

# Specification for welding of steel pipelines on land and offshore —

## Part 1: Carbon and carbon manganese steel pipelines

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# Committees responsible for this British Standard

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- Association of Consulting Engineers
- British Gas plc
- British Institute of Non-destructive Testing
- Electricity Association
- Engineering Equipment and Materials Users' Association
- Health and Safety Executive
- International Marine Contractors Association
- Offshore Contractors Association
- Pipeline Industries Guild
- The Welding Institute
- UK Steel Association
- Welding Manufacturers' Association (BEAMA Ltd.)

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# Contents

|                                                                                                                  | Page               |
|------------------------------------------------------------------------------------------------------------------|--------------------|
| Committees responsible                                                                                           | Inside front cover |
| Foreword                                                                                                         | ii                 |
| 1 Scope                                                                                                          | 1                  |
| 2 Normative references                                                                                           | 1                  |
| 3 Terms and definitions                                                                                          | 1                  |
| 4 Information to be specified and items to be approved                                                           | 2                  |
| 5 Equipment                                                                                                      | 3                  |
| 6 Welding processes                                                                                              | 4                  |
| 7 Welding consumables                                                                                            | 4                  |
| 8 Testing, qualification and approval of welding procedures for butt welds                                       | 4                  |
| 9 Testing, qualification and application of weld procedure for fillet welds                                      | 6                  |
| 10 Testing, qualification and approval of welders                                                                | 7                  |
| 11 Production welding                                                                                            | 9                  |
| 12 Inspection and testing of welds                                                                               | 12                 |
| 13 Acceptance and rectification of welds                                                                         | 13                 |
| Annex A (informative) Recommendations for hyperbaric arc welding                                                 | 16                 |
| Annex B (informative) Recommendations for brazing and aluminothermic welding of anodic bonding leads             | 21                 |
| Annex C (informative) Proposed welding procedure specification                                                   | 23                 |
| Annex D (informative) Example of a record form for an MMA welder qualification test                              | 26                 |
| Annex E (informative) Guidance for establishing preheating requirements                                          | 27                 |
| Annex F (informative) Example of a radiographic specification                                                    | 29                 |
| Bibliography                                                                                                     | 31                 |
| Figure 1 — Preparation of fillet weld specimens                                                                  | 6                  |
| Figure B.1 — Recommended locations for hardness traverses and impressions for brazing and aluminothermic welding | 22                 |
| Figure C.1 — Example of proposed welding procedure specification                                                 | 23                 |
| Figure C.2 — Example of welding procedure specification for production welding                                   | 24                 |
| Figure C.3 — As-run record of welding procedure qualification test                                               | 25                 |
| Figure D.1 — Example of record form for an MMA welder qualification test                                         | 26                 |
| Figure E.1 — Nomogram for preheating requirements                                                                | 28                 |
| Figure F.1 — Example of a radiographic procedure specification                                                   | 29                 |
| Table 1 — Welding procedure specification details and changes affecting approval                                 | 5                  |
| Table 2 — Test specimens for procedure approval tests on fillet welds                                            | 6                  |
| Table 3 — Hardness values                                                                                        | 7                  |
| Table 4 — Diameter and thickness ranges for butt joints and branch connections                                   | 8                  |
| Table 5 — Acceptance criteria for welds                                                                          | 14                 |
| Table A.1 — Welding procedure specification details and changes affecting approval                               | 18                 |
| Table A.2 — Qualified ranges of chemical analysis                                                                | 20                 |

## Foreword

The revision of this British Standard has been prepared under the direction of the Subcommittee WEE/21/7. It is applicable to transmission pipelines for gases, liquids or slurries, both on land and offshore. It supersedes BS 4515:1996 which is withdrawn.

