

Specification for

Class I oxy-acetylene welding of ferritic pipework for carrying fluids

ICS 25.160.10

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Foreword

This revision of this British Standard has been prepared under the direction of the Welding Standards Committee. It embodies the technical developments that have taken place since the previous edition was published in 1957. BS 1821:1957 is now withdrawn. On common aspects the standard has generally been aligned with BS 2633.

Although for carbon steels with not more than 0.25 % carbon, either this standard or BS 2640 may be used according to whether class I or class II welding is required, it is recommended that carbon steels with a carbon content exceeding 0.25 % and the low alloy steels covered by this standard be welded in accordance with the requirements of this standard irrespective of the operating conditions. Because of its increased use for quality control purposes, non-destructive testing has been introduced together with the allied acceptance levels.

The relevant application standard, where it exists, should specify whether class I welding of pipework is required, but the factors to be taken into account in coming to such a conclusion are the operating conditions of the pipework, the degree of inspection and the acceptance requirements. (See also Appendix A.)

The following are companion standards to this standard:

BS 2633, *Class I arc welding of ferritic steel pipework for carrying fluids.*

BS 2640, *Class II oxy-acetylene welding of carbon steel pipework for carrying fluids.*

BS 2971, *Class II arc welding of carbon steel pipework for carrying fluids.*

BS 4204, *General requirements for the flash welding of steel pipes and tubes for pressure and other high duty applications.*

BS 4677, *Class I arc welding of austenitic stainless steel pipework for carrying fluids.*

Inspecting authority. The term “inspecting authority” refers to that competent independent body or association which verifies compliance with this standard.

Pipe and tube. In this British Standard the word “pipe”, alone or in combination, is used to mean “pipe” or “tube”, although these terms are often used for different categories of product by different industries.

Pipe dimensions. Unless otherwise qualified, for the purposes of this British Standard “pipe diameter” relates to the specified value of the outside diameter and “pipe thickness” relates to the specified value of the wall thickness of the pipe in the as supplied condition.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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 to iv, pages 1 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This British Standard specifies requirements for both shop and site class I oxy-acetylene welding of joints in ferritic steel pipework of a thickness not exceeding 10 mm intended to carry fluids.

Attention is particularly drawn to Appendix B which lists items for agreement between the contracting parties.

2 References

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

3 Parent metals

This standard relates to pipes and attachments made from the types of steels listed in Table 1. The use of equivalent alternative steels to those complying with the standards stated in Table 1 is permitted. The material used for pipes and fittings shall be fully suitable for the service conditions.

While the requirements and limitations of this standard apply also to the welding of cast parts, additional precautions in inspection and welding procedure that may be necessary to deal with the presence of non-metallic inclusions or porosity, shall be subject to agreement between the purchaser and the manufacturer.

4 Filler rods

Filler rods of the types specified in Table 1 complying with the requirements of BS 1453 shall be used.

5 Equipment

All welding equipment shall be in good condition and such as to enable the welder to maintain the correct neutral flame at all times.

Where necessary, staging and protection from the weather shall be provided to enable the welding operation to be performed properly.

6 Welding technique

Welding shall be carried out by any of the techniques described in Appendix C, subject to the limits imposed in Table 4.

7 Proximity of welds

The design of joints shall be such as to provide adequate access for the deposition of weld metal to meet the requirements of this standard.

Joints where more than two welded seams meet should be avoided. If the design cannot avoid this, then appropriate precautions shall be taken which shall be agreed between the manufacturer, the purchaser and the inspecting authority.

Table 1 — Parent metals and filler rods

Material classification	Pipe standards	Types of filler rod to BS 1453
Carbon steel ≤ 0.25 C	BS 3059-1-320 BS 3059-2-360 and 440 BS 3601-320, 360 and 430 BS 3602-1-360, 430 BS 3602-2-430 BS 3603-430LT BS 3606-320 and 440	A2 or A3
C-Mo	BS 3059-2-243 BS 3606-243 and 261	A6 or A7
1 Cr $\frac{1}{2}$ Mo 1 $\frac{1}{4}$ Cr $\frac{1}{2}$ Mo	BS 3059-2-620 BS 3604-620 BS 3606-620 BS 3604-621 BS 3606-621	A32

8 Fusion faces

The fusion faces and the adjacent material shall be free from moisture, scale, rust, paint, grease or other foreign matter immediately prior to welding.

