BRITISH STANDARD

BS 7670 :
Part 2 : 1997

Steel nuts and bolts for resistance projection welding

Part 2. Specification for welding of weld nuts and weld bolts

ICS 21.060.10; 21.060.20; 25.160.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee WEE/29, Resistance welding, upon which the following bodies were represented:

British Iron and Steel Producers' Association
Railway Industry Association
Society of Motor Manufacturers and Traders Limited
Welding Institute
IIW-UK Briefing Group III
Co-opted

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 March 1997

Amendments issued since publication

Amd. No.	Date	Text affected

The following BSI references relate to the work on this standard:
Committee reference WEE/29
Draft for comment 95/703043 DC

ISBN 0 580 25550 6

Contents

Foreword

This Part of BS 7670 has been prepared by Technical Committee WEE/29. It specifies weld nuts and weld bolts for resistance welding processes. It supersedes BS 2996 : 1958 which is withdrawn.

This Part should be used in conjunction with Part 1: *Dimensions and properties* which specifies weld bolts and weld nuts.

In a standard of this type, which covers a wide range of engineering applications, it is not practicable to set out specific requirements for equipment or welding conditions to be used. However, guidance on these subjects is given in annexes A to C. Similarly, it is not possible to specify acceptance requirements.

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, pages 1 to 6, an inside back cover and a back cover.

Specification

1 Scope

This British Standard specifies projection welding of weld nuts and weld bolts singly to uncoated and coated steel sheet from 0.5 mm to 5.0 mm thick. Annex A gives recommendations for appropriate welding equipment and annex B outlines typical welding conditions.

NOTE 1. It is emphasized that this type of weld is loaded in compression only. The purpose of the weld is to prevent the fastener from rotating during assembly or disassembly of a fabrication. It is not intended as a structural weld.

This standard specifies weld nuts and weld bolts, the design, dimensions and materials of which are detailed in Part 1 of this standard. Annular projections are not included. In addition to the definitive requirements specified throughout the standard, the documented items detailed in clause **5** shall be satisfied before a claim of compliance with the standard can be made and verified.

2 References

2.1 Normative references

This Part of BS 7670 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 7670 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This Part of BS 7670 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this British Standard the definitions in BS 499 : Part 1 : 1991 apply.

4 Steel

The steel sheet or plate to which the nuts or bolts are to be welded shall be flat rolled in coil or cut length. The thickness shall be from 0.5 mm to 5.0 mm.

Uncoated sheet and strip material shall conform to BS 1449 : Part 1 : Section 1.1. Uncoated plate material shall conform to BS 1449 : Part 1 : Section 1.1, BS EN 10025, or BS EN 10113-3, as relevant.

Coated material shall conform to the relevant requirements and chemical composition specified in BS EN 10142, BS 6536, BS 6582, BS EN 10152, BS EN 10215, and BS EN 10147.

NOTE 1. The recommended application of hole diameter and sheet thickness is given in table 1.

NOTE 2. For a fixed fastener diameter, welding becomes more difficult the larger the sheet thickness. Greater care should be taken when welding coated steels.

5 Information and requirements to be agreed and to be documented

5.1 Information to be supplied by the purchaser

The following information to be supplied by the purchaser shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

a) Whether a special surface treatment is to be applied (clause **6**).

b) Whether a gap between the components to be welded can be tolerated (clause **12**).

c) Which methods of reclamation, if any, are permitted (clause **13**).

d) Whether it is the intention of the purchaser to inspect the production and testing of the parts ordered.

5.2 Requirements to be agreed

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

a) The hole diameter for square nuts (**10.2** and table 1).

b) The procedure for welding assessment tests (**11.1**).

c) Whether a peel test is to be carried out (**11.2.3**).

d) The number, form and frequency of testing of test pieces.

e) Whether a torque value is to be the acceptance criterion for the torque test and, if so, the level of this torque value (**11.2.2**).

f) Whether a peel test or a torque test is to be used to confirm a satisfactory weld in the routine inspection of welded components (clause **12**).

g) Any reclamation of faulty work, other than by further projection welding, to be made and the method to be used (clause **13**).

6 Surface conditions

Prior to welding, all surfaces to be projection welded shall be free from grease, scale, rust, paint, dirt or excessive pitting.

NOTE. Certain surface treatments such as the application of rust prevention treatment, oiling or plating may be applied before welding, provided that the coating is uniform in thickness and that it has been proved that consistent welds which conform to this standard can be obtained. It should be recognized that different welding conditions may be necessary, depending on the type of pre-treatment used, e.g. phosphate- or chromate-treated coated steels.

