K of table 1 of BS 4870 : Part 1 : 1981.

(2) When high alloy ferritic weld metal is specified, a change in parent metal within the range 11 % to 20 % chromium.

NOTE. This range corresponds to groups M and N of table 1 of BS 4870 : Part 1 : 1981.

(3) When austenitic or high nickel alloy weld metal is specified, a change in parent metal or combinations of parent metal within the ranges of carbon, low alloy, high alloy ferritic and austenitic steels.

NOTE. This range corresponds to groups A1, A2, B, C, D, E1, E2, F, G, H, J, K, L, M, N, R, S, T and U of table 1 of BS 4870 : Part 1 : 1981.

(b) A change in weld metal composition (but see item (d)) within one of the groups given in table 1§ or a change within the extent of approval given in table 1a.

*See BS 4570 for requirements for welder approval for steel castings.

†This definition is taken from BS 499 : Part 1.

‡Certain combinations of parent metal and weld metal will not allow destructive testing to be carried out as indicated in 9.1(b). In such cases non-destructive testing is to be used.

§A welder may need some period of training when changing from one electrode type to another.

Table 1. Weld metal/parent metal combinations

Weld metal		Examples of British Standard designations for welding consumables	Parent metal options for test joint
Group	Nominal composition		
W1	< 6 % total alloy	BS 639 : all types* BS 2493 : all types* except 7CrMo B and 9CrMo B BS 2901 : Part 1 : all types BS 4165 : all types	Carbon or low alloy steel with less than 6 % total alloy
W2	≥ 6 % Cr ≤ 20 % Cr ferritic/martensitic steels	BS 2493 : 7CrMo B, 9CrMo B BS 2926 : 13 and 17	Ferritic/martensitic steel within the range 11 % to 20 % chromium
W3	Austenitic/ferritic or austenitic stainless steels in the following ranges 6 to 29 % Cr 5 to 22 % Ni 0 to 4 % Mo 0 to 1.5 % Nb 0 to 1.5 % Ti	BS 2926 : all types except 13 and 17 BS 2901 : Part 2 : all types BS 5465 : all types	Carbon, low alloy, high alloy ferritic or austenitic steel
W4	High nickel alloy	BS 2901 : Part 5 : NA 35, NA 39	

* A change from a rutile electrode to a basic electrode requires reapproval (see item (c) of clause 5).

Table 1a. Extent of approval for weld metal groups

Test joint weld metal group (see table 1)	Extent of approval			
	W1	W2	W3	W4
W1	X			
W2	X	X		
W3			X	
W4			X	X

(c) A change from either

(1) a basic to a rutile covered electrode for group W1 weld metal,

or

(2) from one electrode type to another for other than group W1 weld metal.

(d) A change in filler material composition or parent metal for mechanized welding.

(e) A change in position, thickness, pipe outside diameter or dimension, type of joint and shielding gas within the extent of approval given in clause 6.

(f) A change from an unbacked single sided weld to a backed single sided weld or to a double sided weld.

(g) A change in pre-heating temperature.

(h) A change in post-weld heat treatment.

(b) a test in the horizontal-vertical position includes approval for the horizontal-vertical and flat positions;

(c) a test in the overhead position includes approval for the overhead, horizontal-vertical and flat positions;

(d) a test in the vertical-up direction includes approval for the vertical-up direction and the flat position;

(e) a test in the vertical-down direction gives approval only for that direction;

(f) a test joint inclined at 45° to the horizontal involving the overhead position welded in the vertical-up direction, includes approval for all welding positions but excludes the vertical-down direction.

Approval for all four fundamental positions includes approval for all intermediate positions.

In the case of pipe welds, the extent of approval shall be as given in table 2.

Table 2. Positional approval for pipe

Pipe position during test	Pipe movement during test	Welding positions for which approval is given
Horizontal	Rotated	Flat
Vertical	Rotated or fixed	Horizontal-vertical, flat
Horizontal	Fixed	Flat, vertical, overhead
45°	Fixed	All

6. Extent of approval

6.1 Position. The approval of a welder on a test joint in plate welded in one of the fundamental welding positions shall give approval for welding in the following positions:

(a) a test in the flat position gives approval only for that position;

6.2 Thickness. For the purposes of this clause, thickness t shall have the following meanings:

- (a) for a butt joint, the parent metal thickness;
- (b) for a fillet weld, the leg length;
- (c) for a set-on branch connection, the thickness of the branch;
- (d) for a set-in or set-through branch connection, the thickness of the main pipe.

The approval of a welder on thickness t shall include approval for thicknesses in the following ranges:

Thickness, t	Range approved
less than 1.6 mm	t to $2t$
1.6 mm up to but not including 10 mm	1.6 mm to $2t$
10 mm and over	4.8 mm to $2t$

except that a test made on a thickness t of 20 mm or over shall give approval for welding all such thicknesses of 4.8 mm and above.