If welding in accordance with this British Standard is agreed with a Statutory Authority as a basis for obtaining approval to operate a pipeline, the employer will need to obtain the Authority's agreement to any waivers of requirements. Where this standard provides for the employer to define requirements, the Authority's agreement may be necessary. Topics commonly involved include selecting the definition of the pipeline's starting and termination points, electing to use hardness limits higher than those in Table 5, selecting the methods and frequency of non-destructive examination, electing to use Engineering Critical Assessment to derive acceptance criteria, permitting multiple attempts at repair, or permitting single run or root repairs. The employer should ensure that all relevant points have been agreed with the Statutory Authority before welding begins.

This edition takes into account the publication of BS EN 288-9:1999 and gives additional national requirements for the testing, qualification and approval of butt welding procedures. It should be used in conjunction with BS EN 288-9:1999.

In reflecting current industry practice, this British Standard places duties on, and allocates powers of approval to, the employer. In this it differs from BS EN 288-9 (under which welding procedure approval is independent of the employer). Consequently, the term "qualification" has been retained to describe the series of actions which demonstrate that the technical requirements of this British Standard have been met during the process of welding procedure, and welder, approval.

It has been assumed, in the drafting of this British Standard, that the execution of its provisions will be entrusted to appropriately qualified and experienced personnel.

*Assessed capability.* Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

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 and ii, pages 1 to 31 and a back cover.

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## 1 Scope

This British Standard specifies requirements for the welding of carbon, carbon manganese and low alloy steel pipelines with specified minimum yield strengths not exceeding 500 N/mm<sup>2</sup> and designed in accordance with BS 8010-2 and -3.

The standard applies to pipes of outside diameter 21.0 mm and larger having a thickness of 3.0 mm or greater.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 499-1:1991, *Welding terms and symbols — Part 1: Glossary for welding, brazing and thermal cutting*.

BS 6072:1981, *Method for magnetic particle flaw detection*.

BS 8010-2, *Code of practice for pipelines — Part 2: Pipelines on land: design, construction and installation*.

BS 8010-3, *Code of practice for pipelines — Part 3: Pipelines subsea: design, construction and installation*.

BS EN 970:1997, *Non-destructive examination of fusion welds — Visual examination*.

BS EN 1321:1997, *Destructive test on welds in metallic material — Macroscopic and microscopic examination of welds*.

BS EN 1435:1997, *Non-destructive examination of welds — Radiographic examination of welded joints*.

BS EN 1714:1998, *Non-destructive examination of welded joints — Ultrasonic examination of welded joints*.

BS EN 10160:1999, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*.

BS EN ISO 6507 (all parts), *Metallic materials — Vickers hardness test*.

PD 6493:1991, *Guidance on methods for assessing the acceptability of flaws in fusion welded structures*.

## 3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 499-1:1991 apply together with the following.

### 3.1

#### **employer**

owner company or the engineering agency in charge of construction

NOTE The employer may act through a consultant, an inspector or other authorized representative.

### 3.2

#### **contractor**

firm undertaking the contract and any subcontractors engaged in work covered by this standard

### 3.3

#### **pipeline**

continuous line of pipes of any length without frequent branches, used for transporting fluids

NOTE It does not include piping systems such as process plant piping within offshore installations.

[BS 8010-2 and -3]

### 3.4

#### **joint**

completed weld joining two sections of pipe, a section of pipe to a fitting, or two fittings

### 3.5

#### **welding procedure<sup>1)</sup>**

specific course of action followed in welding, including a list of materials and, where necessary, tools to be used

### 3.6

#### **welder<sup>1)</sup>**

operator who performs the welding

### 3.7

#### **approved welder**

welder who has demonstrated his ability to produce welds meeting the requirements of this standard

### 3.8

#### **root-run<sup>1)</sup>**

first run deposited in the root of a multi-run weld

### 3.9

#### **positional welding**

welding wherein the pipe or assembly is held stationary

### 3.10

#### **roll welding<sup>1)</sup>**

method of manipulation by rotating or rolling pipes or pipe assemblies so that all welding is carried out in or near the flat position

<sup>1)</sup> Definition taken from BS 499-1.

