

Specification for

Arc welding of austenitic stainless steel pipework for carrying fluids

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Committees responsible for this British Standard

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- Associated Offices Technical Committee
- British Gas Corporation
- British Non-ferrous Metals Federation
- British Steel Industry
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Health and Safety Executive
- Heating and Ventilating Contractors' Association
- Institute of Refrigeration
- Institution of Gas Engineers
- Institution of Mechanical Engineers
- Joint Industry Board for Plumbing Mechanical Engineering Services in England and Wales
- Power Generation Association (BEAMA Ltd.)
- Stainless Steel Fabricators' Association of Great Britain
- United Kingdom Atomic Energy Authority
- Water-tube Boilermakers' Association
- Welding Institute
- Welding Manufacturers' Association (BEAMA Ltd.)
- Coopted member

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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 first edition was published in 1971. On common aspects the standard has been aligned with BS 2633. BS 4677:1971 is withdrawn.

It should be appreciated that the welding or post-weld heat treatment of austenitic stainless steel pipework can cause discoloration or oxidation of pipe surfaces. If these effects are not acceptable for the finished product then it is a matter for agreement between the contracting parties to have the welded pipes cleaned after welding.

The following are companion standards to this standard:

BS 1821, *Specification for class I oxy-acetylene welding of ferritic steel pipework for carrying fluids.*

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

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

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

BS 4204, *Specification for flash welding of steel tubes for pressure applications.*

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 purpose 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.

At the time of publication of this British Standard, no corresponding international standard exists.

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.

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 42, 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 arc welding, using manual, semi-automatic, automatic and mechanized welding processes or combinations of these, of joints in austenitic stainless steel pipework intended to carry fluids.

In addition to the definitive requirements, it also requires the items detailed in clause 2 to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

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

2 Information and requirements to be agreed and to be documented

2.1 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 documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

- a) The application standard to be used if any.
- b) Whether records of materials used during fabrication are required (see 3.2).
- c) Whether special procedure tests are required for transition joints (see clause 22).
- d) Whether completed welds are to be ground (see 39.1).
- e) Lower limits on bore protrusion when required (see 39.4).
- f) The percentage of each welder's production of butt joints to be radiographed when more than 10 % is required (see 40.1.1).
- g) Whether liquid penetrant testing is required [see 40.3 b)].
- h) Alternative fault limitations when required (see 41.2).
- i) Whether welding procedure tests using pipe of specified diameter and thickness are required (see 45.2).

2.2 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 material to be used for pipes and attachments (see 3.1).
- b) The precautions in inspection and welding procedure required when welding cast parts (see 3.3).
- c) The use of weld metal having a different composition to that of the parent metal (see 5.1).
- d) The need for ferrite control (see 5.1).
- e) The metal for permanent backing rings if other than of similar composition to the pipe [see 9.1 b)].
- f) The use of copper backing rings (see 9.3).
- g) The precautions to be taken when design factors preclude the avoidance of certain circumstances relating to the proximity of welds (see 11.3).
- h) Details of any post-weld heat treatment when there is no application standard [see 20.1 b)].
- i) The method of attaching thermocouples (see 21.4).
- j) The service conditions for which segmental bends are to be used (see 25.1).
- k) The method and amount of inspection for partial penetration welds on structural attachments (see 35.2).
- l) The inspection and testing requirements for other than butt joints (see 40.1.2).
- m) The radiographic technique to be used (see 40.2).
- n) The use of a method other than liquid penetrant testing to check the building-up of the base of a groove for making a repair weld [see 43.3 b)].
- o) The use of a joint preparation incorporating a wider root gap for making a repair weld [see 43.3 c)].

3 Parent metal

3.1 The parent metal for pipes (including those with a longitudinal or helical welded seam) and attachments shall be one of the types of steel listed in Table 1. The material selected shall be agreed between the contracting parties, taking account of its suitability for the service conditions.

NOTE 1 Austenitic stainless steel pipework may be specified for a wide range of duties, and the correct grade of steel should be chosen, depending on the duty involved. Factors to be considered include the nature of the fluid to be handled and the operating temperature.

