



GS 142-5

PIPELINE FITTINGS

November 1996

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
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SCOPE AND PURPOSE This Guidance for Specification defines the general requirements for the design, manufacture and supply of pipeline fittings (other than flanges) for use with pipeline materials up to API 5L Grade X70 and the equivalent grades in ISO 3183. The purpose of this document is to provide the basis of job specific procurement specifications to ensure that materials of suitable quality, weldability and mechanical properties are supplied for the exacting demands of any particular pipeline application.											
AMENDMENTS <table border="1"> <thead> <tr> <th>Amd</th> <th>Date</th> <th>Page(s)</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td colspan="4"> </td> </tr> </tbody> </table>				Amd	Date	Page(s)	Description				
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

By clearly defining requirements the design and quality of the fittings supplied should be consistent with the main transmission pipeline leading to reduced difficulties during construction, operation or any future modification to the pipeline.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Recommended Practice, and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Principal Changes from Previous Edition

This document replaces BP Standard 166 part 6. Modifications to and rationalisation of permitted chemical compositions have been made. An updated diagram used to determine impact test temperature and revised inspection requirements for laminations and other material defects in the region of weld bevel is incorporated.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.



For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

- 1.1.1 This Specification defines BP general supplementary requirements for the design, manufacture and supply of pipeline fittings (bends, reducers, tees, sleeves and end caps) for use with linepipe [API 5L](#) grades B to grade X70 inclusive or the equivalent grades from [ISO 3183](#).

Where material grades stronger than X70 or equivalent are necessary requirements in addition to those defined herein may be appropriate.

An international standard encompassing the requirements of [API 5L](#) is currently being prepared by ISO. When all three parts of this Standard, [ISO 3183](#), have been issued reference to [API 5L](#) will be deleted from this Specification.

- 1.1.2 This Specification applies to pipe fittings in transmission pipeline systems both on land and offshore connecting well, production and process plants and storage facilities, including any section of the pipeline constructed within the boundaries of such facilities for the purpose of its connection to such units.

- 1.1.3 This Specification shall not be applied to general refinery and chemical plant duties, these applications are covered by the supplementary requirements of BP Group Specification [GS142-12](#).

- 1.1.4 Additional requirements for the chemical composition, mechanical testing and non-destructive examination may be specified by BP for sour service.

BP Group Specification [GS136-1](#) defines the testing required on materials proposed for use in sour environments.

1.2 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this specification. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser. The quality system should ensure that the technical and QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials.

Further suggestions may be found in the BP Group RPSEs Introductory Volume.



2. DESIGN

- 2.1 All fittings shall be designed to [ANSI/ASME B16.9](#), [BS 1640](#) or [MSS SP75](#), except as modified by this Specification.
- 2.2 The fittings shall be designed in material with a strength equal to the linepipe for which they are intended.
- 2.3 The proposed manufacturing method and the associated welding procedures, qualified in accordance with [ASME 1X](#), shall be submitted for approval by BP prior to the commencement of fabrication.
- 2.4 The fittings shall be formed, and heat treated, while longer than the nominal length. The tests required by Section 4 shall be carried out on this excess material. Where this is not possible, tests shall be carried out on an additional fitting manufactured to the same procedure.
- 2.5 The tolerance on nominal internal diameter at the weld bevel (defined as nominal external diameter minus twice nominal wall thickness) shall be ± 1.5 mm (1/16 in). Where an internal bevel is necessary to achieve this, the angle shall not be greater than 14°, equivalent to a 1 in 4 taper.
- This restriction on internal bore dimension for flanges corresponds to that specified for linepipe.*
- 2.6 Ovality of the weld bevels of each fitting shall be checked with a ring type inside gauge. The diameter of this gauge shall be 5 mm (3/16 in) less than the nominal internal diameter. It shall pass freely through the end normal to the axis.
- 2.7 The maximum wall thickness at the weld bevel shall not exceed the nominal wall thickness by more than 10%. Excess material shall be machined back at an angle not exceeding 14°, equivalent to a 1 in 4 taper.
- 2.8 The weld bevel angle shall be 30° plus 5°, minus 0° for thicknesses up to 20mm. Above this thickness details of any alternative end bevel preparation will be provided in the Purchase Order.
- 2.9 The weld bevel root face shall be 1.5 ± 0.5 mm (1/16in $\pm$ 0.020in).