**3.11****semi-automatic welding<sup>1)</sup>**

welding in which some of the welding variables are automatically controlled, but manual guidance is necessary

**3.12****mechanized welding<sup>1)</sup>**

welding in which the welding parameters are controlled mechanically or electronically and may be manually varied during welding to maintain the required welding condition

**3.13****sour service**

pipeline design conditions in which a risk of sulfide stress cracking exists

NOTE This is normally assessed using NACE MR0175 [1].

**3.14****full penetration repair**

repair from the external surface of the original weld which penetrates to the bore of the pipe

**3.15****partial penetration repair**

multi-run repair from the external surface of the original weld which does not penetrate to the bore of the pipe

**3.16****cap repair**

single run repair to the external surface of the original weld

**3.17****internal (back-weld) repair**

repair from the internal surface of the original weld

**3.18****re-repair**

second attempt at repairing a defect in the same location. For qualification purposes this is a full penetration repair, testing a heat-affected zone which has received three full thermal cycles

**3.19****qualification**

series of actions necessary to demonstrate that a proposal meets the technical requirements of this British Standard

**3.20****approval**

formal agreement by the employer that a qualification (or other proposal by the contractor) in accordance with this British Standard is acceptable for the proposed application

**3.21****preliminary welding procedure specification (pWPS)**

tentative welding procedure specification, which is assumed to be adequate by the manufacturer, but which has not been approved.

NOTE Welding of test pieces needed for approval of a welding procedure specification has to be carried out on the basis of a preliminary welding procedure specification (pWPS).

**4 Information to be specified and items to be approved****4.1 Information to be specified by the employer**

The following information shall be supplied by the employer and fully documented:

- a) whether batch testing of electrodes and filler materials is required (see 7.1);
- b) whether specific compositional controls are to be applied to the deposited weld metal (see 7.1);
- c) whether different batches of electrodes and filler materials are to be individually identifiable and completely separated (see 7.2);
- d) whether an alternative location is specified for the excavation location for the repair weld test (see BS EN 288-9:1999, Figures A.1 and A.2);
- e) whether specimens should be allowed to cool for a duration other than 24 h before testing (see 8.1);
- f) whether strain ageing data and/or additional tests are required as the basis for welding procedure approval for pipe-reeling (see 8.1);
- g) the type and number of re-tests required in the event of failure (see 8.1);
- h) whether additional NDT methods for fillet welds apply (see 9.1);
- i) whether a proposed change to a welding procedure will require requalification of the welders (see 10.5);
- j) whether prevailing weather conditions are such that quality of the completed weld would be impaired (see 11.9)<sup>2)</sup>;
- k) the method(s) and frequency of visual inspection and non-destructive testing (see 12.1);
- l) whether completed welds are to be ground (see 12.1);
- m) whether alternative techniques are to be used for radiographic testing of welded butt joints (see 12.4.1);
- n) ultrasonic acceptance criteria (see 12.5.4);
- o) whether automatic ultrasonic testing is to be used (see 12.6);

<sup>1)</sup> Definition taken from BS 499-1.

<sup>2)</sup> Information for this item may not be able to be supplied until the appropriate stage of the work is reached.

- p) whether NDT acceptance criteria are to be based on quality control or engineering critical assessment (see 13.1.1);
- q) whether the maximum planar defect dimension is to be less than 25 mm (see 13.1.2);
- r) whether a more stringent limit for root penetration is required [see Table 4c)].

#### 4.2 Items subject to approval by the employer

The following items shall be subject to approval by the employer and fully documented:

