

Specification and approval of welding procedures for metallic materials

Part 4. Welding procedure tests for the arc welding of aluminium and its alloys

The European Standard EN 288-4 : 1992, together with its amendment A1,
has the status of a British Standard

ICS 25.160.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee WEE/36, Approval testing of welding procedures and welders, upon which the following bodies were represented:

- AEA Technology
- Association of Consulting Scientists
- British Constructional Steelwork Association Ltd.
- British Iron and Steel Producers' Association
- British Nuclear Fuels plc
- British Railways Board
- British Stainless Steel Association
- Castings Technology International
- Electricity Association
- General Municipal Boilermaker and Allied Trades Union
- Health and Safety Executive
- Heating and Ventilating Contractors' Association
- Lloyd's Register of Shipping
- Ministry of Defence
- Power Generation Contractors' Association (PGCA (BEAMA Ltd.))
- Process Plant Association
- Railway Industry Association
- Safety Assessment Federation Ltd.
- Welding Institute
- Welding Manufacturers' Association (BEAMA Ltd.)

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 October 1997

© BSI 1997

Amendments issued since publication

Amd. No.	Date	Text affected
9737	November 1997	Indicated by a sideline in the margin

The following BSI references relate to the work on this standard:
Committee reference WEE/36
Draft for comment 89/70004 DC

ISBN 0 580 28117 5

National foreword

This Part of BS EN 288 has been prepared by Technical Committee WEE/36, and is the English language version of EN 288-4 : 1992 *Specification and approval of welding procedures for metallic materials Part 4: Welding procedure tests for the arc welding of aluminium and its alloys*, incorporating amendment A1, published by the European Committee for Standardization (CEN). It supersedes BS 4870 : Part 2 : 1982 on 31 January 1993.

EN 288-4 and amendment A1 were prepared as a result of international discussions in which the UK took an active part.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or using the 'Find' facility of the BSI Standards Electronic Catalogue.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 24, an inside back cover and a back cover.

UDC 621.791.75(083.1): 669.71 : 620.0

Descriptors: Welding, arc welding, aluminium, aluminium alloys, procedure, qualification, tests, description, specifications, setting-up conditions

English version

Specification and approval of welding procedures for metallic materials — Part 4: Welding procedure tests for the arc welding of aluminium and its alloys (includes amendment A1 : 1997)

Descriptif et qualification d'un mode opératoire de soudage sur les matériaux métalliques —
Partie 4: Epreuve de qualification d'un mode opératoire de soudage à l'arc sur aluminium et ses alliages
(inclut l'amendement A1 : 1997)

Anforderung und Anerkennung von Schweißverfahren für metallische Werkstoffe —
Teil 4: Schweißverfahrensprüfungen für das Lichtbogenschweißen von Aluminium und seinen Legierungen
(enthält Änderung A1 : 1997)

This European Standard was approved by CEN on 5 August 1992. Amendment A1 was approved on 1996-12-11. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Working Group 1 ‘Specification and approval of welding procedures for metallic materials’ of CEN/TC 121 ‘Welding’.

For this standard, ISO/TC 44/SC10N177 was considered and used as a basis. However, alterations were necessary due to the consideration of experience and updated knowledge.

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 1993-02, and conflicting National Standards shall be withdrawn at the latest by 1993-02.

In accordance with the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Foreword of amendment A1

This amendment EN 288-4 : 1992/A1 : 1997 to EN 288-4 : 1992 has been prepared by Technical Committee CEN/TC 121, Welding, of which the secretariat is held by DS.

This Amendment to the European Standard EN 288-4 : 1992 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 1997, and conflicting national standards shall be withdrawn at the latest by December 1997.

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.

Contents

	Page
Foreword	2
Foreword of amendment A1	2
0 Introduction	3
1 Scope	3
2 Normative references	3
3 Definitions	4
4 Preliminary welding procedure specification (pWPS)	4
5 Welding procedure test	4
6 Test piece	4
6.1 General	4
6.2 Shape and dimensions of test pieces	4
6.3 Welding of test pieces	4
7 Examination and testing	9
7.1 Extent of testing	9
7.2 Location and cutting of test specimens	9
7.3 Non-destructive examination	13
7.4 Destructive tests	13
7.5 Re-testing	14
8 Range of approval	15
8.1 General	15
8.2 Related to the manufacturer	15
8.3 Related to the material	15
8.4 Common to all welding procedures	16
8.5 Specific to processes	18
9 Welding procedure approval record (WPAR)	18
Annexes	
A (informative) Welding Procedure Approval Record form (WPAR)	19
B (informative) Types of aluminium and its alloys according to the grouping system of table 4	22

0 Introduction

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

However, this standard does not invalidate previous welding procedure approvals made to former national standards or specifications providing, the intent of the technical requirements is satisfied and the previous procedure approvals 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 approval technically equivalent, it is only necessary to do the additional tests on a test piece which should be made in accordance with this standard.

