bsi.

...making excellence a habit.™

Please be aware that this PDF has been created from the original hardcopy document, which might not be in good condition and so the PDF might reflect this.

BSI Group
389 Chiswick High Road
London, W4 4AL
United Kingdom

T: +44 20 845 086 9001
F: +44 20 8996 7400
cservices@bsigroup.com
bsigroup.com

British Standards Limited
Registered in England no: 07864997
Registered address: 389 Chiswick High Road
London, W4 4AL, United Kingdom

AVA Documents
INVESTORS IN PEOPLE
Document Sharing Hub

Full document details: BS 1821:1952

BRITISH STANDARD 1821 : 1952

OXY-ACETYLENE WELDING OF HIGH TEMPERATURE & HIGH PRESSURE PIPELINES

BRITISH STANDARDS INSTITUTION

AVA Documents
Document Sharing Hub

BRITISH STANDARD SPECIFICATION

OXY-ACETYLENE WELDING OF HIGH TEMPERATURE & HIGH PRESSURE PIPELINES

B.S. 1821 : 1952

Price ~~8/-~~ 10/6 net, post free

BRITISH STANDARDS INSTITUTION
Incorporated by Royal Charter
Telegrams : Standards, Sowest, London Telephone : Abbey 3333
Sales Branch Telephone : Victoria 0522
24 VICTORIA STREET, LONDON, S.W.1

AVA Documents
Document Sharing Hub

THIS BRITISH STANDARD, having been approved by the Welding Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council as a British Standard on 29th January, 1952.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 1700, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 7s. 6d. post free.

Reference is made in this standard to the following British Standards :—

B.S. 534. Steel spigot and socket pipes and specials for water, gas and sewage.
B.S. 806. Ferrous pipes and pipe installations for and in connection with land boilers.
B.S. 1295. Tests for use in the training of welders.
B.S. 1453. Steel filler rods for gas welding of mild steel.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or edition.

WEE/21

CONTENTS

	Page
Co-operating organizations	5
Foreword	6
PART 1. GENERAL	
1. Scope	7
2. Parent metals	7
3. Filler rods	8
4. Supervision, workmanship and equipment	8
5. Welding technique	9
6. Fusion faces	9
7. Assembly for welding	9
8. Cold pull	10
9. Heat treatment	10
10. Qualifying tests for welders	10
PART 2. BUTT JOINTS	
11. General	17
SECTION ONE : ALL TYPES OF END-TO-END BUTT JOINT	
12. Matching of bores	17
13. Bevelling of pipe ends	18
14. Requirements for completed welds	19
15. Tests of completed welds	25
SECTION TWO : FLANGES	
16. Flange dimensions	26
SECTION THREE : BENDS	
17. General	27
18. Preparation	27
19. Welding technique	27
20. Qualifying tests for welders	27
PART 3. BRANCHES	
21. General	29
SECTION ONE : ALL TYPES OF BRANCHES	
22. Angle of branch	29
23. Spacing of branches	29
24. Compensation	29
25. Removal of oxide and scale	29
26. Requirements for completed welds	29
27. Qualifying tests for welders employed on branch joints	29

Full document details: BS 1821:1952
AVA Documents
Document Sharing Hub

Page

SECTION TWO : SET-ON BRANCHES

28. Scope 35
29. Joint preparation 35
30. Welding procedure 35

SECTION THREE : SET-IN BRANCHES

31. Scope 36
32. Joint preparation 36
33. Welding technique 36

SECTION FOUR : EXTRUDED BRANCHES

34. Scope 39
35. Length of stub 39
36. Joint preparation and welding technique 39

SECTION FIVE : FORGED FITTINGS

37. Scope 40
38. Joint preparation and welding technique 40

PART 4. SLEEVE WELDS

39. General 41
40. Definition 41
41. Sleeve details 41
42. Welding technique 42
43. Qualifying tests for welders 42
44. Requirements for completed welds 42