- a) the tensile strength of weld metal for joints between dissimilar materials if other than that of the higher strength parent metal (see 7.1);
- b) consumables to be used (see 7.1);
- c) the definition of a batch when batch testing of electrodes and filler materials is required (see 7.1);
- d) test weld production on pipes shorter than full length (see 8.1);
- e) explanation for NDT failure if a test weld is to be destructively tested or rewelded to the same procedure (see 8.1);
- f) the type and number of re-tests of a welding procedure when they are permitted (see 8.1);
- g) welding procedure qualification test details and welding procedure specification for production welding (see 8.1);
- h) use of roll welding (see 8.1);
- i) simulation of a fillet weld joint using flat plate fillet welds [see 10.4.1b)];
- j) alternative methods of NDT for welder test pieces [see 10.6c)];
- k) giving a welder a second opportunity to gain approval (see 10.8);
- l) all documentation relating to welder qualification tests (see 10.9);
- m) use of manual thermal cutting for pipe end bevelling and the ability of the operator (see 11.2);
- n) method of obtaining minimum misalignment other than rotation of the pipes (see 11.4);
- o) method of marking for ultrasonic testing (see 11.2);
- p) the blending out by grinding of minor imperfections within the joint preparation area [see 11.2a)];
- q) alternative alignment methods other than internal line-up clamps (see 11.5.1);
- r) the stage at which line-up clamps are removed (see 11.5.1);
- s) the stage at which the pipe is lowered onto skids, or support is removed from fittings (see 11.5.2);
- t) reduction of preheating requirements for tack welds [see 11.6b)];
- u) repair of places where stray arcs have occurred (see 11.8);
- v) means of applying preheat (see 11.10.2);
- w) methods of attaching and removing thermocouples (see 11.10.4);
- x) the welding procedure for branch connections where the angle between the main and branch is less than 60° (see 11.11.1);
- y) written ultrasonic examination procedure for pipe material around a planned cut-out (see 11.11.3);
- z) all non-destructive testing procedures to be used (see 12.1);
- aa) all inspection personnel (see 12.2);
- ab) the technique in BS EN 1435 to be used for radiographic examination (see 12.4.1);
- ac) any method for magnetic particle testing to be used at above ambient temperature (see 12.7.1);
- ad) any proposal to repair a weld (see 13.2.1);
- ae) any alternative limits on repair weld length (see 13.2.1);
- af) use of root sealing or single run repair deposits (see 13.2.4);
- ag) more than one attempt at a repair (see 13.2.4);
- ah) technique and equipment for brazing or aluminothermic welding of anode bonding leads (see annex B);
- ai) proposed brazing or aluminothermic welding procedure specification (see annex B).
- aj) the position of the longitudinal seam weld (if applicable) on the subsea pipeline at the hyperbaric weld location (see annex A).

#### 5 Equipment

The contractor shall maintain all welding plant and ancillary equipment in good working order. Welding and cutting plant, instruments, cables and accessories shall conform with the requirements of the appropriate British Standard, e.g. BS 638. Pipe handling equipment, rollers and line-up clamps shall be such that they avoid damage or permanent deformation to the pipe, ensure that pipe axes are aligned as specified in 11.4 and allow the welding procedure to be used.

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 mechanized and semi-automatic 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.

The welding equipment shall be capable of controlling the parameters given in Table 1b) to within the limits stated in that table.

NOTE Copper contact tips and backing strips should be checked regularly for damage which could indicate copper contamination of welds.

## 6 Welding processes

The process used shall be a manual, semi-automatic or mechanized arc welding process or combination of processes.

## 7 Welding consumables

### 7.1 General

Electrodes, filler wires and shielding gases, and wire/flux combinations shall produce weld metal that has a tensile strength at least equal to the minimum specified for the parent metal. Moisture content of shielding gases shall correspond to a dewpoint of  $-30\text{ }^{\circ}\text{C}$  or lower.

In the case of joints between dissimilar materials, the weld metal shall have a tensile strength at least equal to that specified for the higher strength parent metal unless an alternative value is approved by the employer.

The chemical composition of the deposited weld metal shall be selected to ensure adequate resistance to degradation from the pipeline contents under the intended operating conditions. The employer shall indicate whether specific compositional controls are to be applied to meet these requirements.

NOTE 1 Where high transverse strains are expected consideration should be given to requirements for weld metal yield strength.

Only consumables which have received the prior approval of the employer shall be used. When required by the employer, batch testing of electrodes and filler materials shall be carried out, in which case the definition of a batch shall be subject to the approval of the employer.