Consideration of previous procedure approvals to former national standards or specifications should be at the time of the enquiry or contract stage and agreed between the contracting parties.

1 Scope

This standard specifies how a welding procedure specification is approved by welding procedure tests. 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 variables listed in clause 8.

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

This standard applies to the arc welding of wrought aluminium and its weldable alloys according to EN 515 and EN 573-3. In this standard the term aluminium stands for aluminium and its alloys. The principles of this standard may be applied to other fusion welding processes subject to agreement between the contracting parties.

NOTE. Specific service, material or manufacturing conditions may require more comprehensive testing than is specified by this standard in order to gain more information and to avoid repeating the welding procedure test at a later date just to obtain additional test data.

Such tests may include:

- longitudinal weld tensile test;
- weld bend test or special bend test to measure elongation;
- Charpy V-notch impact test;
- 0,2 % proof stress;
- elongation;
- chemical analysis.

Arc welding is covered by the following processes in accordance with EN 24063:

- 131- metal-arc inert gas welding (MIG welding);
- 141- tungsten inert gas arc welding (TIG welding);
- 15- plasma arc welding;
- other fusion welding processes by agreement.

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 287-2	<i>Approval testing of welders — Fusion welding — Part 2: Aluminium and aluminium alloys</i>
EN 288-1	<i>Specification and approval of welding procedures for metallic materials — Part 1: General rules for fusion welding</i>
EN 288-2	<i>Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding</i>
EN 515	<i>Aluminium and aluminium alloys — Wrought products — Temper designation</i>
EN 571-1	<i>Non destructive testing — Penetrant testing — Part 1: General principles</i>
EN 573-3	<i>Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition</i>
EN 895	<i>Destructive tests on welds in metallic materials — Transverse tensile test</i>
prEN 910	<i>Destructive tests on welds in metallic materials — Bend test</i>
prEN 970	<i>Non-destructive examination of fusion welds — Visual examination</i>
prEN 1321	<i>Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds</i>
EN 24063	<i>Welding brazing, soldering and braze welding of metals — Nomenclature of processes and reference numbers for symbolic representation on drawings (ISO 4063 : 1990)</i>
EN 30042	<i>Arc-welded joints in aluminium and its weldable alloys — Fusion welding — Guidance on quality levels for imperfections (ISO 10042 : 1992)</i>
CEN CR 12187	<i>Welding — Guidelines for a grouping system of materials for welding purpose</i>
EN ISO 6947	<i>Welds — Working positions — Definitions of angles of slope and rotation (ISO 6947 : 1991)</i>

3 Definitions

For the purpose of this standard, the definitions listed in Part 1 of this standard apply.

4 Preliminary welding procedure specification (pWPS)

The preliminary welding procedure specification shall be prepared in accordance with EN 288-2. It shall specify the tolerance for all the relevant parameters.

5 Welding procedure test

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

The welder who undertakes the welding procedure test satisfactorily in accordance with this standard is approved for the appropriate range of approval given in the relevant part of EN 287.

6 Test piece

6.1 General

The welded assembly to which the welding procedure will relate in production shall be represented by making a standardized test piece or pieces, as specified in 6.2.

6.2 Shape and dimensions of test pieces

The test pieces shall be of a sufficient size to ensure a reasonable heat distribution.

In figures 1 to 4, t is the thickness of the thicker component part.

Additional test pieces, or longer test pieces than the minimum size, may be prepared in order to allow for extra and/or for re-testing specimens (see 7.5).

If required by the application standard, the direction of working, e.g. extrusion, should be marked on the test piece.

The thickness and/or pipe outside diameter of the test pieces shall be selected in accordance with 8.3.2.1 to 8.3.2.4.

Unless otherwise agreed, the shape and minimum dimensions of the test piece shall be as follows.