3. MANUFACTURE

- 3.1 The steel shall be made by the electric furnace or basic oxygen process and shall be fully killed and of fine grain size.



- 3.2 Hot formed fittings shall be normalised, or quenched and tempered after forming or fabrication to obtain the required mechanical properties. Where required, welds shall be stress relieved after the completion of all fabrication activities. The tempering and stress relieving temperatures used in manufacture shall take account of the stress relieved property requirements of Section 4.2.6.

4. MATERIALS

4.1 Chemical Composition

- 4.1.1 Unless alternative analyses proposed by a Manufacturer are approved by BP, each steel heat analysis and product analysis shall fall within the following limits. Alternative analyses which significantly infringe the limit on carbon equivalent are not normally acceptable.

Carbon	0.20% max
Manganese	0.80% to 1.60%
Silicon	0.15% to 0.40%
Sulphur	0.010% max
Phosphorus	0.015% max
Copper	0.35% max
Aluminium	0.025% to 0.060%
Nitrogen	0.012% max
Boron	0.0005% max
Calcium	0.006%
Nickel plus chromium plus molybdenum	0.30% max
Vanadium plus niobium plus titanium	0.15% max

Carbon Equivalent (CEV): 0.43% max.

$$\text{where, CEV} = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

Additional limitations on Manganese (to 1.40% max.) and Sulphur (to 0.003% max.) may be deemed necessary for flanges in sour service.

- 4.1.2 The analysis shall be determined both on each heat of steel used, and on a broken mechanical test piece from each heat.
- 4.1.3 Other elements shall not be added to the steel without approval of the BP Materials Engineer.
- 4.1.4 If any part of the product analyses fails to meet the requirements of 4.1.1, the whole heat shall be rejected or each individual item shall be fully analysed and all items failing to meet the requirements shall be rejected.



4.2 Mechanical Properties

- 4.2.1 The following tests shall be carried out on one fitting of each size and form in every heat (or in every heat treatment lot if this occurs more frequently). Tensile and impact testing shall be carried out in accordance with [ASTM A370](#) or agreed alternative.
- 4.2.2 The tensile properties (yield strength, tensile strength, elongation and reduction of area) shall be determined in the parent metal, transverse to the axis of the fitting. The tensile properties transverse to any weld shall also be determined. The round bar specimen detailed in [API Specification 5L](#) for transverse tests shall be used for base metal and cross weld tensile tests. The tensile properties shall meet the requirements for the equivalent linepipe and the transverse yield strength shall not exceed 600 MPa.
- 4.2.3 Guided-bend tests shall be conducted on any longitudinal weld in accordance with the requirements of [API Specification 5L](#) except that the specimens shall be bent over a former with radius a maximum of three times the nominal wall thickness of the fitting.
- 4.2.4 Hardness tests shall be made on the parent steel, and on any heat-affected zones and longitudinal weld on a macro section of the finished fitting. The hardness shall not exceed 248 HV10 where service is sour, or 300 HV10 where service is non-sour. The approximate positions of the hardness indents required in any weld region are shown in Figure 1. In addition, random surface hardness checks shall be carried out, using an equipment type approved by BP, at ten locations on both the internal and external surfaces of the fitting selected for mechanical testing.
- 4.2.5 Transverse Charpy V-notch impact test pieces shall be taken from parent metal. In addition Charpy V-notch impact test pieces shall be taken from any longitudinal weld and HAZ, as shown in Figure 2. The minimum acceptable Charpy toughness shall be an average, from three specimens, of 50J with no individual value below 40J. The test temperature shall be established from Figure 3, using the wall thickness of the matching linepipe. The test temperature shall not be greater than the minimum design temperature.
- The Charpy impact toughness requirements specified is that considered necessary to meet the HAZ toughness requirement specified in an applicable pipeline welding code e.g. [BS 4515](#).*
- 4.2.6 Unless otherwise specified on the Purchase Order, the above mechanical test requirements shall also be met by samples from the first fitting of each type after an additional heat treatment of 2 hours at $600^{\circ}\text{C} \pm 10^{\circ}\text{C}$ ($112^{\circ}\text{F} \pm 18^{\circ}\text{F}$).



- 4.2.7 For fittings in sour service BP may specify additional testing based on BP Group Guidance for Specification [GS136-1](#). BP will confirm testing frequency and acceptance criteria prior to contract.
- 4.2.8 BP will only permit a retest if there is reason to believe that failure was due to some fault in preparation or testing, and that the result was not representative of the test sample. Otherwise the failed test shall be carried out on every fitting in the heat or lot, or alternatively the entire heat or lot shall be re-heat treated and the full set of tests carried out on one item.