APPENDICES

A. Welding techniques 43
B. Macro-etching 47
C. Non-destructive examination of pipe joints 48

CO-OPERATING ORGANIZATIONS

The Welding Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations :—

*Admiralty
Aluminium Development Association
*Associated Offices Technical Committee
Association of Consulting Engineers, Incorporated
*British Acetylene Association
British Constructional Steelwork Association
*British Electrical and Allied Manufacturers' Association
*British Iron and Steel Federation
British Railways, The Railway Executive
*British Welding Research Association
Crown Agents for the Colonies
Department of Scientific and Industrial Research
*Institute of Welding
Institution of Civil Engineers
Institution of Electrical Engineers
*Institution of Mechanical Engineers
Institution of Structural Engineers
*Lloyds Register of Shipping
Ministry of Housing and Local Government
Ministry of Labour and National Service
*Ministry of Supply
Shipbuilding Employers' Federation
Society of British Aircraft Constructors
War Office

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard :—

Association of Heating, Ventilating and Domestic Engineering Employers
British Engineers' Association
British Refrigeration Association
Institute of Plumbers
Institution of Heating and Ventilating Engineers
Ministry of Works
Oil Companies Materials Committee
Individual firms.

Full document details: BS 1821:1952
AVA Documents
Document Sharing Hub

BRITISH STANDARD SPECIFICATION FOR

OXY-ACETYLENE WELDING OF HIGH TEMPERATURE AND HIGH PRESSURE PIPELINES

FOREWORD

In the welding of joints in pipelines considerable variation has occurred in the past in methods of preparation, technique of welding and the training and skill of welders, with the result that some welded joints have been of poor quality. Methods of preparation and technique have now been sufficiently developed to justify the provision of British Standards, to co-ordinate the experience now gained.

This standard is the first of a series of standards which will eventually be incorporated in a comprehensive specification for pipeline welding. The series will form part of the wider scheme for the preparation of welding standards authorized by the Welding Industry Standards Committee of the Institution.

The range of duties which will eventually be covered by the comprehensive British Standard has been classified as follows :—

Grade A. Pipelines for service conditions in which the pressure exceeds 250 lb/sq. in. and/or the temperature exceeds 425°F. (220°C.).

Grade B. Pipelines for service conditions in which the pressure does not exceed 250 lb/sq. in. and/or the temperature exceeds 180°F. (82°C.) but does not exceed 425°F. (220°C.).

Grade C. Pipelines for service conditions in which the pressure does not exceed 250 lb/sq. in. and the temperature does not exceed 180°F. (82°C.).

Grade D. Pipelines for use under service conditions where the temperature is below 32°F. (0°C.) at any pressure.

Each of the above grades will be dealt with in the following manner :—

Stage 1. *Oxy-acetylene welding.*

Stage 2. *Metal-arc welding.*

Stage 3. *Flash butt welding.*

Where appropriate, the standards will cover a wide range of joints, including butt joints, bends, branches, sleeve joints and flanges.

This British Standard is for the oxy-acetylene welding of joints in Grade A pipelines in mild steel, carbon steel containing not more than 0·3 per cent carbon, and low-alloy steels of the 0·5 per cent molybdenum and chromium molybdenum types. It is considered that there is, at present, insufficient experience of the oxy-acetylene welding of other alloy steels to justify including them in this edition of the standard.

As welding of larger diameter pipes is usually carried out by the metal-arc process, the requirements of this standard have been limited to the oxy-acetylene welding of pipes up to 20 in. diameter. No limit has been placed on thickness although it is realized that thick pipes are generally welded by the metal-arc process. The scope of the standard is limited to considerations of joint detail, welding technique and procedure. Reference should be made to the appropriate specifications for information concerning design of the pipelines.

Additional information and recommendations concerning welding technique and the method of preparing macro-etched weld sections are contained in the Appendices.

SPECIFICATION

PART 1. GENERAL

SCOPE

1. This British Standard covers the shop and site welding of joints in steel pipelines and fittings up to and including 20 in. diameter, of the grade specified below, provided that pre-heating is carried out when the thickness exceeds 7/16 in. It specifies the standards of workmanship of which the welders shall be capable, and the standards to which the welds shall conform.

Grade A. Service conditions in which the pressure exceeds 250 lb/sq. in. and/or the temperature exceeds 425°F. (220°C.).