6.2.1 Butt weld in plate

The test piece shall be in accordance with figure 1. The length of the test piece shall be such as to provide for the appropriate test specimens as given in table 1.

6.2.2 Butt weld in pipe

The test piece shall be in accordance with figure 2. When small pipe diameters are used, several test pieces may be necessary.

NOTE. The word 'pipe', alone or in combination is used to mean 'pipe', 'tube' or 'hollow section'.

6.2.3 Branch connection

The test piece shall be in accordance with figure 3. The angle α is the minimum to be used in production.

A branch connection is considered as a fully penetrated joint (set-on or set-in or set-through joint).

6.2.4 Fillet weld

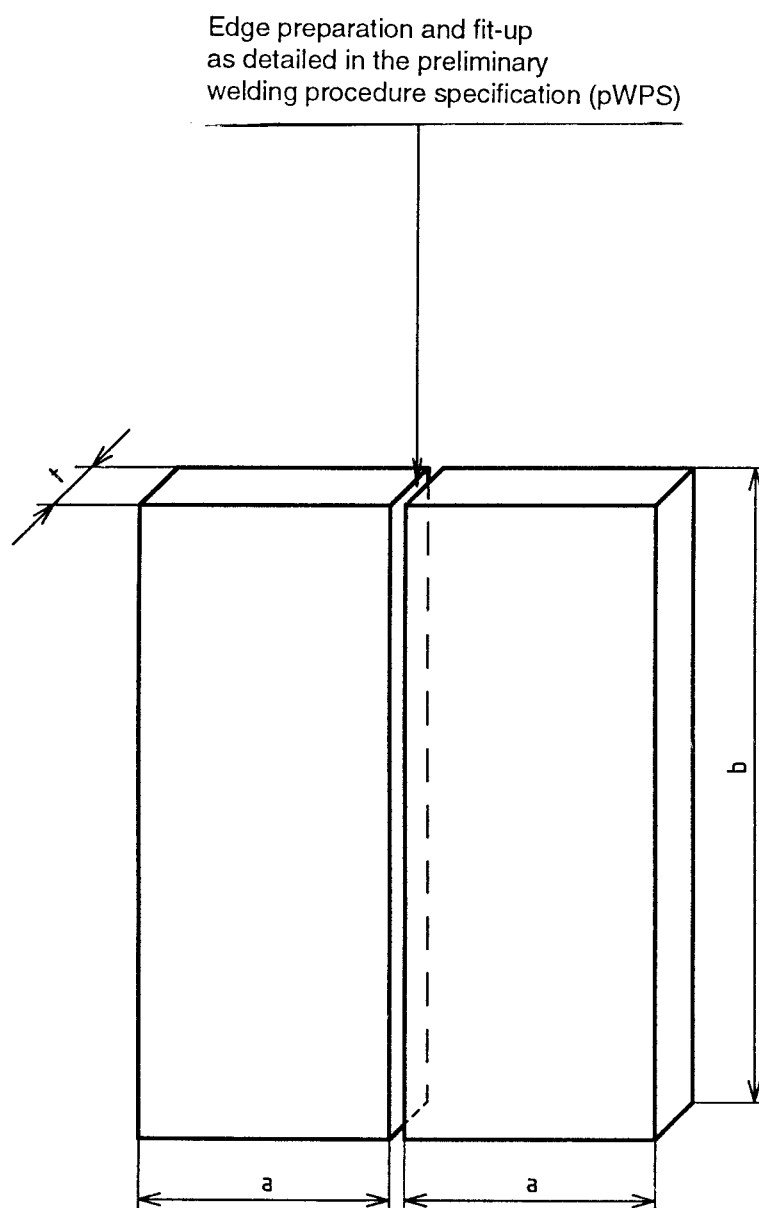
The test piece shall be in accordance with figure 3 or 4. These may also be used with an edge preparation to give partial penetration.

6.3 Welding of test pieces

Preparation and welding of test pieces shall be carried out in accordance with the pWPS, and under the general conditions of welding in production which they shall represent. Welding positions and limitations for the angle of slope and rotation of the test piece shall be in accordance with EN ISO 6947.

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

Welding and testing of the test pieces shall be witnessed by an examiner or examining body.



$a = 3t$; minimum value 150 mm

$b = 6t$; minimum value 350 mm

Figure 1. Test piece for a butt weld in plate