5. NON-DESTRUCTIVE TESTING (NDT)

- 5.1 Personnel performing NDT activities shall be qualified in the technique being applied in accordance with [ISO 9712](#) or approved equivalent.
- 5.2 All NDT shall be carried out after the final heat treatment using procedures approved by BP.
- 5.3 All surfaces of each fitting shall be blast cleaned to Sa 2 1/2 or better as defined by [ISO 5801-1](#) and visually examined internally and externally for surface defects to the requirements of [ASTM A 694](#). Illumination greater than 500 lux shall be required to enable proper inspection.
- 5.4 Defects on the surface of the fitting may be removed by grinding, provided that a smooth curved surface is maintained, and that the remaining thickness, as verified by ultrasonic testing, is not less than the specified minimum wall thickness.
- 5.5 Any welds shall be of uniform width and profile, and shall blend smoothly into the body of the fitting. The height of any internal or external weld beads (as defined in [API Specification 5L](#)) shall not exceed 3 mm (1/8 in). BP may specify tighter tolerances for the height of internal weld beads.
- 5.6 Any internal longitudinal weld bead shall be ground flush for a distance of 100 mm (4 in) from the end of the fitting.
- 5.7 Longitudinal, circumferential (and any repairs made to those welds) shall be 100% radiographed. The radiographic examination shall be conducted with X-ray equipment using lead screens and films of agreed type. The image quality indicator (IQI) shall be of agreed type and the thinnest wire clearly visible across the weld shall be not more than 1.25% of the nominal wall thickness of the fitting.



- 5.8 The following faults disclosed by radiography are unacceptable:
- (a) Cracks or incomplete penetration or fusion of any size.
 - (b) Porosity exceeding 1% of the weld area in any 50mm (2 in) length of weld.
 - (c) Any slag inclusion exceeding 3mm (1/8 in) long or 1.5mm (1/16 in) wide.
 - (d) Slag inclusions exceeding 6mm (1/4 in) total length in 100mm (4 in) of weld.
 - (e) Any porosity of slag appearing on the X-ray within 50mm of the bevel ends.
- 5.9 Repairs to welded seams shall be limited to two per fitting, shall not exceed 5% of the seam length, and shall be carried out prior to final normalising heat treatment.
- 5.10 Repairs to body imperfections or defects by welding shall not be permitted.
- 5.11 Cracks shall not be repaired and shall be cause for rejection. The cause of cracking shall be investigated, and established to the satisfaction of BP.
- 5.12 Each fitting shall be examined for laminations and inclusion clusters, over a band at least 25mm (1 in) wide at each end of the fitting, using an ultrasonic method approved by the BP Materials Engineer. The area so examined will meet the acceptance criteria defined by quality level E3 of [BS 5996](#) or an equivalent level of [ISO 11496](#).
- 5.13 Where the Purchase Order specifies that a fitting is intended for sour service applications, the bodies of all fittings shall be checked for laminations and inclusion clusters using an approved ultrasonic procedure. Unless stated otherwise in the Purchase Order, the acceptance level for this examination shall be to quality grade B4 of [BS 5996](#).
- 5.14 Hardness tests shall be performed on the internal and external surface of each fitting at twenty equally spaced locations along its entire length. A portable instrument of a type approved by BP e.g. EQUOTIP shall be used. Values shall not exceed those stated in 4.2.4.
- 5.15 After bevelling, the whole surface of the bevel and 100mm (4 in) at each end of any longitudinal weld shall be examined by wet magnetic



particle inspection, to [BS 6072](#) or [ASTM E 709](#). Defects such as laps, cracks or laminations shall not be permitted. Laps and laminations less than 5mm (3/16in) deep may be ground out but the remaining wall thickness shall not be decreased below the minimum acceptable value.

- 5.16 Each fitting shall be dimensionally checked for the tolerance on diameter and out of roundness in accordance with this Specification and the approved shop drawings. The tolerance on wall thickness shall be checked at a minimum of 10 points equidistant around the circumference of the fitting.

6. HYDROSTATIC TEST

- 6.1 When the fittings have been installed they may be required to undergo a field hydrostatic test. BP will specify the pressure prior to contract. The Manufacturer will be required to provide a warranty for all fittings supplied to this Specification at all pressures up to and including that advised for the field test following installation.

