BS ISO 16338:2017

BSI Standards Publication

Welding for aerospace applications — Resistance spot and seam welding

Documents
Document Sharing Hub

Full document details: BS ISO 16338:2017

National foreword

This British Standard is the UK implementation of ISO 16338:2017. It supersedes BS ISO 16338:2013 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/-/1, Briefing committee for welding.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2017.
Published by BSI Standards Limited 2017

ISBN 978 0 580 94953 1

ICS 25.160.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2017.

Amendments/Corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 16338:2017

INTERNATIONAL STANDARD

ISO 16338

Second edition
2017-01

Welding for aerospace applications — Resistance spot and seam welding

Soudage pour applications aérospatiales — Soudage par résistance par points et à la molette

Reference number
ISO 16338:2017(E)

Documents
Document Sharing Hub

© ISO 2017

Full document details: BS ISO 16338:2017

COPYRIGHT PROTECTED DOCUMENT

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 16338:2017

Contents

Page

Foreword ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Symbols and abbreviated terms **4**
5 Specific engineering requirements **4**
6 Classification of the joint **4**
7 Production requirements **4**
8 Welding personnel requirements **5**
9 Person responsible for welding procedure qualification and welding machine qualification tests **5**
10 Material groups **5**
11 Preparation of parts to be welded **5**
11.1 General 5
11.2 Cleaning requirements 5
11.3 Surface coatings 6
11.4 Assembly 6
12 Equipment requirements **6**
12.1 Welding machines 6
12.2 Electrodes 6
12.3 Shear testing machines 6
12.3.1 General 6
12.3.2 Stationary shear testing machines 6
12.3.3 Portable shear testing machines 6
12.4 Jigs and fixtures 6
13 Welding machines **6**
13.1 Qualification requirements 6
13.1.1 General 6
13.1.2 Method of welding machine qualification 7
13.2 Test piece configuration and examination requirements 8
14 Welding procedure (WPS) **9**
14.1 Qualification requirements 9
14.1.1 General 9
14.1.2 Determination of weld settings 9
14.1.3 Methods of welding procedure qualification 9
14.1.4 Thickness combination limits 10
14.1.5 Welding procedure specification (WPS) 10
14.1.6 Welding procedure requalification 11
14.2 Test piece configuration and examination requirements 11
15 Quality requirements for production **13**
15.1 General 13
15.2 Production witness testing 13
15.2.1 General 13
15.2.2 Witness test specimens 13
15.2.3 Surface resistance 13
15.2.4 Parameter adjustments 13
15.2.5 Production witness test specimen configuration and examination 14
15.2.6 Alternate testing requirements in lieu of production witness testing 16

AVA Documents
Document Sharing Hub

© ISO 2017 – All rights reserved

Full document details: BS ISO 16338:2017

15.3 Production parts ... 16
15.3.1 Examination requirements ... 16
15.3.2 Deterioration of welding quality ... 16
15.3.3 Tack welds ... 16

16 Test pieces ... 16
16.1 Standard test pieces ... 16
16.2 Test pieces for specific purposes ... 20

17 Examination, testing and acceptance criteria ... 20
17.1 General ... 20
17.2 Visual examination ... 20
17.2.1 Visible imperfections in test specimens or production parts ... 20
17.2.2 Sheet separation between welded members ... 21
17.2.3 Electrode indentation ... 21
17.3 Radiographic examination ... 22
17.4 Metallographic examination ... 24
17.4.1 General ... 24
17.4.2 Electrode indentation ... 24
17.4.3 Internal imperfections ... 25
17.4.4 Nugget penetration ... 25
17.4.5 Nugget diameter or seam weld width ... 26
17.5 Mechanical testing ... 27
17.5.1 Spot welds — Sheet ... 27
17.5.2 Spot welds — Foil ... 31
17.5.3 Seam welds — Foil ... 31
17.5.4 Multiple members test specimen ... 31

18 Welding procedure qualification record (WPQR) ... 32

Annex A (informative) **Machine qualification test report form ... 33**

Annex B (informative) **WPS form ... 36**

Annex C (informative) **Forms for welding procedure qualification record (WPQR) — Examples ... 37**

Annex D (informative) **Commentary on machine qualification ... 39**

Bibliography ... 42

© ISO 2017 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 44, *Welding and allied processes*, Subcommittee SC 14, *Welding and brazing in aerospace*.