NOTE 2 Appendix A gives details of grades in British Standards for the types of steel listed in Table 1.

Table 1 — Parent metals

Types of steel
18 Cr 10 Ni
18 Cr 12 Ni, low carbon
18 Cr 12 Ni, Ti stabilized
18 Cr 12 Ni, Nb stabilized
18 Cr 12 Ni 2½ Mo
18 Cr 12 Ni 2½ Mo, Ti stabilized
18 Cr 12 Ni 2½ Mo, low carbon
18 Cr 12 Ni 3½ Mo
15 Cr 10 Ni 6 Mn Nb V
25 Cr 20 Ni

3.2 When required by the purchaser, the manufacturer shall maintain records of the materials used during fabrication.

3.3 While the requirements 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, alloy segregations or porosity, shall be subject to agreement between the contracting parties.

4 Condition of pipes before welding

Unless otherwise stated in any relevant application standard or unless the welded pipework is to be solution heat treated, pipes shall be in the solution heat treated condition before welding.

5 Weld metal

5.1 Chemical composition

Weld metal, including that from fusible inserts, having a different chemical composition to that of the parent material shall only be used by agreement between the contracting parties. When the need for ferrite control is agreed between the contracting parties, the delta ferrite content of the weld metal shall be determined as part of the welding procedure test.

NOTE 1 In the case of autogenous welding, the composition of the parent metals may have to be modified to ensure control of delta ferrite.

NOTE 2 Guidance on suitable types of weld metal is given in Appendix B.

NOTE 3 When high temperature creep rupture properties are important, care should be taken to ensure that the high temperature mechanical properties of the weld metal fulfil design requirements.

5.2 Submerged arc welding consumables

Electrode wire/flux combinations shall be such that the chemical composition of the weld metal complies with BS 5465.

Since welding conditions have a significant effect on the chemical composition of the weld metal, the required composition shall be established under test conditions similar to those to be used on the actual fabrication. The welding conditions shall be controlled to ensure consistent weld metal composition, especially where the alloying elements are contained in the flux.

5.3 Storage and handling

Electrodes, filler wires and rods, and fluxes shall be stored and handled so as to avoid damage or deterioration to them and to the containers in which they are transported. Electrodes, filler wires and rods, and fluxes that show signs of damage or deterioration shall not be used.

6 Gases for shielding and purging

6.1 Shielding gases

Where appropriate, gases or gas mixtures of the following quality shall be used.

- a) *Argon*, complying with BS EN 439.
- b) *Argon/oxygen mixtures*, consisting of argon, with up to 5 % added oxygen and complying with BS EN 439.
- c) *Argon/carbon dioxide mixtures*, consisting of argon, with up to 20 % added carbon dioxide, with or without up to 5 % oxygen and complying with BS EN 439.
- d) *Argon/hydrogen mixtures*, consisting of argon, with up to 5 % added hydrogen and complying with BS EN 439.
- e) *Helium*, complying with BS EN 439.
- f) *Other gases or gas mixtures* that have been proved to be satisfactory as a result of procedure approval tests.

6.2 Gases for back purging

For purging the back of a weld during welding, argon, argon/hydrogen mixtures or helium of the quality specified in 6.1 or one of the following gases shall be used.

- a) *Nitrogen*, complying with BS EN 439.
- b) *Nitrogen/hydrogen mixtures*, consisting of nitrogen with up to 5 % hydrogen and complying with BS EN 439.

7 Equipment

Welding plant, instruments, cables and accessories shall comply with the appropriate Parts of BS 638. Their capacity shall be adequate for the welding procedure proposed and subsequently to be approved.

The installation, operation and maintenance shall be effected by competent persons in accordance with the appropriate safety recommendations. All electrical equipment used in connection with the welding operation shall be adequately earthed.

Adequate means of measuring current shall be available either as part of the welding plant or by the provision of a portable ammeter. In the case of semi-automatic, automatic and mechanized welding, means shall be provided for measuring the arc voltage since this may exert considerable influence on the form, composition and soundness (e.g. porosity) of the weld. When using a gas-shielded welding process, means of measuring the gas flow shall be provided.