7. INSPECTION

- 7.1 BP or a BP appointed inspector may require:
- (a) Full access to all stages of the manufacturing process at all reasonable times.
 - (b) Reasonable facilities for inspection.
 - (c) To stamp or otherwise identify fittings and test pieces, and to reject any material which does not comply with the requirements of this Specification.
 - (d) To witness all mechanical tests and confirm that all heat treatment and residual imperfections are within the agreed limits, and chemical analyses are within the approved range and that the dimensions of the finished product are within agreed tolerances.
 - (e) To carry out dimensional checks on any fitting at any point to ensure that it conforms to the requirements of this Specification and the approved drawings.

NOTE: Inspection by BP does not relieve the Manufacturer of his responsibility to ensure that the quality plan is strictly implemented and that related documentation is available.



8. CERTIFICATION

- 8.1 The original steel makers and pipe makers certificates, when applicable, shall be supplied for each heat of steel used.

The fitting Manufacturer shall prepare a test certificate for each heat of steel used (or each heat treatment lot where more than one lot is made from the same heat). This shall show the steel manufacturer, steelmaking process, heat number, heat analysis, product analysis, heat treatment, full mechanical properties as determined from test pieces for that heat or lot, and reference numbers of all fittings covered by that certificate.

When bends, or other type of fitting, manufactured by pressing and longitudinal welding are approved, full details of the welding consumables and weld metal properties shall be included. The certificate shall be subject to approval by the BP Materials Engineer.

9. MARKING, COATING AND PACKING

- 9.1 Each fitting shall have its reference number stamped on the weld bevel, using low stress stamps. The Manufacturer's name, the heat number, fitting reference number and the strength grade shall be marked on each fitting, by painting on the inside, in a manner approved by the BP Materials Engineer.
- 9.2 Each fitting shall be re-blast cleaned after testing to a surface finish of Sa 2 1/2, or better, in accordance with [ISO 8501-1](#). All surfaces, other than those within 25mm (1in) of weld bevel, shall be coated with epoxy primer to a dry film thickness of 50 microns (0.002 in).
- 9.3 Where the Manufacturer is responsible for handling and transportation, he shall be responsible for maintaining all dimensional tolerances while the fittings are in his custody.
- 9.4 Protection, labelling and packing shall comply with the requirements specified on the Purchase Order.

10. INFORMATION REQUIRED WITH BID

- 10.1 Any proposed deviations from this Specification.
- 10.2 The proposed chemical composition range.
- 10.3 The proposed guaranteed minimum mechanical properties.
- 10.4 Details of the dimensions and appropriate tolerances for each finished product.



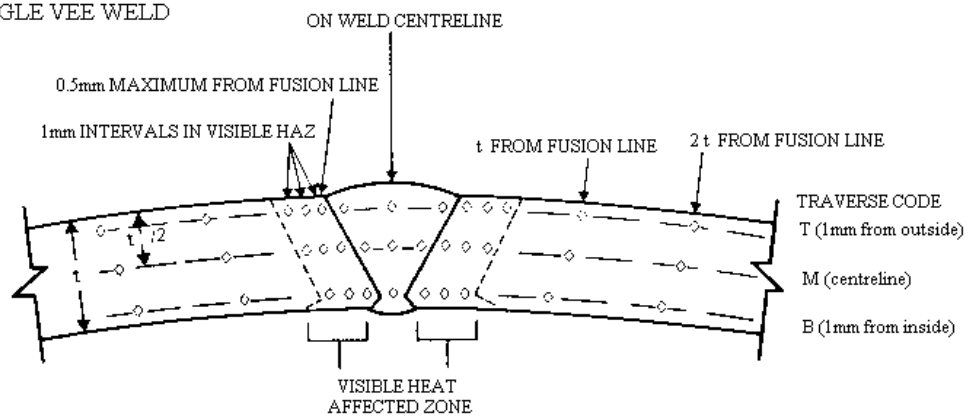
- 10.5 If appropriate, the names of companies to whom similar fittings have previously been supplied should be given, together with the actual composition used and mechanical properties obtained.
- 10.6 Proposals for warranty in the event of failure of the fitting during field hydrostatic test.
- 10.7 The proposed manufacturing procedure and quality plan including steel making technique, casting technique, forming processes, heat treatments, welding procedure specifications and qualification test records where appropriate, non-destructive testing techniques and equipment, and the names of any subcontractors involved, including steelmakers and pipemakers.