This second edition cancels and replaces the first edition (ISO 16338:2013), of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

a) notes on different determination of clear annulus zone for radiographic and metallographic examination have been added under the keys of Figures 8 and 9;

b) transposed numbering in column *t* in Table 14 has been corrected: row changed for 0,60 mm and 0,65 mm;

c) 17.5.1.2 Span *S* is no longer expressed in %;

d) to correct a hanging paragraph, a 14.1.3.1 "General" subheading has been introduced;

e) other editorial revisions.

Requests for official interpretations of any aspect of this document should be directed to the Secretariat of ISO/TC 44/SC 14 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

Documents
Document Sharing Hub

INTERNATIONAL STANDARD ISO 16338:2017(E)

Welding for aerospace applications — Resistance spot and seam welding

1 Scope

This document specifies requirements for resistance spot and seam welding for aerospace applications.

This document does not apply if resistance welding is simply an intermediate operation and does not affect the quality of the end product, for example when tacking basic parts prior to assembly with another process.

Resistance welding of dissimilar material group combinations is not covered by this document.

Safety and health issues and concerns are not covered by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 6520-2, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 2: Welding with pressure*

ISO 14731, *Welding coordination — Tasks and responsibilities*

ISO 17677-1:2009, *Resistance welding — Vocabulary — Part 1: Spot, projection and seam welding*

ISO/TR 25901-1:2016, *Welding and allied processes — Vocabulary — Part 1: General terms*

ISO/TR 25901-3, *Welding and allied processes — Vocabulary — Part 3: Welding processes*

ISO/TR 25901-4, *Welding and allied processes — Vocabulary — Part 4: Arc welding*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6520-2, ISO 14731, ISO 17677-1, ISO/TR 25901-1, ISO/TR 25901-3, ISO/TR 25901-4 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
chisel test
destructive or non-destructive test in which welds are tested by applying a predominantly tensile force that results in stresses primarily normal to the surface of the joint interface

[SOURCE: ISO 10447:2015, 3.1, modified — “or non-destructive test” has been added and the note 1 to entry has been deleted.]

3.2
close spaced welds
spot welds with weld pitch of less than two diameters

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

3.3
coring
incipient melting
melting and resolidification of material at the grain boundaries of the heat affected zone and/or in the weld nugget

Note 1 to entry: These features appear to be cracks when examined at low magnification, but when examined at high magnification, are seen to be completely filled. This occurs primarily in nickel alloys.

3.4
design authority
engineering authority
organization having the responsibility for the structural integrity or maintenance of airworthiness of the hardware and compliance with all relevant documents

3.5
foil
joint member with a thickness of 0,20 mm or less

3.6
metallographic section
<resistance welding for aerospace applications> transverse cut on the diameter of a spot weld or across a seam weld, or a longitudinal cut down the centre of a seam weld

3.7
nugget
zone in spot, projection or seam weld where the metal has been melted

[SOURCE: ISO 17677-1:2009, 4.10, modified — "See Figure 2." following the term has been deleted.]

3.8
nugget diameter
diameter of nugget measured at the faying surface

3.9
nugget penetration
extent of the nugget or fusion zone into the thickness of a joined member

3.10
peel test
destructive test in which a resistance-welded lap joint is tested by applying a peel force which results in stresses mainly in the thickness direction of the weld

3.11
preliminary welding procedure specification
pWPS
document containing the required variables of the welding procedure which has to be qualified

[SOURCE: ISO/TR 25901-1:2016, 2.5.6]

3.12
production witness test specimen
weld of test specimen made in production setups and destructively tested to provide data on the qualities of production welds

© ISO 2017 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

3.13
resistance seam welding
<resistance welding for aerospace applications> resistance welding process which produces coalescence at the faying surfaces by the heat obtained from resistance to electric current through the work parts held together under pressure by electrodes

Note 1 to entry: The resulting weld is a series of overlapping resistance spot welds made progressively along a joint by turning wheel electrodes or indexing the part under fixed electrodes.

3.14
resistance spot welding
resistance welding process that produces a weld at the faying surfaces between overlapping parts by the heat obtained from resistance to the flow of welding current through the workpieces from electrodes that serve to concentrate the welding current and pressure at the weld area

[SOURCE: ISO 17677-1:2009, 1.12]

3.15
roll spot welding
resistance welding process variant that makes intermittent spot welds using one or more rotating circular electrodes

Note 1 to entry: The rotation of the electrodes might or might not be stopped during the making of a weld.