NOTE 2 Appropriate electrodes and filler materials conforming to the requirements of this subclause are specified in BS 639, BS 2493, BS 7084, BS 4165 and BS EN 1435. Carbon dioxide used as a shielding gas should conform to BS 4105.

### 7.2 Storage and handling

Different grades and, when specified by the employer, different batches of electrodes and filler materials shall be individually identifiable and be completely separated. When the electrode manufacturer recommends that electrodes are stored at a stated temperature, the contractor shall follow such recommendations. The electrodes and filler materials shall be stored and handled at all times during construction so as to avoid damage to them and to the containers in which they are transported. Electrodes, filler wires and fluxes that show signs of damage or deterioration shall not be used. Submerged-arc welding flux shall only be recycled in accordance with the manufacturer's recommendations.

Shielding gases shall be stored in the containers in which they are supplied.

Mixing of gases in the field shall be allowed provided this is an integral part of a mechanized process which utilizes a fail-safe cut-off when the proportions fall outside those specified in the approved welding procedure.

## 8 Testing, qualification and approval of welding procedures for butt welds

### 8.1 General

Testing, qualification and approval of welding procedures shall be in accordance with BS EN 288-9 except in the event of a failure, where the type and number of such re-tests shall be specified by the employer, and with the additional requirements 8.2 to 8.4, which also apply to repair welds.

The quality of the test welds shall be determined by non-destructive and destructive testing after specimens have been allowed to cool to ambient temperatures in simulated site conditions for 24 h unless an alternative duration is specified by the employer.

When a welding procedure is to be qualified and approved for pipe-reeling, the proposed welding procedure shall include relevant previously-documented strain ageing data and/or any additional tests specified by the employer.

NOTE 1 These tests may include representative strain cycles and accelerated ageing typically for 1 h at  $100\text{ }^{\circ}\text{C}$ .

The test weld shall be produced in accordance with the proposed welding procedure specification under simulated site conditions on full pipe lengths unless otherwise approved by the employer.

If non-destructive testing indicates the presence of flaws exceeding the levels permitted in 13.1, the reason for this shall be investigated and explained to the satisfaction of the employer before approval is given for the use of this test piece for the purposes of destructive testing or alternatively for re-welding the test piece to the same details.

Recorded details for each welding procedure qualification test shall be submitted by the contractor together with the welding procedure specification for production welding to the employer for approval (see 10.9).

NOTE 2 Forms similar to those shown in annex C should be used.

NOTE 3 When welding procedure qualification tests have been carried out in accordance with this standard and witnessed by an independent inspector, the results may be offered for consideration by other employers provided that the procedure remains valid within the changes affecting approval given in 8.2.

Roll welding shall only be used with the employer's approval and only when it can be demonstrated that the joint can be adequately supported to maintain its axial alignment.

### 8.2 Changes affecting qualification and approval (essential variables)

In addition to the requirement of BS EN 288-9:1999, clause 8, the items specified in Table 1 shall apply. In addition, for repair welds in group 1 materials as specified in PD 6588, a repair procedure shall be qualified if it is outside the range of approval given in BS EN 288-9:1999, clause 8.