11. INFORMATION REQUIRED PRIOR TO MANUFACTURE

- * 11.1 BP will specify whether the fitting will operate in sour or non sour service.
- 11.2 The Manufacturer shall submit detailed shop drawings including all nominal dimensions, wall thicknesses, tolerances, end bevel angles, grade of material and location of any weld seams) and his manufacturing procedure for approval by the BP Materials Engineer before manufacture begins.
- 11.3 The Manufacturer shall also submit his proposals for protection during shipment.



a) SINGLE VEE WELD



b) DOUBLE VEE WELD
(TEXT AS FOR a)

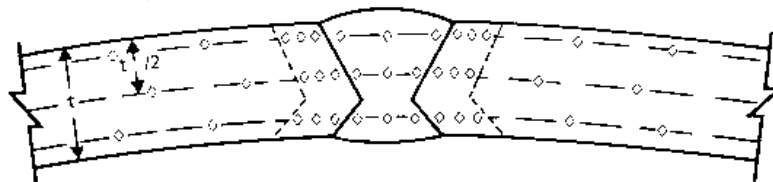
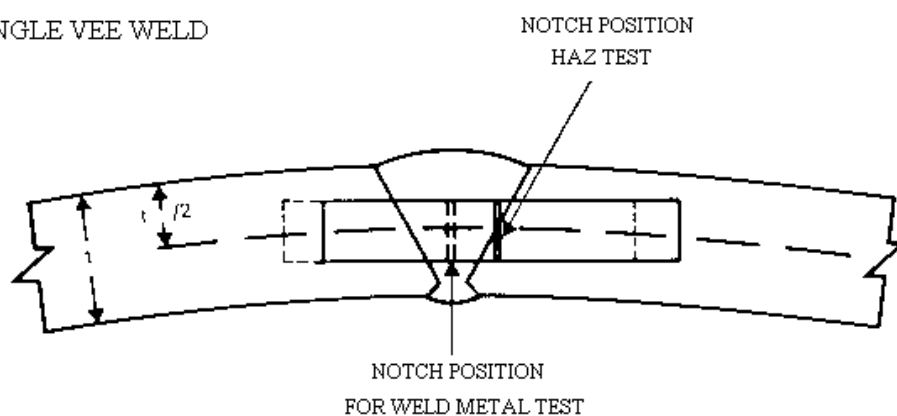