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

8 Welding processes

8.1 Complete welds

Welds shall be made by one of the following welding processes or by a combination of those processes:

- manual metal-arc welding
- MIG welding
- metal active-gas welding
- TIG welding
- submerged-arc welding
- flux cored or coated welding with or without gas-shielding

8.2 Root runs

Methods of making the initial root run in butt joints by the various welding processes shall be as given in Table 2.

9 Backing rings

9.1 Permanent backing rings

When permanent backing rings are permitted the rings shall be one of the types shown in Figure 1. The gap between the outside diameter of the backing ring and the bore of the pipe end shall not exceed 0.4 mm.

Backing rings fitting tightly into machined recesses with square or sharp corners or of such a shape as to restrict longitudinal contraction (Figure 2) shall not be used as they increase the tendency to basal crack formation. Permanent backing rings shall be of a metal either:

- a) of similar composition to that of the pipe; or
- b) agreed between the contracting parties.

9.2 Steel temporary backing rings

Steel temporary backing rings (e.g. see Figure 3) shall be of similar composition to the pipe.

9.3 Copper backing rings

Removable copper backing rings shall only be used by agreement between the purchaser and the manufacturer, since there is a danger of copper pick-up in the weld metal and heat-affected zone.

9.4 Temporary non-metal backing rings

Temporary non-metal backing rings shall be of non-combustible materials and shall be completely removed after completion of welding.

10 Joint preparation

Joint preparations shall be as shown in the approved welding procedure.

NOTE Typical joint preparations are given in Appendix C.

11 Proximity of welds

11.1 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.

11.2 The toes of adjacent butt welds shall whenever possible be no closer than four times the nominal thickness of the pipe.

11.3 If design factors preclude the avoidance of the circumstances given in the following notes 1 and 2, then appropriate precautions shall be taken which shall be agreed between the contracting parties.

NOTE 1 Joints where more than two welded seams meet should be avoided.

NOTE 2 Attachments of non-pressure parts by welds which cross existing main welds or for which the minimum nominal distance between the toe of the attachment weld and the toe of existing main welds or branch welds is less than the smaller of twice the thickness of the pressure part or 40 mm, should be avoided (see Figure 4).