[SOURCE: ISO 17677-1:2009, 3.5]

3.16
seam weld width
width of the weld metal in the plane of the faying surfaces in a direction normal to the longitudinal axis of the linear seam weld

[SOURCE: ISO 17677-1:2009, 4.14]

3.17
sheet
<resistance welding for aerospace applications> joint member with a thickness of more than 0,20 mm

3.18
weld pitch
centre-to-centre distance between adjacent spot welds

[SOURCE: ISO 14373:2015, 3.4]

3.19
welding condition
<resistance welding for aerospace applications> provision for the manufacture of a given weld, including material, configuration, material preparation, cooling, electrode material, electrode geometry, welding machine number, and all weld parameters that have a direct influence on the quality of the weld

3.20
welding parameter
<resistance welding for aerospace applications> machine setting or adjustment

EXAMPLE Examples are electrode force, welding current, welding speed, welding time.

3.21
welding procedure specification
WPS
document that has been qualified and provides the required variables of the welding procedure to ensure repeatability during production welding

[SOURCE: ISO/TR 25901-1:2016, 2.5.4]

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

4 Symbols and abbreviated terms

D_s	minimum required nugget diameter or seam weld width (see Table 11)
e_l	lower electrode indentation
e_u	upper electrode indentation
F	force
l	length of test specimen
s_M	actual nugget diameter or seam weld width, as determined by metallographic examination
t	thickness of the thinner sheet
t_o	thickness of outer member
w	test specimen width/overlap
Ac	test lot average
NDT	non-destructive testing
pWPS	preliminary welding procedure specification
QA	quality assurance
SPC	statistical process control
WPQR	welding procedure qualification record
WPS	welding procedure specification

5 Specific engineering requirements

In the event of any conflict between the requirements of this document and those requirements specified in the engineering definition, the engineering definition shall take precedence.

The classification of the joint (see Clause 6) shall be designated on the part specification or drawing.

6 Classification of the joint

Classification of the joint is based on the following.

— Class I: a welded joint whose failure under operating conditions causes the loss of the aircraft/spacecraft or one of its main components, or constitutes a direct hazard to people.

— Class II: a welded joint whose failure causes malfunctions without compromising continued safe flight until the end of the mission.

— Class III: a welded joint whose failure does not affect the safety and the transport function of the aircraft/spacecraft.

7 Production requirements

Prior to production, the following requirements shall be met:

a) personnel qualification;

© ISO 2017 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

b) welding machine qualification;

c) welding procedure qualification.

8 Welding personnel requirements

The welding personnel shall be trained and be competent for the process. If requested by the design/engineering authority, ISO 14732 may be invoked.

9 Person responsible for welding procedure qualification and welding machine qualification tests

The welding coordinator (see ISO 14731) shall be designated, in writing, as responsible for welding procedure qualification and welding machine qualification test. The welding coordinator shall have knowledge and experience relevant to the welding process, and be acceptable to the responsible design/engineering authority or recognized examining body.

It is recommended that the welding coordinator be qualified as International Welding Engineer (IWE) according to IIW IAB-252-11.

The welding coordinator may authorize another person to administer the welding procedure qualification or welding machine qualification test.

10 Material groups

Material group A: unalloyed steel, low-alloyed steels, high-alloyed ferritic steels.

Material group B: high-alloyed austenitic and martensitic steels, nickel and nickel alloys, cobalt alloys.

Material group C: titanium and titanium alloys, niobium, zirconium and other reactive metals.

Material group D: aluminium and aluminium alloys, magnesium and magnesium alloys.

Material group E: materials that do not conform to material groups A to D (e.g. molybdenum, tungsten and copper alloys).

11 Preparation of parts to be welded

11.1 General

External and faying surfaces of the parts to be welded shall be free from contaminants, such as heavy oxides, scale, ink, grease, dirt or other substances, or surface conditions detrimental to the welding process. The surfaces shall be regular, this being a determining factor in ensuring good reproducibility of the weld.

11.2 Cleaning requirements

A specific cleaning procedure (e.g. pickling) shall be determined according to the materials and precisely defined by each manufacturer in line with the design/engineering authority requirements.

The cleaning procedure used to prepare materials for welding procedure qualification shall be specified on the pWPS. For materials in group D, surface resistance requirements shall be specified by the design/engineering authority.