FIGURE 1
POSITION FOR HARDNESS INDENTS

a) SINGLE VEE WELD



b) DOUBLE VEE WELD

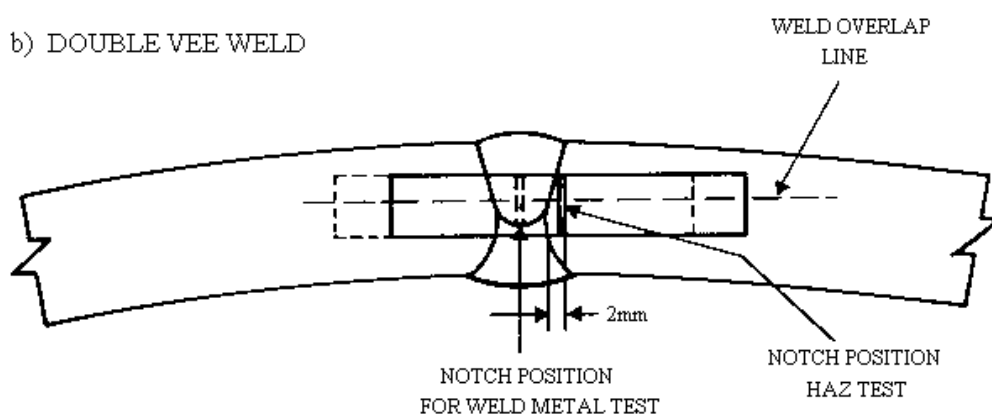


FIGURE 2

POSITIONS FOR WELD CENTRE LINE AND HAZ CHARPY TESTS

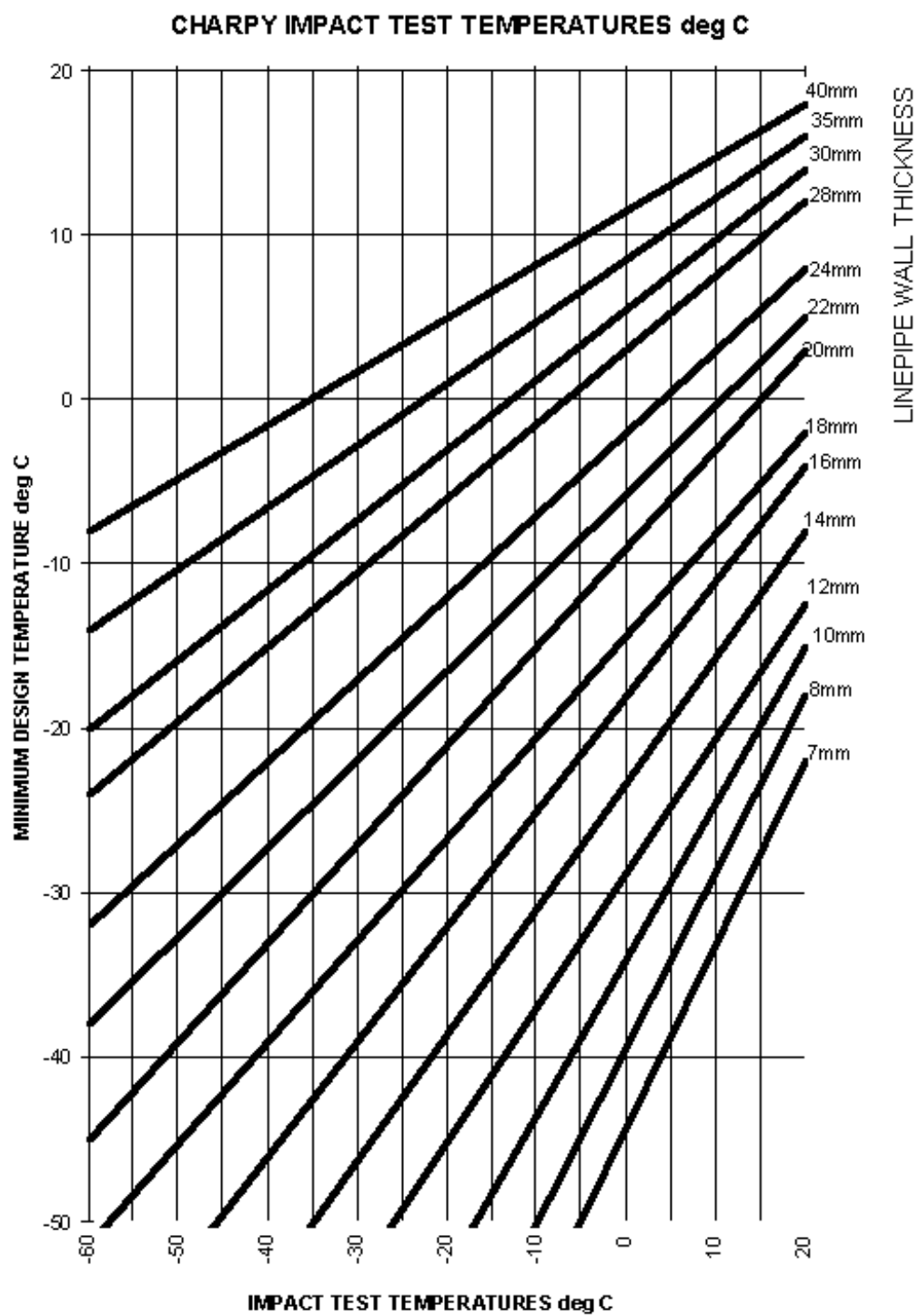


FIGURE 3

CHARPY IMPACT TEST TEMPERATURES



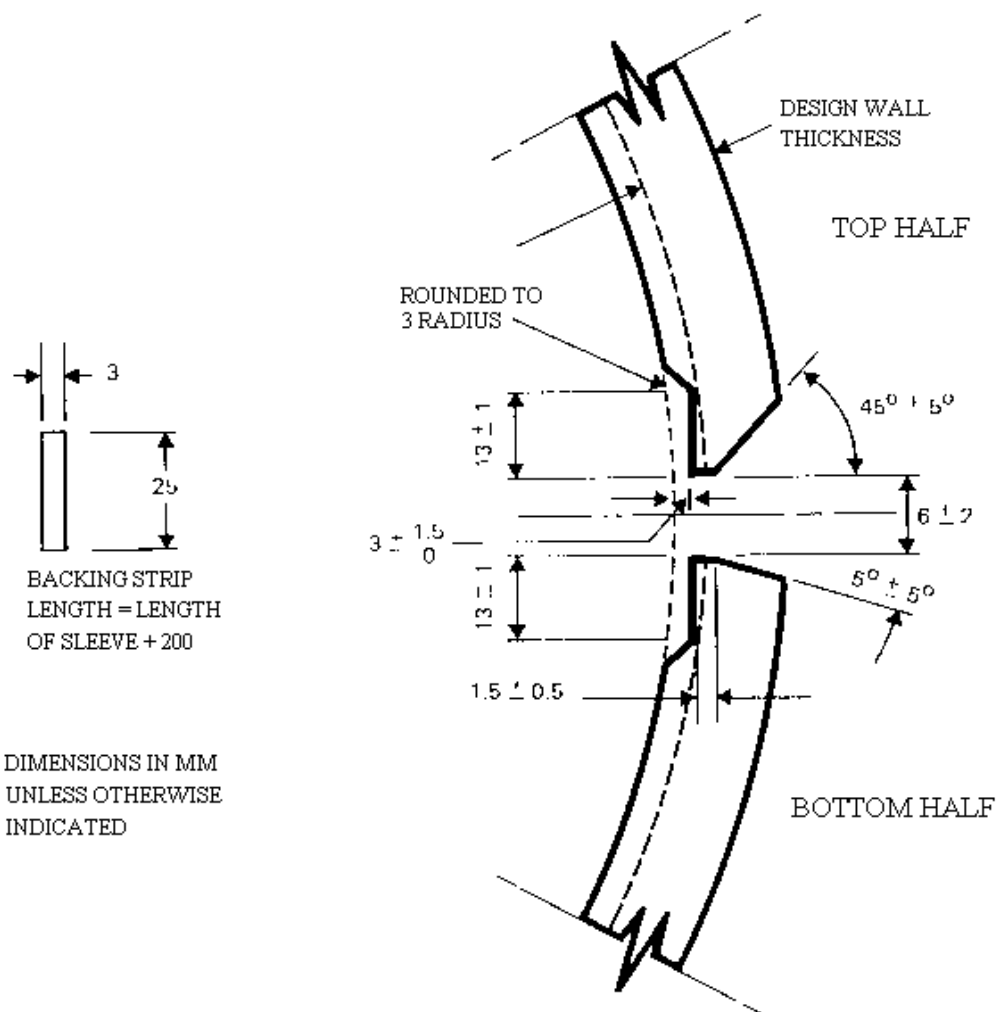


FIGURE 4

DIMENSIONS & WELD PREPARATION FOR SPLIT FITTINGS



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory volume.

In this Specification the following definitions apply:

BP:	The British Petroleum Company p.l.c., an associate or subsidiary or other organisation as defined in the Conditions of Contract on a project.
BP Materials Engineer:	a BP specialist engineer appointed to ensure that the provisions of this Specification are met.
defect:	an imperfection of sufficient magnitude to warrant rejection of the product based on the stipulations of this Specification.
imperfection:	a discontinuity or irregularity in the product detected by the methods outlined in this Specification.
inspector:	an inspector directly responsible to BP for checking work covered by this Specification.
Manufacturer:	a manufacturer of fittings or his accredited agent.
independent inspectorate	an external body, independent of the purchaser and Manufacturer, possessing the necessary competence to verify that the Manufacturer has satisfied the requirements of this Specification.
sub-contractor:	a Manufacturer or fabricator making fittings for or to the design of a supplier, manufacturer or contractor employed by BP.
Note:	Any specific application of these terms and the responsibilities for the parties defined above is a matter for the Conditions of Contract on the project.



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

Note: This is a list of other codes and standards referred to in this BP Specification. A reference in this Specification to these documents invokes the latest published issue or amendment unless otherwise stated.

American Documents

API 5L	API Specification for Line Pipe
ANSI/ASME B31.8	Gas Transmission and Distribution Piping Systems
ANSI/ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ASME IX	Welding and Brazing Qualifications
ASTM A 370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 694	Forgings, Carbon and Alloy Steel, for flanges, fittings, valves and parts for high-pressure transmission.
ASTM E 709	Practice for Magnetic Particle Examination
MSS SP75	Specification for High Test Wrought Butt Welding Fittings

International Documents

ISO 3183	Linepipe Standard
ISO 8501-1	Preparation for steel substrates
ISO 9712	Non-destructive testing: qualification and certification of Personnel



[ISO 11496](#)

Seamless and Welded Steel Tube for Pressure Purposes -
Ultrasonic Testing of Tube Ends for the Detection of Laminar
Imperfections.