PARENT METALS

2. This standard relates to pipes made from the following types of steel:—

a. Mild steel and carbon steel containing not more than 0·3 per cent carbon.

b. Alloy steels of the 0·5 per cent molybdenum type, with carbon content not exceeding 0·3 per cent.

c. Alloy steels containing not less than 0·6 per cent and not more than 1·2 per cent chromium, not less than 0·4 per cent and not more than 0·7 per cent molybdenum, and not more than 0·25 per cent carbon.

This clause does not purport to specify the materials to be used in the manufacture of the pipes and reference should be made to the appropriate British Standard.

AVA Documents
Document Sharing Hub

FILLER RODS

3. The filler rods shall comply with the following requirements :—

a. For pipes in mild steel and carbon steel containing not more than 0·3 *per cent carbon.*

B.S. 1453, 'Steel filler rods for gas welding of mild steel.'

b. For pipes in alloy steels of the 0·5 *per cent molybdenum type with carbon content not exceeding* 0·3 *per cent.*

Carbon	not more than 0·18 per cent
Silicon	not more than 0·5 per cent
Manganese	not less than 0·6 per cent
Molybdenum	not less than 0·45 per cent, and not more than 0·65 per cent
Chromium (if present as a residual)	not more than 0·2 per cent
Nickel (if present as a residual)	not more than 0·2 per cent
Sulphur	not more than 0·04 per cent
Phosphorus	not more than 0·04 per cent.

c. For pipes in alloy steels containing not less than 0·6 *per cent and not more than* 1·2 *per cent chromium, not less than* 0·4 *per cent and not more than* 0·7 *per cent molybdenum, and not more than* 0·25 *per cent carbon.*

Carbon	not more than 0·15 per cent
Silicon	not more than 0·5 per cent
Manganese	not less than 0·6 per cent
Chromium	not less than 0·40 per cent, and not more than 0·65 per cent
Molybdenum	not less than 0·45 per cent, and not more than 0·65 per cent
Nickel (if present as a residual)	not more than 0·2 per cent
Sulphur	not more than 0·04 per cent
Phosphorus	not more than 0·04 per cent.

The use of a welding rod containing chromium is not essential for this type of steel, and the plain molybdenum steel welding rod may be used.

With more than 0·6 per cent chromium the welding becomes more difficult on large welds owing to the formation of a scum on the molten metal.

SUPERVISION, WORKMANSHIP AND EQUIPMENT

4. The contractor shall employ sufficient competent supervisors to ensure that the workmanship complies with the requirements of this standard and that the welding material used is correct for the pipe being welded.

The contractor shall also take the necessary steps to ensure that all welders employed on pipelines of which the welded joints are required to comply with this standard are capable of making welds of the types required, and of passing the tests laid down in Clause 10 and other relevant tests (see Clauses 20, 27 and 43).

Where necessary, staging and protection from the weather shall be provided to enable the welding operation to be performed correctly. All welding equipment shall be in good condition, and such as to enable the welder to maintain the correct neutral flame at all times.

WELDING TECHNIQUE

5. Welding shall be carried out by any of the methods described in Appendix A, subject to the limits imposed in Table 4 (page 19).

If the thickness exceeds 7/16 in., pre-heating shall be carried out.* The temperatures for pre-heating shall be as specified in Table 1 and shall be maintained during welding.

TABLE 1 PRE-HEATING TEMPERATURES

Thickness	Pre-heating temperature (min.)
in.	
Over 7/16 up to and including 11/16	100°C. (212°F.)
Over 11/16 up to and including 7/8	200°C. (392°F.)
Over 7/8	300°C. (572°F.)

FUSION FACES

6. The fusion faces and the adjacent material shall be thoroughly cleaned of scale, rust, paint, oil or other foreign matter.

ASSEMBLY FOR WELDING

7. To maintain the specified alignment and gap during welding (see Tables 2 and 4, pages 18 and 19) the pipes to be welded shall be securely held in position by mechanical means, welded-on bridge pieces, or by tack welding. Where 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.

* This may be done by means of a portable pipe furnace, or by means of a welding torch used by a second operator. The temperature may be ascertained by means of a thermocouple, or judged by the use of temperature indicating paint or crayon.

AVA Documents
Document Sharing Hub

COLD PULL

8. Where the effects of thermal expansion in service are to be counteracted by cold pull during erection of the pipeline, the cold pull shall be maintained during preheating (where applicable), welding, subsequent heat treatment and cooling.