**Table 1 — Welding procedure specification details and changes affecting approval**

| Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    | Welding procedure specification details                                                                                | Changes affecting approval (essential variables)                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Electrode or filler materials                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | a  | Trade name                                                                                                             | Any changes when Charpy testing is required                             |
| Welding parameters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | b  | The following information is needed for each wire size (different values <sup>a</sup> may be used for different runs): |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | b1 | Electrical stick-out (SAW, MAG, FCAW) <sup>b</sup>                                                                     | Any change exceeding $\pm 5$ mm                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | b2 | Arc voltage <sup>b</sup>                                                                                               | Any change exceeding $\pm 10$ %                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | b3 | Wire feed speed (SAW, MAG, FCAW) <sup>b</sup> or welding current <sup>a</sup>                                          | Any change exceeding $\pm 10$ % ( $\pm 15$ % for cellulosic electrodes) |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | b4 | Travel speed <sup>b</sup>                                                                                              | Any change exceeding $\pm 10$ %                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | b5 | Calculated value of heat input <sup>a,b</sup>                                                                          | No separate restriction                                                 |
| Welding position                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | c  | Angle of pipe axis to the horizontal                                                                                   | Any change exceeding $\pm 25^\circ$                                     |
| Direction of welding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | d  | Vertical up, vertical down or horizontal                                                                               | Any change                                                              |
| <sup>a</sup> These items shall be specified on the proposed WPS but are not mandatory for the production WPS if they are controlled through other procedures.<br><sup>b</sup> These parameters shall be specified as single nominal values on the proposed WPS but as qualified ranges (nominal values $\pm$ permitted variation) on the production WPS. In cases where the mean value measured in qualification differs from the nominal value, the qualified range shall be calculated from the mean value measured in qualification. |    |                                                                                                                        |                                                                         |

### 8.3 Destructive testing

#### 8.3.1 Transverse tensile testing requirements

In addition to the requirements of BS EN 288-9:1999, 7.4.1, the following shall apply.

If a specimen breaks outside the weld or fusion zone at a tensile strength of not less than 95 % of that of the specified minimum tensile strength of the pipe material, that specimen shall be deemed to meet the test requirement.

Any specimen that breaks outside the weld or fusion zone at a tensile strength less than 95 % of that of the specified minimum tensile strength of the pipe material shall be rejected and an equal number of additional specimens shall be cut from the same test joint and subjected to the tensile test.

NOTE If any of the additional specimens break outside the weld or fusion zone at a tensile strength below the minimum stated above, the pipe material should be considered to be suspect and its physical properties should be investigated before any additional joints are made.

#### 8.3.2 Macro-examination requirements

In addition to the requirements of BS EN 288-9:1999, 7.4.2, the following specimens shall be tested.

For upwards welding, macro examination shall be at the 12 o'clock and 3 o'clock position.

For downwards welding, macro examination shall be at the 6 o'clock and 12 o'clock position.

#### 8.3.3 Hardness requirements

In addition to the requirements of BS EN 288-9:1999, 7.4.4, for sour service, hardness testing shall be carried out at the 3, 6 and 12 o'clock position.

#### 8.3.4 Impact testing requirement

In addition to the requirements of BS EN 288-9:1999, 7.4.3, Charpy tests are additionally required at the 12 o'clock position, notched at the weld centre line and the weld fusion line. When tested at the minimum design temperature, the requirements for all Charpy impact test specimens shall be not less than 40 J average and 30 J minimum individual value. The requirements for sub-size and specimens shall be reduced pro rata with their dimensions.

These Charpy requirements shall apply for pipe and wall thicknesses up to and including 25 mm, minimum design temperatures that are not lower than  $-10^\circ\text{C}$  and pipe strength grades that are not greater than X 65 (minimum yield strength 448 N/mm<sup>2</sup>). Toughness requirements for other conditions shall be specified by the employer.

NOTE 1 Attention is drawn to the *European Pipeline Research Groups guidelines on acceptable girth weld defects in transmission pipelines*, by P. Hopkins and R. Denys [2].

NOTE 2 When it is not possible to meet the requirement of this subclause, the use of CTOD testing may also be considered for welding procedure approval subject to agreement between the contracting parties.

9 Testing, qualification and application of weld procedure for fillet welds

9.1 Non-destructive testing

All fillet welds shall be examined visually in accordance with BS EN 970 followed by:

- a) magnetic particle testing (see 12.7); and
- b) any additional method specified by the employer.

The results from visual examination and non-destructive testing shall be assessed according to the appropriate acceptance criteria specified in 13.1.

9.2 Destructive testing

9.2.1 Test specimens

The minimum number of test specimens and the tests to which they shall be subjected shall be as given in Table 2.

Two of the fracture specimens shall be taken from those locations shown to have the greatest and least root gap. Macro-examination shall be carried out on one face of each of these two fracture specimens prior to being fractured.