British Standards

[BS 1640](#)

Steel Butt-Welding Pipe Fittings for the Petroleum Industry

[BS 4515](#)

Welding of Steel Pipelines on Land and Offshore

[BS 5996](#)

Acceptance levels for internal imperfections in steel plate, strip
and wide flats, based on ultrasonic testing

[BS 6072](#)

Method for Magnetic Particle Flaw Detection

BP Group Documents

BP [GS136-1](#)

Materials for Sour Service

BP [GS142-12](#)

Supplementary Requirements for Pipe Flanges and Fittings



SUPPLEMENTARY REQUIREMENTS FOR PARTICULAR FITTINGS

A1.1	BENDS
A1.1.1	Bend dimensions in the BP preliminary design assume a material strength equal to that of the linepipe. Any reduction in strength shall be accompanied by an appropriate increase in thickness.
A1.1.2	Manufacture of bends by hot forming of pipe is preferred, but plates pressed and longitudinally welded may be considered.
A1.1.3	Where bends are formed from longitudinal welded linepipe, the weld shall lie within 5% of the neutral axis of the bend.
A1.1.4	Where large bends are fabricated by joining two smaller bends, the girth welding procedure shall be qualified using the mechanical tests defined in Section 5 of this Specification, and where both smaller bends have longitudinal welds these shall be separated by 180 degrees at the girth weld.
A1.1.5	The tolerance on specified bend angle shall be $\pm 0.75^\circ$.
A1.1.6	The maximum out of plane deviation shall be 5mm for bend angles up to 45° and 10mm for angles between 45° and 90° .
A1.1.7	Ovality over the length of the bend, including tangents, shall be checked by passing a gauging having an outside diameter equal to 95% of nominal internal diameter through the bend. For acceptance, the gauging pig shall pass completely and freely through the bend.
A1.1.8	Where bends are produced with a parallel portion at each end, the test pieces shall be taken from a separate bend (made to the same procedure) with an arc not less than 45° .
A1.1.9	Mechanical test pieces from the body of the bend shall be taken from both the inner and outer radii (intrados and extrados), and both sets shall meet the specified requirements.
A1.1.10	For bend diameters above NPS 600mm (24in) the internal visual examination shall be carried out by an inspector passing through the bend.
A1.1.11	BP may also require wet magnetic particle inspection of the bend surfaces including any welds.



A1.2	REDUCERS
A1.2.1	Reducers shall be fabricated either by forging, or by longitudinal welding of rolled plate.
A1.2.2	Rolled and welded reducers shall have a taper not exceeding degrees (1 in 4).
A1.3	TEES
A1.3.1	Branch reinforcement shall be in accordance with ANSI/ASME B31.8 .
A1.3.2	Extruded branches are preferred to fabricated branches.
A1.3.3	The branch shall be formed diametrically opposite any longitudinal weld.
A1.3.4	Non-destructive testing of fabricated branches shall be by ultrasonic testing. The acceptance levels for defects shall be those of BS 4515 .
A1.3.5	When a pup piece is welded to a branch, the tee shall be normalised or stress relieved after welding.
A1.3.6	The internal diameter tolerance in the body of the tee shall be $\pm 1\%$, and a gauging plate of 95% of the nominal internal diameter shall be passed through the barrel of the tee.
A1.3.7	In the design of split tees, any reinforcement from the existing pipeline shall be neglected.
A1.3.8	Each split tee shall be hydrostatically tested before splitting. This test shall be witnessed and certified by an independent inspectorate.
A1.3.9	After splitting a tee, the longitudinal weld bevel shall be machined in accordance with Figure 4 .
A1.4	SPLIT SLEEVES
*A1.4.1	Normalising is not required. Stress relief is required after cold forming when the ratio of pipeline diameter to sleeve thickness is below 20:1. If this ratio is below 10:1, additional requirements will be specified by the BP Materials Engineer.
A1.4.2	Each split sleeve shall be hydrostatically tested before splitting. This test shall be witnessed and certified by an independent inspectorate.



A1.4.3 After splitting, the longitudinal weld bevel shall be machined in accordance with Figure 4 .

A1.5 END CAPS

A1.5.1 There are no specific, additional requirements for end caps.