Certain proprietary protective coatings are specially formulated with the intention that they should not interfere with subsequent welding. The use of such coatings is not excluded by the requirements of this clause, but if so required by the purchaser the manufacturer shall demonstrate by means of specimen welds that the coating does not affect the quality of the weld.

9 Assembly for welding

To maintain the specified alignment and gap during welding (see Table 2 and Table 4) the pipes to be welded shall be securely held in position by mechanical means, welded-on bridge pieces or tack welding. If tack welding is adopted, the tack welds shall be either melted out during welding or made as part of the main weld and of the same quality as that weld.

It is appreciated that there may be difficulty in complying strictly with the specified requirements for the root gap. Slight modifications imposed by practical considerations shall be subject to agreement between the purchaser and the manufacturer.

10 Cold pull

Where the effects of thermal expansion in service are to be counteracted by “cold pull” during erection of the pipe assembly, the “cold pull” shall be maintained during welding, post-weld heat treatment (if any) and cooling.

Before applying “cold pull” to a joint, all other joints in the pipe assembly shall have been welded, subjected to any post-weld heat treatment, inspected and accepted.

11 Heat treatment

It is advisable for the purchaser in all cases to inform the manufacturer of the use to which the pipework will be put. Normalizing or other post-weld heat treatment is not required for welded joints in pipework covered by this standard, unless the purchaser states in the enquiry and order that welds are to be heat treated, in which case all details relating to such heat treatment shall be agreed between the contracting parties.

12 Inspection

The purchaser or his representative shall have access at all reasonable times to those parts of the works or site engaged on the preparation, fabrication and testing of the pipe assemblies which he has ordered.

Section 2. Butt joints¹⁾

13 General

Section 1 of this standard details the basic procedure requirements with which all welded joints between pipes and fittings shall comply. These basic requirements are supplemented by the specific requirements detailed in this section 2. Both section 1 and section 2 of this standard shall be applied in determining the full procedure requirements.

14 All types of butt joint

14.1 Matching of ends. The bores of the ends of adjacent pipes shall preferably, for welding purposes, match exactly, but in any case shall not differ at any diameter by more than the amounts specified in Table 2, whilst the alignment shall be within the limits specified in that table.

NOTE 1 The difference in thickness that can be tolerated between adjacent pipes for oxy-acetylene welding decreases with increasing pipe thickness.

NOTE 2 It is recognized that the ends of pipes and welding fittings are supplied to standard tolerances and may not match, especially if placed together at random. Additional workmanship may therefore be required to ensure the alignment specified in Table 2.

The welding of pipe joints in accordance with this standard shall include the proper sizing or matching by the welding contractor of the pipe ends at each joint, if necessary, before welding. (See also Figure 1(a).) Matching shall be effected by selection, drifting, machining or the use of a suitable expander. If drifting is employed, a slow taper drift shall be used under the conditions specified in Table 3.

When drifting or expanding hot, the pipes shall be heated to a temperature either within the range 900 °C to 975 °C or within the range 500 °C to 620 °C.

Wherever the thickness is reduced by drifting, machining or expanding, the thickness at every point in the circumference clear of the weld preparation shall be not less than the design thickness for the particular pipe. Any machining shall run out smoothly at a taper not steeper than 1 in 4 [see Figure 1(b) and Figure 1(c)].

NOTE 3 If the maximum permissible amount of machining is insufficient to match the ends, drifting should be employed, but a combination of drifting or expanding, with machining within the permitted limits, may also be used.

14.2 Preparation of pipe ends. The joint preparation for the pipe ends shall comply with the requirements of Table 4 appropriate to the welding technique adopted.

NOTE Although Table 4 provides for the welding of pipes with square cut ends, this requires a greater degree of skill on the part of the welder.

The ends shall be prepared by sawing, machining, grinding or machine gas cutting or by hand flame cutting with subsequent filing or grinding if necessary.

For pipes which are intended to be in axial alignment, the plane of the ends shall be square with the axis of the pipe. For pipes which are intentionally out of axial alignment, the plane of the joint shall bisect the angle between adjacent pipes.