HEAT TREATMENT

9. Welds in mild steel pipes shall be normalized by heating the metal to a temperature between 900 and 950°C. (1650–1740°F.), the temperature then being maintained for not less than two minutes for pipes up to and including 4 in. bore, and for not less than five minutes for pipes over 4 in. bore.

Welds in pipes made from the alloy steels specified in Clause 2 shall be normalized by heating the metal to a temperature between 925 and 975°C. (1700–1790°F.), the temperature then being maintained for not less than two minutes for pipes up to and including 4 in. bore, and for not less than five minutes for pipes over 4 in. bore. The higher temperatures of between 950 and 975°C. (1740–1790°F.) shall be used for alloy steels having a carbon content up to and including 0·12 per cent, and the lower temperatures of between 925 and 950°C. (1700–1740°F.) shall be used for alloy steels having a carbon content of more than 0·12 per cent. After normalizing, the joint shall be covered with a suitable muff or asbestos cloth to ensure slow and even cooling.

The normalizing of welds in pipes up to 4 in. bore may be carried out with welding flames, the temperature being judged with the aid of a colour card,* or measured by means of one or more thermocouples or an optical pyrometer.

The normalizing of welds in pipes over 4 in. bore shall preferably be carried out in a portable pipe normalizing furnace or muffle, the temperature being measured by means of one or more thermocouples or an optical pyrometer.

The width of the zone to be heat-treated to the specified temperature shall extend at least ½ in. on either side of the weld reinforcement.

QUALIFYING TESTS FOR WELDERS

10. In order to meet the requirements of Clause 4 the welders shall be capable of producing test pieces satisfying the requirements specified below and in the appropriate section of this standard, and, upon request of the purchaser or his representative, the contractor shall provide satisfactory evidence of the capability of the welders to do so. Where records of tests are produced as such evidence they shall show that the tests have been carried out within the preceding twelve months and that

* Suitable colour cards may be obtained at a price of 2s. each from the British Welding Research Association, 29, Park Crescent, London, W.1.

the welder has since been employed with reasonable continuity on welding the type of joint concerned.

a. Preparation of sample. For the purpose of qualifying tests, sample welds shall be made under conditions similar to the working conditions to be met on the contract in respect of materials, sizes, thicknesses, pipe-end preparation, welding positions, access for welding, and heat treatment. A test length approximately 8 in. long shall then be cut from the pipe with the welded joint disposed approximately at the centre.

b. Visual examination. The specimens so obtained shall be visually examined in accordance with Schedule 1 of B.S. 1295, 'Tests for use in the training of welders', and any specimen showing serious defects shall be rejected.

c. Bend tests. The test length prepared as in *a* shall be submitted to the following tests :—

(i) *Pipes up to and including 4 in. nominal bore.* A tongue bend specimen shall be prepared from each half of each test weld as shown in Fig. 1. Each tongue shall be bent back through 90° round a former of a diameter equal to three times the thickness of the pipe. The bending may be carried out by blows or by pressure. Care shall be taken during bending to ensure that the former is so positioned that the weld is maintained at the crown of the bend. If the tongue is at a point in the weld where slight excess of internal bead has occurred (see Clause 14*d*, page 25) the bead may be filed until it is 1/32 in. proud of the general surface before bending is carried out.

In doubtful cases a further tongue bend test shall be made on an adjacent part of the weld.

If preferred, two reverse bend test specimens may be cut from each test weld in the manner shown in Fig. 2, and treated as for pipes over 4 in. nominal bore.

(ii) *Pipes over 4 in. nominal bore.* Two reverse bend test specimens, and two normal bend test specimens, shall be cut from each test weld as shown in Fig. 2. They shall be bent through 90° round a former of a diameter equal to three times the thickness. The bending may be carried out by blows or by pressure. If the bend test specimen is at a point where a slight excess of internal bead has occurred (see Clause 14*d*, page 25) the bead may be filed until it is 1/32 in. proud of the general surface before bending is carried out.

Test specimens in each case shall be capable of being bent through 90° without signs of failure, although slight premature failure at the edges of a specimen need not be considered a cause for rejection.