Time limits between cleaning and welding shall be specified in the pWPS or other manufacturing documentation.

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

11.3 Surface coatings

Surface coatings, specified by the design/engineering authority, shall be identified in the pWPS.

11.4 Assembly

Mating parts assembled for welding shall fit so that before the first and each subsequent weld is made, the surfaces to be joined by the weld are in contact with one another or can be made to contact one another by manual pressure.

12 Equipment requirements

12.1 Welding machines

The welding machine shall be qualified according to Clause 13, calibrated and maintained according to manufacturer recommendations and/or any other requirements as defined by the design/engineering authority.

A preventative maintenance procedure shall be established and maintenance records kept.

12.2 Electrodes

All electrodes in use shall be permanently marked with the electrode material designator, as a minimum.

12.3 Shear testing machines

12.3.1 General

Shear testing machines shall be accurate to within ± 2 % of the indicated reading. The shear testing speed shall not exceed 13 mm/min.

12.3.2 Stationary shear testing machines

Stationary shear testing machines shall be calibrated for accuracy at intervals not to exceed one year.

12.3.3 Portable shear testing machines

Portable shear testing machines shall be calibrated for accuracy at intervals not to exceed two months.

12.4 Jigs and fixtures

Jigs and fixtures shall be so designed as to minimize the shunting of welding current through them instead of passing through the workpieces. All tooling that is required to locate welds or assist in the assembly of welded parts that passes through the magnetic field during the welding operation should be made of nonmagnetic materials insofar as possible.

13 Welding machines

13.1 Qualification requirements

13.1.1 General

Existing machine qualifications to other standards prior to the release of this document are considered qualified, unless otherwise specified by the design/engineering authority.

© ISO 2017 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

Prior to production, qualification shall be performed on each resistance spot or seam welding machine to determine its ability and consistency of operation. The purpose of qualification is to identify and verify the range of welding for which a welding machine may be considered capable. Welding conditions shall be documented on a WPS as part of a machine qualification test report. Typical examples of report forms are given in Annexes A and B. Such forms may be modified or expanded as required. After approval is obtained, these reports shall be available for review.

Machines shall be qualified to meet the weld requirements for the most critical class (see Clause 6) in each material group (see Clause 10) for which it is intended to be used in production. A welding machine qualified to weld to the requirements of one class in a material group shall be automatically considered qualified for less critical classes in the same material group. A spot welding machine qualified for spot welding is also qualified for overlap spot welding. Machines used for class III foil welding may be qualified by establishing a WPS. Machines qualified to a class for seam welding shall be considered qualified for roll spot welding to the same class.

13.1.2 Method of welding machine qualification

13.1.2.1 General

No maintenance work or control adjustments are permitted during the welding of test specimens.

13.1.2.2 Test materials

Test materials for material groups A, B, C and D qualification may be any material from that group commonly used in production.

Qualification with material of group A qualifies for welding material of group A only.

Qualification with material of group B qualifies for welding material of group B only.

Qualification with material of group C qualifies for welding material of group C only.

Qualification with material of group D qualifies for welding material of group D only.

Qualification with a specific material of group E qualifies for welding with the same material only.

13.1.2.3 Test requirements

Weld tests listed in 13.2 shall be performed and shall meet applicable acceptance criteria. For each material group, two test sets shall be required: the high-end (thickest) machine qualification test and the low-end (thinnest) machine qualification test. Typically, the high-end and low-end machine qualification tests are each made up of two members of equal thickness. Alternatively, members of different thicknesses and/or a weld combination of more than two members may be used. The following requirements shall be used to determine the required machine qualification tests to cover production work.

a) The total thickness of all members in a production weld combination shall not be more than the total thickness of all members in the high-end machine qualification test and shall not be less than the total thickness of all members in the low-end machine qualification test.

b) The thinnest contact member (member in contact with the electrode) of any production weld combination shall not be thicker than the thinnest member in the high-end machine qualification test

c) The thinnest contact member (member in contact with the electrode) of any production weld combination shall not be thinner than the thinnest member in the low-end machine qualification test.

d) If a machine is used for a specific weld combination then it need only be qualified for that weld combination according to the quantities and methods specified in 13.2.

NOTE 1 For examples of the application of rules stated in this subclause, see Annex D.

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

NOTE 2 If more than one welding machine of the same type is to be qualified, the extent of testing can be reduced at the discretion of the design/engineering authority.