6.3 Pipe* outside diameter or dimension. The approval of a welder on pipe of outside diameter or dimension D of 25 mm or above shall include approval for diameters or dimensions in the range $0.5D$ to $2D$ with a minimum diameter or dimension of 25 mm, except that a test made on pipe of outside diameter or dimension 168.3 mm or larger shall give approval for welding outside diameters or dimensions 88.9 mm and above. For approval to weld diameters or dimensions below 25 mm, a test made on pipe of diameter or dimension D less than 25 mm shall include approval in the range D to 25 mm. For rectangular structural hollow sections D shall be the dimension of the smaller side. For branch connections D shall be the diameter or dimension of the branch.

6.4 Type of joint

6.4.1 The approval of a welder on a test butt joint in pipe shall include approval for a butt joint in plate for the same test conditions, but the converse shall not apply, except as stated in **6.4.2**.

6.4.2 The approval of a welder on a test butt joint in plate welded in the flat position shall include approval for a butt joint in pipe of outside diameter or dimension 88.9 mm or above welded in the flat position (pipe rotated) for the same test conditions, subject to the limitations of item (f) of clause 5.

6.4.3 The approval of a welder on a test fillet weld on plate shall include approval for a fillet weld on pipe of outside diameter or dimension 88.9 mm or above welded in the flat position (pipe rotated) for the same test conditions, and vice versa.

6.4.4 For manual metal-arc and TIG-welding, the approval of a welder on a test butt joint shall include approval for a fillet weld for the same test conditions.

NOTE. A welder approved for butt joints may need some period of training when changing to fillet welds. However, if the production work on which the welder is to be employed is predominantly fillet welds, then an approval test on a joint with a fillet weld may be desirable.

6.4.5 For manual metal-arc and TIG-welding, the approval of a welder on a test butt joint in pipe only shall include approval for a branch connection for the same test conditions, provided that the included angle between the axes of the main and the branch is not less than 60° .

*In this standard the word 'pipe' alone or in combination is used to mean 'pipe' or 'tube' or 'structural hollow section' (circular or rectangular), although these terms are often used for different categories of product by different industries.

6.5 More than one welder. When more than one welder is employed on making a complete test weld, the satisfactory testing of the test weld shall approve each welder only for his respective portion. When there are unacceptable defects present in a test weld and they can be attributed to one welder, this shall not adversely affect the approval of the other welders.

6.6 Shielding gas

6.6.1 MIG/MAG welding. For the purposes of this clause, shielding gases for MIG/MAG welding shall be grouped as follows:

- MG 1 argon/oxygen mixtures
- MG 2 argon/carbon dioxide mixtures
- MG 3 carbon dioxide
- MG 4 helium/argon mixtures
- MG 5 self-shielded.

The approval of a welder on a test joint using a shielding gas from one of the above groups shall only include approval within that group.

For solid or tubular wires, approval of a welder using a shielding gas from group MG 1, MG 2 or MG 4 shall include approval for all combinations of mixtures within the same group.

For the dip transfer technique, approval of a welder using a shielding gas from group MG 2 shall include approval for the mixture used and any mixture with a higher carbon dioxide content.

6.6.2 TIG welding. For the purposes of this clause, shielding gases for TIG welding, with or without filler (hot or cold wire), shall be grouped as follows:

- TG 1 argon
- TG 2 argon/hydrogen mixtures
- TG 3 helium/argon/hydrogen mixtures
- TG 4 helium
- TG 5 nitrogen and nitrogen/argon mixtures.

The approval of a welder on a test joint using a shielding gas from one of the above groups shall only include approval within that group. Approval using a shielding gas mixture from group TG 2, TG 3 or TG 5 shall include approval for all combinations of mixtures within the same group.

6.6.3 Plasma welding. A change in shielding gas composition for plasma welding shall not entail reapproval of a welder.

7. Test pieces

Except as permitted by the requirements of **6.4** the welder shall weld a test piece or pieces representative of each type of joint to which the welding procedure will relate in production, preferably selected from the following.

- (a) A butt joint (plate and/or pipe). (See figures 1 and 2.)
- (b) A fillet weld (plate). (See figure 3.)
- (c) A branch connection (pipes) forming the minimum angle, θ , likely to be involved in production. (See figure 4.)

The root run of the test weld shall be stopped and restarted within the central 50 mm of the length of the test piece as shown in figure 1 and at about 75 mm from one end of the test piece as shown in figure 3. In the case of manual metal-arc welding, the restart shall be made with a fresh electrode. The test piece shall be marked so that the