7 Edge conditions and form of component

The surfaces of the component to which the fastener is to be welded shall be free from burrs or other defects that would in any way interfere with the proper collapse of the projections during welding, or cause current to flow other than through the projections.

NOTE. No identification or maker's mark should be on the face in contact with the electrode.

The form of the sheet metal component shall be such that the collapse of the projections on the fastener can take place unrestrained by any other surface contacts.

The form of the sheet metal component shall be such that the welding force is equally distributed over all the projections, prior to and during welding.

8 Shape and dimensions

The shapes of projections and dimensions for the fasteners shall conform to figures 1, 2, and 3 and tables 1, 3 and 4 respectively of BS 7670 : Part 1.

9 Materials for electrode assembly

The electrode holder shall be of copper alloy of sufficient section and strength to carry the welding current and electrode force (see table B.1) without overheating or deforming.

NOTE. The electrode assembly can consist of an electrode holder and electrode(s) with or without insert(s).

The part in contact with the workpiece shall be either the electrode(s) or the insert(s) in accordance with annex A of BS 4577.

10 Design of electrode assembly

10.1 Contact faces

The electrode in contact with the fastener shall support the complete area of the weld nut or bolt head. The electrode in contact with the sheet metal component shall have a minimum section of 1.5 times the cross-sectional area of the weld nut or bolt head.

If copper alloy inserts are used, the electrode shall be capable of supporting the electrode force used without distortion. The insert shall be attached to the electrode in such a manner as to give good electrical and thermal contact.

NOTE 1. Contact faces should ensure intimate contact with workpieces for minimum contact resistance.

NOTE 2. Cooling arrangements should bring the cooling water as close as possible to the contact faces, in order to minimize electrode wear and maintain weld quality.

10.2 Location of components

10.2.1 *Weld nut*

The weld nut shall be located as shown in figure 1 either by means of a central pin or by the outer form of the weld nut itself. In all cases where a pin is used as a locator, the welding current shall pass only through the projection and not through the means of location, particularly between the pin and the thread inside the nut.

NOTE 1. In some cases the location pin can be provided with a shoulder to locate the sheet metal component relative to the nut. The pin may also be spring loaded to retract into the electrode by the descent of the upper electrode, or may be retracted by means of a pneumatic cylinder.

Dimensions for the hole in the sheet shall conform to table 1. For hexagonal nuts, the values quoted for d_5 are a requirement.

NOTE 2. For square nuts d_4, the values are recommended values only, as d_4 can vary according to the method used for location of the nut. In this latter case, the hole diameter should be agreed between the manufacturer and the purchaser (see **5.2**).

If ceramic pins are used, the diameter of the clearance hole for square nuts d_4 shall be 1 mm greater than the thread clearance. This is not applicable to collared nuts.

10.2.2 *Weld bolt*

The weld bolt shall be located as shown in figure 2.

a) Square nut

b) Hexagonal nut

Figure 1. Positioning of square and hexagonal nuts prior to welding

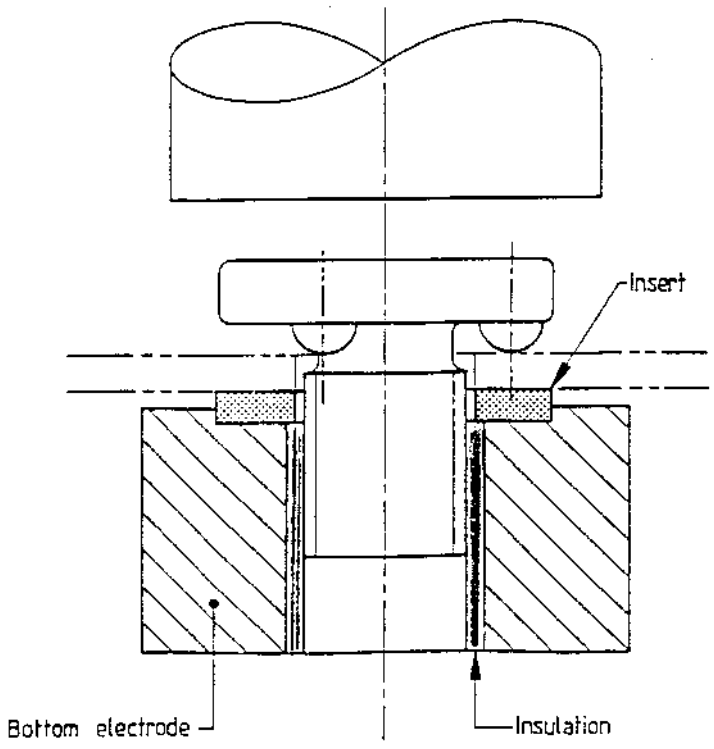

Figure 2. Location of weld bolt

11 Weld assessment

11.1 General

Welding procedure information shall be recorded for each machine, for each combination of weld nut size and sheet metal thickness. The record of procedures shall be based on the appropriate items listed in annex C.