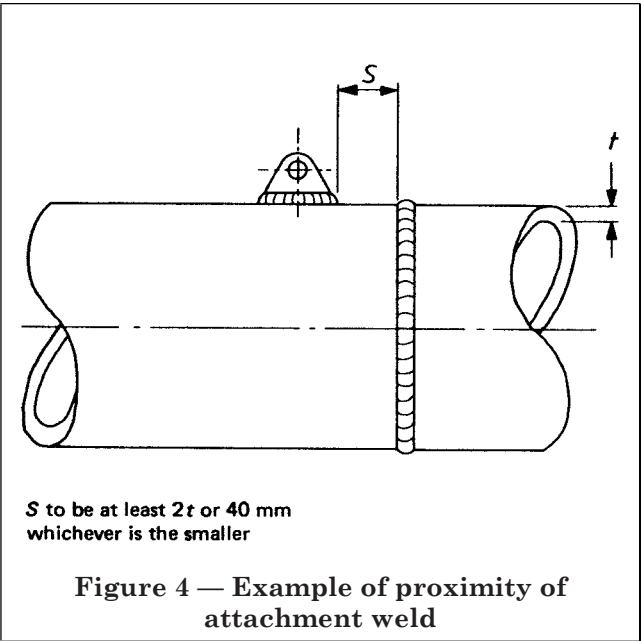
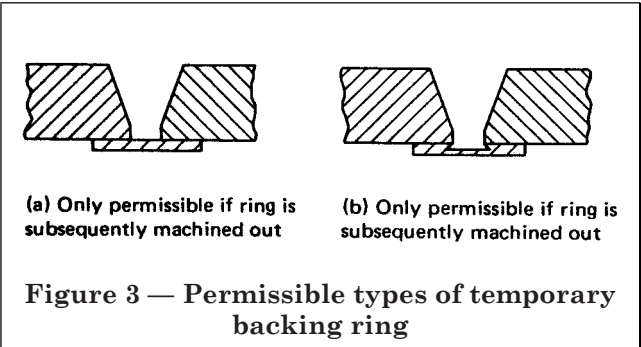
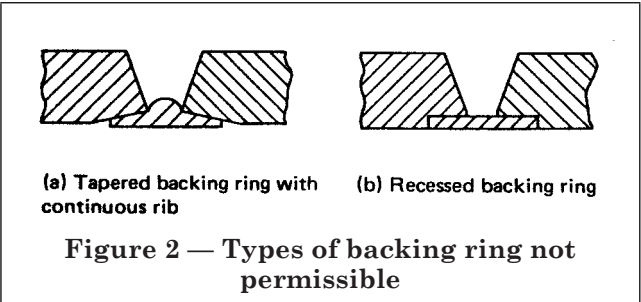
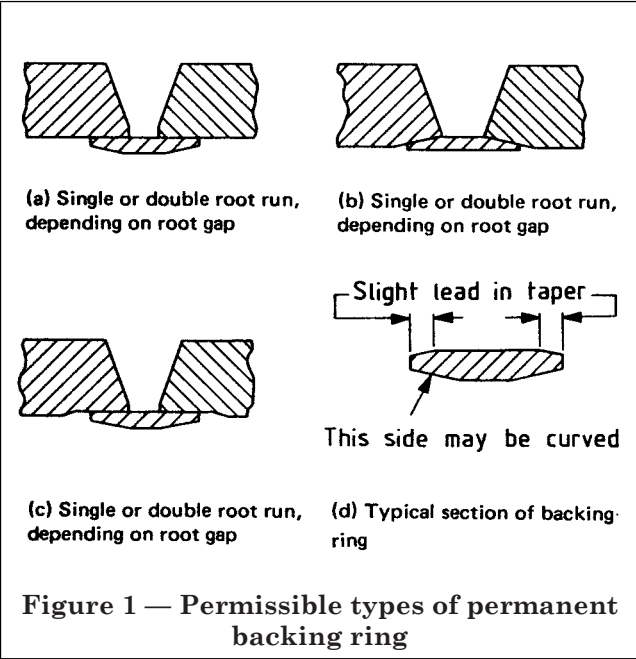
If such welds cannot be avoided, they should cross the main weld completely rather than stop abruptly near the main or branch weld in order to avoid stress concentrations in these areas.

Table 2 — Methods of making root runs in butt joints

Welding processes	Type of joint
Manual metal-arc welding	With permanent or temporary ^a backing ring or unbacked
MIG welding Metal active-gas welding	With permanent or temporary ^a backing ring or unbacked with purge ^b
TIG welding a) With fusible insert b) Without fusible insert but using filler wire c) Fusing root without using either fusible insert or filler wire	Unbacked with purge
Submerged-arc welding Flux cored or coated welding with or without gas-shielding	With permanent or temporary ^a backing ring

^a The use of temporary backing rings is dependent upon access for their removal on completion of the weld; see also clause 9.
^b By agreement between the contracting parties flux applied to the back of the weld preparation may replace back purging; see also clause 14.

11.4 All intersections of welds made to this standard shall be non-destructively tested (see section 8).



12 Fusion faces

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

13 Assembly for welding

To maintain the specified alignment (see Table 3) and gap, where used, during welding, the parts to be welded shall be securely held in position by mechanical means, welded-on bridge pieces, or tack welding.

When bridge pieces are used they shall be of austenitic stainless steel, or of ferritic steel whose fusion faces have been “buttered” with austenitic stainless steel weld metal. Austenitic stainless steel weld metal shall be used for welding all bridge pieces.

NOTE The specified dimensions of the root gap are the dimensions after tack welding. 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 may be permitted by agreement between the contracting parties.

Hot setting to achieve alignment shall only be carried out under controlled conditions.

Electrodes or filler materials used for tack welding shall be of the same type and class as, and of a size not larger than, those to be used for completing the first run of weld metal.