The specimens shall be prepared as shown in Figure 1 and shall be at least 25 mm wide and at least 50 mm long.

They shall be prepared by machine cutting or thermal cutting followed by grinding, but the sides of the specimens shall be smooth and parallel.

Table 2 — Test specimens for procedure approval tests on fillet welds

| Outside diameter of pipe mm | Minimum number of specimens |                   |                              |
|-----------------------------|-----------------------------|-------------------|------------------------------|
|                             | Fracture test               | Macro-examination | Hardness survey <sup>a</sup> |
| ≤114.3                      | 2                           | 2                 | 1                            |
| >114.3                      | 4                           | 2                 | 1                            |

<sup>a</sup> The hardness survey is made on a macro-examination specimen.

9.2.2 Fracture test

9.2.2.1 Requirements

When tested as described in 9.2.2.2 the exposed surface of each broken specimen shall be free from cracks, lack of fusion and lack of penetration. Other defects in the weld metal shall be within the following limits.

- a) *Gas pores.* The greatest dimension of any pore shall not exceed 20 % of the pipe thickness or 3 mm whichever is the smaller. The combined areas of all pores shall not exceed 5 % of the cross-sectional area;
- b) *Inclusions.* Inclusions shall not exceed 1 mm in depth and 3 mm or 50 % of the pipe thickness in length, whichever is the shorter. There shall be at least 12 mm of sound weld metal between adjacent inclusions.

9.2.2.2 Method

Break the specimens by one of the following methods in such a way that the root of the weld is in tension:

- a) supporting both ends and striking the centre of the specimen;
- b) gripping one end and striking the other.

9.2.3 Macro-examination

9.2.3.1 Requirements

When tested as described in 9.2.3.2 the profile, dimensions and number of runs of the fillet weld shall be as specified in the welding procedure. The specimens shall be free from cracks, lack of fusion and lack of penetration and the total area of any cavities or inclusions shall not exceed 5 % of the fillet weld cross-sectional area.

9.2.3.2 Method

Prepare and etch the specimens as described in BS EN 1321. Examine the polished and etched surfaces using a hand lens of ×5 magnification.