The following tests shall be carried out:

a) thread test (see **11.2.1**);

b) torque test (see **11.2.2**);

c) peel test (see **11.2.3**) (applies to weld nuts only); (optional, by agreement between the contracting parties).

11.2 Test methods and conditions

11.2.1 *Thread test*

A bolt of the specified thread size shall be engaged in the nut and shall travel freely through the whole length of the thread of the nut and the sheet to which the nut is attached.

11.2.2 *Torque test*

Hold or clamp the welded assembly so that minimal panel distortion occurs during the test. Using a torque spanner fitted with a socket or adaptor to fit the weld nut or bolt, apply torque in a steadily increasing manner up to the agreed value.

On the torque test, the bolt shall fail or the thread shall strip before the joint fractures unless a torque value, previously agreed between the contracting parties, is achieved.

NOTE. Typical guideline values are given in table 2.

11.2.3 *Peel test*

If required (see **5.2** item c), the peel test shall be as follows. Hold the welded assembly, by means of the fastener, firmly in a vice. Using a hammer and chisel or pliers, peel the sheet away from the fastener. A portion of the material from either component at each projection shall be pulled away.

12 Routine inspection of welded components

At the beginning of each welding period, a peel or torque test, as agreed between the purchaser and supplier (see **5.2**) shall be performed in accordance with clause **11**. In the event of this pre-production test failing, any subsequent welding shall be deemed not to conform to this British Standard.

In the event of the test piece tested at the end of the shift or work period failing, 2 % or 10 pieces, whichever is the greater, shall be selected from the production during the period following the previous test on that machine and shall be tested in accordance with clause **11**. In the event of any of the selected components failing, the whole of the production during that period shall be deemed not to conform to this British Standard.

For visual inspection, no dressing, painting or other operation interfering with the examination of the weld zone shall be carried out on the assemblies until after the welding has been inspected.

The welded components shall conform to the design drawings and unless otherwise specified, a gap shall be allowed between components provided they conform to clause **11**.

13 Reclamation

Faulty work shall not be reclaimed by further projection welding of the same components.

NOTE. Other methods of reclamation may be used, by agreement between purchaser and manufacturer (see **5.1**).

Table 1. Weld nut size relative to sheet thickness

Thread size as specified in BS 7670 : Part 1	Sheet or strip thickness, a		Hole diameter d_4 and d_5
	min.	max.	
M3	0.50	2.5	4.5
M4	0.75	3	6
M5	0.88	3.5	7
M6	0.88	4	8
M8	1	4.5	10.5
M10	1.25	5	12.5
7/16 - 20 UNF -2B	1.25	5	13.5
M12	1.5	5	14.8

NOTE. d_4 and d_5 have the same dimensions in order to allow interchangeability but d_4 may be varied by agreement between the contracting parties (see **10.2**).

Table 2. Typical torque values for weld nuts

Nominal thread size	Minimum torsional load N·m
M3	3.5
M4	6
M5	12
M6	20
M8	50
M10	100
7/16 − 20 UNF	136
M12	180

Annexes

Annex A (informative)

Recommendations for appropriate welding equipment

The machine should be equipped with automatic control gear which, on the initial actuation of a foot-operated or hand-operated auxiliary switch, automatically performs at least the following cycle of operations in the sequence given:

a) brings the electrodes into contact with the components, and applies an electrode force to the workpiece;

b) causes the welding current to flow after the pre-set electrode force has been attained;

c) maintains the flow of welding current for a pre-set time, the electrode force being maintained throughout;

d) interrupts the welding current at the end of the pre-set time;

e) maintains the electrode force for a minimum of 0.1 s (the forging time), after the current ceases to flow;

f) releases the electrode force at the end of this time and returns the welding machine to a condition where it is ready to recommence the same cycle of operations again.

NOTE 1. The moving head of the machines should be free to move in the direction of the applied loads, so that it will follow the collapse of the projection and maintain the load on the weld as it is formed. The electrodes of the machine should remain parallel, as far as possible, throughout the welding process.