Particular attention shall be paid to the quality of tack welds which shall be deposited by approved welders. The throat thickness of tack welds shall be similar to that of the initial root run. Where necessary, the extremities of these tack welds shall be dressed by grinding or chipping to facilitate proper fusion when they are incorporated in the root run. All cracked tack welds shall be completely removed.

Where welded-on bridge pieces are used, the pipe surfaces shall not be left in a damaged condition after the bridge pieces are removed. All welded-on bridge pieces shall be removed and the welded area ground flush and liquid penetrant tested before applying any post-weld heat treatment, which shall embrace the area occupied by the bridge pieces.

14 Purging

When back purging all air shall be removed by the admission of a volume of purging gas at least six times the volume of air being displaced, in order to prevent oxidation of the penetration bead.

15 Damage to parent metal

While arc strikes are to be avoided, all accidental arc strikes shall be ground smooth and liquid penetrant tested. A piece of scrap austenitic stainless steel plate clamped to the pipe near the weld shall be used for dabbing the electrode where such a procedure is necessary for removing slag from the tip or to facilitate the starting of the arc.

NOTE 1 It is recommended that electrode holders be of the fully insulated type.

Precautions shall be taken to avoid contact of the pipe with incompatible materials.

NOTE 2 Under certain circumstances, liquid metal embrittlement could result from contamination by some non-ferrous metals or their alloys. Certain types of austenitic stainless steel may be attacked by chlorides and therefore care is needed to ensure that materials such as identification tapes or penetrants are as free as practicable from chlorides.

16 Inter-run cleaning

Each run of weld metal shall be clean before a further run is applied, particular attention being paid to the junctions between the weld metal and the fusion faces. Brushes used in cleaning shall be of stainless steel wire.

NOTE For certain applications “iron free” grinding wheels may be necessary.

Brushes and grinding wheels shall have only been used on austenitic steel. When grinding is used, care shall be taken to avoid overheating the material due to the grinding action. Visible defects such as cracks, cavities and other deposition faults shall be removed before deposition of further weld metal.

17 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, and any subsequent heat treatment 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.

18 Pre-heating

Any pre-heating shall be in accordance with the details given in the approved welding procedure.

NOTE In general, pre-heating is not required for the welding of materials covered by this standard. Special circumstances might occur, however, where the thickness, mass or rigidity of the part to be welded may necessitate pre-heating up to 125 °C.

19 Continuity of welding

Irrespective of the type of steel, root runs shall be made without interruption, except for the changing of electrodes or to allow the welder to re-position himself.

20 Heat treatment after welding

20.1 Any post-weld heat treatment shall be either:

- a) in accordance with the application standard¹⁾; or
- b) in the absence of an application standard, as agreed between the contracting parties.

NOTE Factors to be taken into account in deciding the need for and the type of heat treatment to be used include the grade of stainless steel, the degree of cold working during fabrication and the service conditions under which the pipework is to operate.

20.2 Heat treatment shall be carried out by one of the following methods, care being taken to ensure that the minimum stipulated temperature is achieved through the thickness of the pipe:

- a) heating in a stationary industrial furnace;
- b) local heating:
 - 1) portable muffle furnace;
 - 2) induction coils;
 - 3) resistance heating.

Manually-operated gas torches shall not be used.

NOTE Alternative methods of heating may be used provided that the reproducibility of the technique can be demonstrated to the satisfaction of the purchaser and it can be shown that the method is metallurgically acceptable for the steel involved.

When solution heat treatment is used, care should be taken to minimize the risk of distortion and sagging.

21 Temperature measurement

21.1 General

Pre-heating, interpass and post-weld heat treatment temperatures, when specified, shall be checked during the period of their application and all post-weld heat treatment conditions shall be recorded.

21.2 Pre-heating and interpass temperature

Temperature indicating paints or crayons, thermometers, thermocouples or pyrometers shall be used to check pre-heating and interpass temperatures.

NOTE Temperature indicating paints or crayons will not indicate by how much the minimum temperature is exceeded. Some types will not show, once the temperature has been reached, that this temperature is being maintained. In these cases the paint or crayon has to be re-applied if continued temperature observations are to be made.

When thermocouples are used they shall be located in positions within 40 mm from the outside edge of the fusion faces.