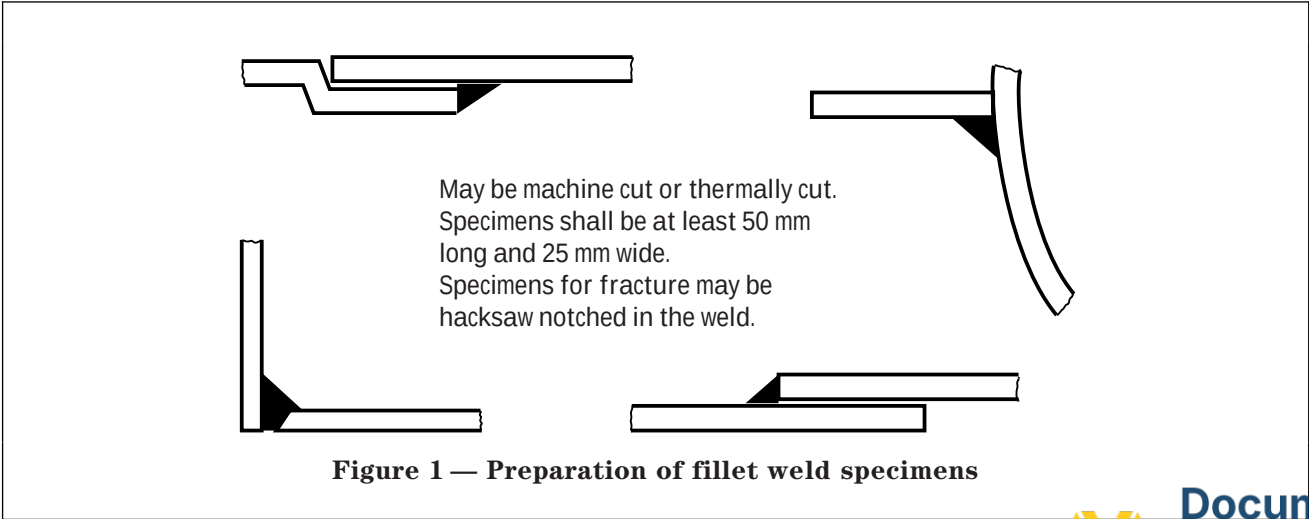


Figure 1 — Preparation of fillet weld specimens

## 9.2.4 Hardness survey

### 9.2.4.1 Requirements

When tested as described in 9.2.4.2 the hardness values shall not exceed those given in Table 3 unless otherwise specified by the employer.

### 9.2.4.2 Method

Carry out the hardness survey on a macro-examination or fracture test specimen as appropriate. Test the specimens as described in BS EN ISO 6507 using a 10 kg load. Make two weld zone traverses, one across the root and one near the weld cap. The root traverse shall consist of at least five impressions: two in the heat-affected zone, one in the weld metal and one in the parent metal each side of the weld. The traverse near the cap shall consist of at least eight impressions: two in the heat-affected zone each side of the weld, two in the weld metal and one in the parent metal side of the weld.

## 10 Testing, qualification and approval of welders

### 10.1 General

Each welder shall make a test weld or part of a weld using a qualified procedure to make the welds or parts of welds he will be required to make on the pipelines. A welder who has satisfactorily completed a welding procedure qualification test shall automatically be qualified in that procedure.

Where more than one process or welder is employed in producing a complete welded joint, the successful testing of the completed weld shall qualify each welder for his respective portion. Each welder's portion shall be clearly identified.

Each welder shall weld that portion of the pipe circumference which he will weld in construction in accordance with the qualified welding procedure.

A welder shall be given a single qualification for one or more of the following categories, a separate test being required for each category:

- butt joint;
- branch connections;
- fillet welds for sleeves, sockets, slip-on flanges, other attachments and pipe supports.

The validity of the welder's qualification begins from the date when all the required tests are satisfactorily completed. This date may be different to the date of issue marked on the certificate.

A welder's qualification shall remain valid for a period of two years providing that the relevant certificate is signed at six month intervals by the employer/coordinator and that all the following conditions are fulfilled.

- The welder shall be engaged with reasonable continuity on welding work within the current range of qualification. An interruption for a period no longer than six months is permitted.
- The welder's work shall be in general accordance with the technical conditions under which the qualification test is carried out.

NOTE There should be no specific reason to question the welder's skill and knowledge.

If any of these conditions are not fulfilled, the qualification shall be cancelled.

### 10.2 Butt joints

#### 10.2.1 Roll welding

The test joint shall be made between two pieces of pipe rolled about the horizontal axis. The welder shall deposit metal at or near the position specified in the welding procedure until he has completed 200 mm or slightly less than 25 % of the joint, whichever is the greater.

NOTE After leaving a short distance unwelded another welder may weld a similar portion and so on, thus making it possible to test up to four welders on one joint.

When a welder does not complete the whole joint, the root run shall include a stop/start position.

Table 3 — Hardness values

| Hardness location      | Sour service        | Non sour service                                |                   |
|------------------------|---------------------|-------------------------------------------------|-------------------|
|                        | Any welding process | Manual metal-arc welding, cellulosic electrodes | Other processes   |
|                        | HV10                | HV10                                            | HV10 <sup>a</sup> |
| Weld metal:            |                     |                                                 |                   |
| root and mid-thickness | 250                 | 275                                             | 275               |
| cap                    | 275                 | 275                                             | 275               |
| Heat-affected zone:    |                     |                                                 |                   |
| root and mid-thickness | 250                 | 275                                             | 350               |
| cap                    | 275 <sup>b</sup>    | 325                                             | 350               |

<sup>a</sup> See 9.2.4.2 regarding load for mechanized processes.

<sup>b</sup> 300 HV10 pipe 9.5 mm thick and above.