NOTE 2. The welding force, welding current, weld time and the forging time should be variable over a range sufficient to ensure that optimum welding conditions can be obtained.

NOTE 3. The following standards are relevant to resistance welding equipment : BS 3065, BS 4577 and BS EN 20865.

Annex B (informative)

Typical welding conditions

Typical welding conditions are given in table B.1 for weld nuts, the form and dimensions of which are shown in BS 7670 : Part 1 : 1993. Typical welding conditions are given in table B.2 for the most common sizes of weld bolts, the form and dimensions of which are given in BS 7670 : Part 1 : 1993.

Table B.1 Typical welding condition for square weld nuts					
Thread size	**Sheet thickness**	**Electrode force**	**Weld time**		**Current**[1)]
	mm	kN	cycles	s	kA
M4	1.0	2.9	5	0.10	7.5
	2.0	3.1	5	0.10	8.0
M5	1.0	3.6	5	0.10	9.0
	2.0	3.8	5	0.10	9.5
M6	1.0	4.2	6	0.12	10.5
	2.0	4.5	6	0.12	11.0
M8	1.0	4.9	9	0.18	17.0
	2.0	5.1	10	0.20	18.0
M10	2.0	6.0	10	0.20	21.0
M12	2.0	7.1	12	0.24	24.0

[1)] Current is quoted for guidance only and should be adjusted to compensate for variations in components, equipment or power supply.

Table B.2 Typical welding conditions for weld bolts					
Thread size	**Sheet thickness**	**Electrode force**	**Weld time**		**Current**[1)]
	mm	kN	cycles	s	kA
M5	1.0 to 2.0	2.7	12	0.24	8
M6	1.5 to 2.5	3.5	15	0.30	8.5
M8	1.5 to 2.5	3.5	15	0.30	9.5

[1)] Current is quoted for guidance only and should be adjusted to compensate for variations in components, equipment or power supply.

Annex C (informative)

Welding procedure information

Some or all of the following information should appear on the welding procedure sheet:

a) welding procedure number;

b) related specification and/or drawing number;

c) material to be welded: specification number or composition;

d) metallurgical condition of material;

e) welding machine;

f) top electrode particulars;

g) bottom electrode particulars;

h) cleaning procedure for material;

i) fastener size and means of location;

j) clearance and hole size tolerances;

k) weld configuration;

l) welding sequence;

m) particulars of welding conditions or machine settings:

1) throat depth;

2) throat gap;

3) electrode force;

4) squeeze time;

5) weld time;

6) hold time;

7) transformer tap setting;

8) heat control position or welding current;

n) routine for making test welds.

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 499	*Welding terms and symbols*
BS 499 : Part 1 : 1991	*Glossary for welding, brazing and thermal cutting*
BS 1449	*Steel plate, sheet and strip*
BS 1449 : Part 1:	*Carbon and carbon-manganese plate, sheet and strip*
BS 1449 : Part 1 : Section 1.1 : 1991	*General specification*
BS 4577 : 1970	*Specification for materials for resistance welding electrodes and ancillary equipment*
BS 6536 : 1985	*Specification for continuously hot-dip aluminium/silicon coated cold reduced carbon steel sheet and strip*
BS 6582 : 1985	*Specification for continuously hot-dip lead alloy (terne) coated cold reduced carbon steel flat rolled products*
BS 7670	*Steel nuts and bolts for resistance projection welding*
BS 7670 : Part 1 : 1993	*Specification for dimensions and properties*
BS EN 10025 : 1993	*Hot rolled products of non-alloy structural steels — Technical delivery conditions*
BS EN 10113	*Hot-rolled products in weldable fine grain structural steels*
BS EN 10113 : Part 3 : 1993	*Delivery conditions for thermomechanical rolled steels*
BS EN 10142 : 1991	*Specification for continuously hot-dip zinc coated low carbon steel sheet and strip for cold forming: technical delivery conditions*
BS EN 10147 : 1992	*Specification for continuously hot-dip zinc coated structural steel sheet and strip — Technical delivery conditions*
BS EN 10152 : 1994	*Specification for electrolytically zinc coated cold rolled steel flat products — Technical delivery conditions*
BS EN 10215 : 1995	*Continuously hot-dip zinc-aluminium (AZ) coated steel strip and sheet — Technical delivery conditions*

Informative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 3065 : 1982	*Specification for rating of resistance welding equipment*
BS EN 20865 : 1992	*Slots in platens for projection welding machines*

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