21.3 Post-weld heat treatment temperature

Thermocouples shall be used for recording post-weld heat treatment temperatures. They shall be disposed so as to give a true measure of the joint temperature and where local post-weld heat treatment is used they shall be located so as to indicate the temperature at significant points on the weld.

21.4 Thermocouple attachment

Thermocouples shall be in metallic contact with the parts being heated and attached by a method agreed between the contracting parties, e.g. capacitor discharge welding.

21.5 Thermocouple junctions

Thermocouple junctions and wires shall be protected from flame impingement. To prevent direct radiation from the heating elements on the hot junction when electrical resistance heating is used, thermocouples shall be covered with thermal insulation.

22 Transition joints between dissimilar metals

Several welding processes are suitable for making transition joints between dissimilar metals but each shall be subject to procedure test approval. When special service conditions require special procedure tests, the need for them shall be specified by the purchaser in the enquiry and order.

NOTE 1 Transition joints may be made as separate items and welded to components so that all subsequent welds are between like materials.

The interior and exterior surfaces shall, where necessary, be machined to facilitate inspection.

NOTE 2 For welding joints between ferritic steel and austenitic stainless steel, guidance is given in Appendix D.

¹⁾ For example BS 1113.

Section 2. Butt joints²⁾

23 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.

24 All types of butt joint

24.1 Matching of bores

It is preferred that, for welding purposes, the bores of the ends of adjacent pipes match exactly, but in any case they shall not differ at any diameter by more than the amounts given in Table 3, whilst the alignment shall be within the limits stated in the table.

NOTE 1 It is recognized that the ends of pipes and welding fittings will be 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 3.

The welding of pipe joints in accordance with this standard shall include the proper matching by the welding contractor of the pipe ends at each joint, if necessary, before welding.

Matching shall be effected by selection, drifting, machining or the use of a suitable expander. When either bore expanding or reducing is done hot it shall be carried out at 950 °C to 1 150 °C. This shall be done before any final solution heat treatment. Temperatures shall be checked by one of the methods given in 21.2.

When cold expanding is used the change in bore diameter shall not exceed 5 %, and it shall be followed, if necessary, by heat treatment to make the material suitable for the intended service conditions.

NOTE 2 Cold expanding is not normally applied.

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 on the inside of the pipe shall run out smoothly into the bore at a taper not steeper than 1 in 4.

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.

24.2 Preparation of pipe ends

The ends shall be prepared by machining, grinding or arc-plasma cutting or by powder cutting with subsequent machining or grinding (see clause 16 regarding grinding wheels).

NOTE Typical joint preparations for pipe ends are shown in Figure 8 to Figure 11 (see also clause 10).

The joint preparation shall be concentric with the bore of the pipe within the tolerance limits for the root face.

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.

25 Segmental bends

25.1 General

The service conditions for which segmental bends are to be used shall be the subject of agreement between the contracting parties except where an application standard permits the use of such bends.

25.2 Preparation

The preparation of each segment for a segmental bend shall be done by cutting the pipe end to the correct angle, followed by the weld preparation as specified in 24.2. The planes of the ends of the separate pieces of pipe prepared for welding to form a segmental bend shall all be inclined at the same angle to the axis of the piece.

The width of a segment at the throat of a bend measured at the outside diameter of the pipe shall be not less than 16.5 mm. For right angle bends of radius equal to the bore of the pipe, the dimensions of the segments shall be as shown in Figure 5, with only two cuts being necessary for pipe not exceeding 88.9 mm outside diameter.

To prepare the segment 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 segment tacked in position.

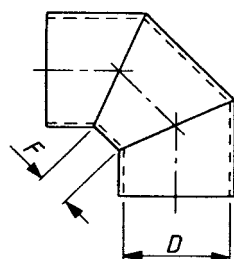
25.3 Welding procedure

All welds in a segmental bend shall be treated as butt welds and the requirements of clauses 13, 23 and 24.2 shall apply.

²⁾ In this section the term “pipe” is intended to cover pipes and fittings (e.g. welding neck flanges, forged tees, welding elbows).