13.1.2.4 Welding machine requalification

Requalification shall be required if the welding machine is rebuilt or if significant operational changes (e.g. replacement of main components, facility relocation and change of power supply) are made. The number of test specimens for sheet welding may be reduced (see Table 2).

Unless otherwise authorized by the design/engineering authority, when welding machine requalification is required, all WPS shall be requalified prior to production use.

Changes that do not require requalification of the welding machine are as follows:

a) change of location within a plant, which maintains the same electrical circuit;

b) general machine maintenance;

c) replacement of parts, such as electrodes and electrode holders, which do not affect the pressure or power characteristics.

13.2 Test piece configuration and examination requirements

Tests shall be as specified in Table 1 and as shown in Figure 1 and Figures 3 to 5.

Table 1 — Welding machine qualification test pieces and examination requirements

Class	Test piece	Amount per test set	Examination			
			Visual	Radiographic	Mechanical	Metallographic
Spot welds — Sheet						
I	Figure 1 a) or 1 b)	105 weld spots	all	all	100 shear	5 microsections
II	Figure 1 a) or 1 b)	105 weld spots	all	all	100 shear	5 macrosections
III	Figure 1 a) or 1 b)	53 weld spots	all	none	50 shear	3 macrosections
Spot welds — Foil						
I, II, III[a]	Figure 3	l = 300 mm continuous length of weld	all	none	peel	none
Seam welds — Sheet						
I	Figure 5	l = 600 mm continuous length of weld	all	all	none	8 microsections (4 transverse, 4 longitudinal)
II	Figure 5	l = 600 mm continuous length of weld	all	all	none	8 macrosections (4 transverse, 4 longitudinal)
III	Figure 5	l = 300 mm continuous length of weld	all	none	none	4 macrosections (2 transverse, 2 longitudinal)
Seam welds — Foil						
I, II, III[a]	Figure 4	l = 300 mm continuous length of weld	all	none	peel	none

[a] Machines used for class III foil welding may be qualified by establishing a WPS.

For welding machine requalification, the number of test specimens for sheet welding may be reduced according to Table 2.

© ISO 2017 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017

Table 2 — Machine requalification test pieces and examination requirements

Class	Test piece	Amount per test set	Examination			
			Visual	Radiographic	Mechanical	Metallographic
Spot welds — Sheet						
I	Figure 1 a) or 1 b)	53 weld spots	all	all	50 shear	3 microsections
II	Figure 1 a) or 1 b)	53 weld spots	all	none	50 shear	3 macrosections
III	Figure 1 a) or 1 b)	28 weld spots	all	none	25 shear	3 macrosections
Seam welds —Sheet						
I	Figure 5	l = 300 mm continuous length of weld	all	all	none	4 microsections (2 transverse, 2 longitudinal)
II	Figure 5	l = 300 mm continuous length of weld	all	all	none	4 macrosections (2 transverse, 2 longitudinal)
III	Figure 5	l = 150 mm continuous length of weld	all	none	none	2 macrosections (1 transverse, 1 longitudinal)

14 Welding procedure (WPS)

14.1 Qualification requirements

14.1.1 General

Existing WPS qualifications to other standards prior to the release of this document are considered qualified, unless otherwise specified by the design/engineering authority.

Prior to production, a WPS shall be established to produce the minimum strength, nugget diameter or seam weld width or quality requirement specified in this document or as defined by the design/engineering authority. Qualification results shall be entered on the test report, which includes the settings used to weld the test specimens. Weld settings shall not be adjusted during the welding of the qualification test specimens. After qualification acceptance, production setups shall be allowed to deviate from the WPS as allowed by 15.2.4.

NOTE If production parts are used for qualification, design/engineering authority approval can be required.

14.1.2 Determination of weld settings

For each welding machine and each combination of relevant material conditions (such as alloy, heat treatment, surface conditions, geometry, material stack-up and thickness combinations), effective welding machine settings for test and production parts shall be determined. The conditions and parameters shall be defined on a pWPS before welding the qualification test pieces. Typical examples of report forms are given in Annexes A and B. These shall be modified or expanded as required. After acceptance, production setups shall be made to the qualified pWPS, with the variation of 15.2.4 allowed.

14.1.3 Methods of welding procedure qualification

14.1.3.1 General

A welding procedure shall be qualified by one of the following methods.

© ISO 2017 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16338:2017