The opening out of a slight defect due to incomplete root penetration or lack of root fusion need not be considered a cause for rejection, providing the defect has sound metal at the back, and on either side of

AVA Documents
Document Sharing Hub

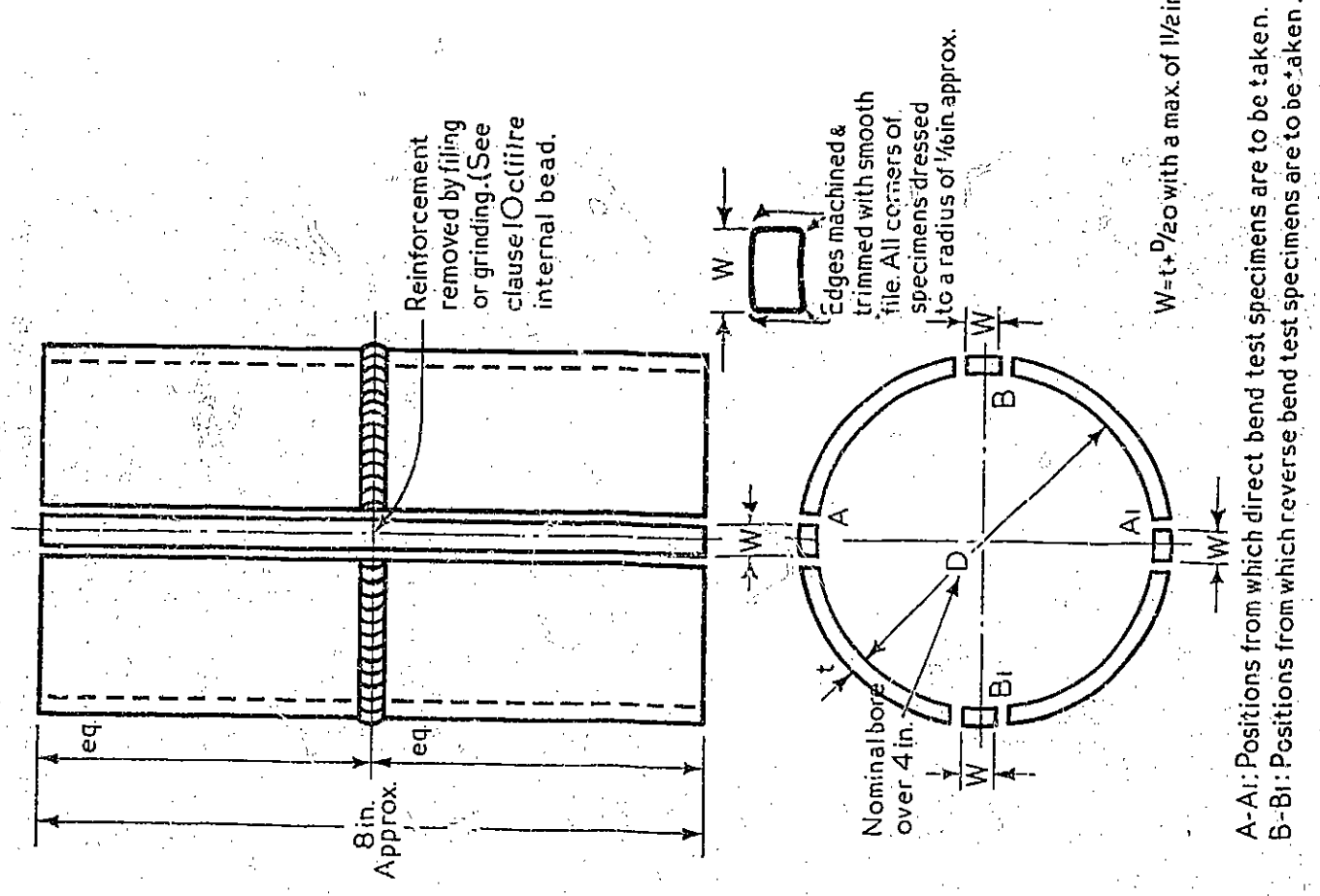

Fig. 1. Tongue bend test pieces

Nom. bore D	Pipe thickness t	Tongue width W
in.	in.	in.
Less than 2	t	t + D/10
2 and over	t	t + D/20

Fig. 2. Method of obtaining test pieces for bend test

Full document details: BS 1821:1952