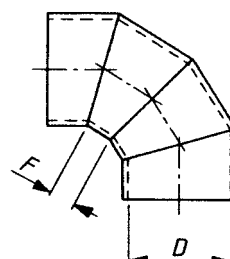
Table 3 — Bore difference and alignment

Bore		Processes other than TIG welding		TIG welding, close butt welds		TIG welding with root gap
Over	Up to and including	With backing ring	Without backing ring	With fusible insert or without filler wire	With filler wire	
Maximum permissible difference in bore						
mm	mm	mm	mm	mm	mm	mm
—	100	0.4	0.8	0.4	0.8	0.8
100	300	0.4	1.6	0.4	0.8	1.6
300	—	0.8	2.5	—	1.2	2.5
Maximum out of alignment at the bore						
—	100	0.4	0.8	0.4	0.8	0.8
100	300	0.4	1.6	0.4	0.8	1.6
300	—	0.8	1.6	—	0.8	1.6



2 cuts, 1D radius

Inside diameter, D	Outside diameter	F
mm	mm	mm
50	60.3	16.5
65	76.1	22.5
75	88.9	25.0



3 cuts, 1D radius

Inside diameter, D	Outside diameter	F
mm	mm	mm
90	101.6	21.0
100	114.3	23.0
115	127.0	28.0
125	139.7	29.5
150	165.1	36.0
150	168.3	35.5
180	193.7	44.5
200	219.1	48.5
230	244.5	57.5
250	273.0	61.0
300	323.9	74.0
—	355.6	95.0
—	406.4	109.0

Figure 5 — Segmental bends

Section 3. Branches and small bore connections

26 General

Section 1 of this standard details the basic procedure requirements with which all welded joints between pipes and fittings shall comply. For branches or small bore connections that are made from pipe, tube or bar, the basic requirements are supplemented by the specific requirements detailed in this section 3. Both section 1 and section 3 of this standard shall be applied in determining the full procedure requirements.

NOTE It is preferable that branches and small bore connections be welded at the works.

27 Branches

27.1 Angle of branch

In view of the additional difficulty involved in making a satisfactory joint at the intersection of two pipes not at right angles, for branch pipes sloping away from a main, a right angle branch and a bend to give the required slope shall be used wherever possible.

Where a sloping branch has to be connected directly to the main, the angle between the centre line of the main and that of the branch shall whenever possible be not less than 60°. Where the angle is unavoidably less than 60°, special consideration shall be given to joint design and fabrication.

NOTE The difficulty of making a weld at the acute crotch position might make special precautions necessary to ensure a sound weld at that position.

27.2 Spacing of branches

Spacing of branches on the main pipe and the lengths of flanged branches shall be such that there is adequate access for satisfactory welding (see also clause 11).

27.3 Joint preparation

Branch connections and branch openings in the main pipe shall be cut by machining, powder cutting or arc-plasma cutting. To remove any roughness the cut edges shall then be dressed by chipping, filing or grinding.

NOTE 1 Typical edge shapes are shown in Figure 12 to Figure 17 (see also clause 10).

NOTE 2 When using the powder injection method of cutting holes in main pipes for branches, there is a possibility of iron contamination inside the pipe which could, for example, affect corrosion resistance. This area should be inspected and cleaned as necessary.

27.4 Welding procedure

27.4.1 Gap. The gap where specified shall be maintained during deposition of the first run (see clause 13).

27.4.2 Internal root runs. When, in order to satisfy the requirements of section 8, it is necessary to apply an internal root run, access for the manual metal-arc welding of such an internal weld shall be considered possible:

- a) where the main is 450 mm bore or larger, irrespective of branch length; or
- b) where the main is less than 450 mm bore, and the branch length (face of branch to flank of joint) does not exceed the bore of the branch.

NOTE Using other welding processes it may be possible to weld in the bore of branches which have a length greater than that given in b).

28 Small bore connections

When the bore of the branch is 50 mm or less the guidance given in C.3 shall be taken into account.

NOTE Typical forms of small bore connections are illustrated in Figure 18. (See clause 3 regarding materials and clause 5 on deposited weld metal.)