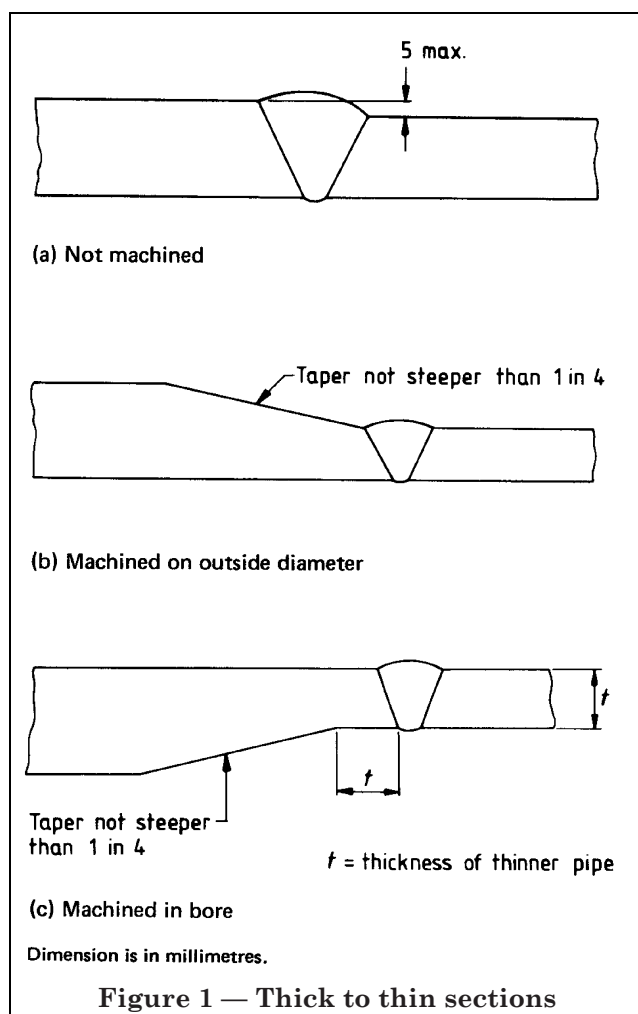
Table 2 — Sizing and alignment

Outside diameter		Maximum permissible difference in internal diameter	Maximum out of alignment at the bore
Over	Up to and including		
mm	mm	mm	mm
—	42.4	0.8	0.8
42.4	114.3	1.6	0.8
114.3	—	3.0	1.6

¹⁾ In this section the term “pipe” is intended to cover pipes and fittings, (e.g. welding neck flanges, forged tees, welding elbows).

Table 3 — Drifting of pipe ends

Outside diameter		Amount of expansion as percentage of diameter	Condition for expansion
Over	Up to and including		
mm	mm		
—	323.9	Not more than 3 %	Hot or cold (as desired)
		Over 3 %	Hot
323.9	—	All values	Hot



15 Gusseted bends

15.1 General. The service conditions for which gusseted bends may be used shall be the subject of agreement between the purchaser, the manufacturer and the inspecting authority, except where an application standard permits the use of such bends.

Gusseted bends are of the following types.

- Segmental*: separate pieces of pipe cut at an angle and welded together.
- Cut-and-shut*: wedge shaped pieces cut from one side of a pipe, the pipe pulled round until the cut edges come to the correct welding position and then welded.

15.2 Preparation

15.2.1 General. The preparation of any gusset for any gusseted bend shall be done by cutting the pipe end to the correct angle followed by the weld preparation as specified in 14.2.

To prepare the gussets for welding, all spatter, oxide and ragged edges shall be removed from the prepared edge and the bore of the pipes, the correct gap shall be set and the gussets tacked in position.

15.2.2 Segmental bends. The planes of ends of the separate pieces of pipe prepared for welding to form a segmental bend shall be inclined at the same angle to the axis of the piece.

The change of angle of the centreline at each cut shall not exceed approximately 30° except that right angle bends of radius equal to the inside diameter of the pipe made from pipe not exceeding 88.9 mm outside diameter may be made with a minimum of two cuts (see Figure 2).

For segmental right angle bends of radius equal to the inside diameter of the pipe, the dimensions of the segments at the throat of the bend shall be as shown in Figure 2. The width of the segment at the throat of the bend measured at the outside diameter of the pipe shall not be less than 16.5 mm.

15.2.3 Cut-and-shut bends. A cut-and-shut bend shall have the angle of cut equally disposed about a line at right angles to the axis of the pipe (see Figure 3).

15.3 Welding procedure. A weld in a gusseted bend shall be treated as a butt weld and the requirements of clauses 9 and 13 and 14.2 shall apply.