Gas Industry Standard

GIS/E56: 2025

Specification for

Ancillary Pipeline Equipment

Cadent Your Gas Network
Gas Networks Ireland
Northern Gas Networks
national gas transmission
SGN Your gas. Our network.
WALES&WEST UTILITIES

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Foreword

Gas Industry Standards (GIS) are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition. Contractors and other users external to Gas Transporters should direct their requests for copies of a GIS to the department or group responsible for the initial issue of their contract documentation.

Comments and queries regarding the technical content of this document should be directed in the first instance to the contract department of the Gas Transporter responsible for the initial issue of their contract documentation.

This standard calls for the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Compliance with this engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

Mandatory and non-mandatory requirements

For the purposes of a GIS the following auxiliary verbs have the meanings indicated:

can indicates a physical possibility;

may indicates an option that is not mandatory;

shall indicates a GIS requirement;

should indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment needs to be completed to show that the alternative method delivers the same, or better, level of protection.

Disclaimer

This engineering document is provided for use by Gas Transporters and such of their contractors as are obliged by the terms of their contracts to comply with this engineering document. Where this engineering document is used by any other party, it is the responsibility of that party to ensure that the engineering document is correctly applied.

Brief history

First published incorporating the documents E10 and DAT6 part 1. E17 parts 1 & 3 and DAT 30 as part 2. E18 as part 3. E24 as part 4.	April 2004
Editorial updates for rebranding	October 2005
Modified key changes including parts 1,2,3 and 4	September 2010
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1. Introduction

1.1 This Gas Industry Standard* sets out requirements for Pig traps, Insulation Joints (IJs), Test ends and Pigs for use on steel pipeline systems operating on natural gas pressures greater than 7 bar and normally in the temperature range -20°C to 50°C.

*Hereinafter referred to as 'this specification'.

2. Scope

2.1 Part 1 of this document specifies the requirements for pig traps of 200mm to 1200mm nominal bore, the pressure containing parts of which comply with GIS/PV3.

2.2 Part 2 of this document specifies the requirements for IJs for class ratings 150, 300 and 600.

2.3 Part 3 of this document specifies the requirements for test ends for use when testing pipe from 300mm to 1200mm inclusive nominal to **/PM/PT/1.

2.4 Part 4 of this document specifies the requirements for the design and manufacture of pigs of 100mm to 1200mm nominal bore, for the cleaning, gauging, purging and swabbing of gas transmission pipelines during testing, commissioning, operation and de-commissioning.

3. References

Gas Transporter Specifications	
TS-C4GAS-PIPO	Specification for steel pipes for pipelines (withdrawn)
**/SP/PIP/1	Specification for steel line pipe for natural gas pipelines operating at pressures greater than 7 bar (with specific requirements to BS EN ISO 3183:2012 including Annex M)
**/PM/MSL/1	Management procedure for mains laying and service laying
**/PM/OLI/2	Management procedure for pressure testing pipework, pipelines, small bore pipeworks and above ground austenitic stainless steel pipeworks
**/PM/PT/1	Work procedure for weldability testing of pipe fittings for service at pressures above 7 bar
**/SP/WP/1	Specification for weldability testing of pipe fittings for service at pressures above 7 bar
**/SP/B/12	Specification for steel bends, tees, reducers and end caps for operating pressures greater than 7 bar
**/SP/CM/1	Specification for internal coating operations for steel line pipe and fittings
GIS/CM2	Specification for internal coating materials for steel line pipe and fittings
**/SP/DAT/6	Specification for standard sizes of carbon and carbon manganese steel pipe for operating pressures greater than 7 bar
*GIS/E55	Specification for bolting, jointing, threading and fasteners for pressures >7 barg
**D/SP/EL/13	Specification for earthing
**/SP/F/1	Specification for carbon and carbon manganese steel forgings and forged components for operating pressures greater than 7 bar
**/SP/F/6	Specification for carbon and carbon manganese steel pipe pups for operating pressures greater than 7 bar
**/SP/PC/2	Specification for the use of pigs in gas transmission pipelines
**/SP/P/10	Specification for general pipelining designed to operate at pressures greater than 7 bar (Complementary to BS8010)
**	Gas Transporters will each have their own procedures & specifications normally in the referenced format **/SP/XX/No, where ** is replaced by the Gas Transporters reference e.g. T for National Gas Transmission, or SGN, WWU etc. followed by the specification initials and number reference.

Gas Industry Standards	
GIS/C9	Specification for carbon steel castings for pressure purposes above 7 bar
GIS/CW5	Specification for field applied external coatings for buried pipework and systems
GIS/PV3	Specification for pressure vessels manufactured to PD 5500 in carbon, ferritic alloy and austenitic stainless steels
GIS/P2	Specification for welding of land pipelines and installations designed to operate at pressures greater than 7 bar
GIS/P16	Specification for the dimensions and applications of standard weld end preparations for steel pipe, fittings and valves
GIS/PA10	Specification for new and maintenance painting at works and site for above ground pipeline and plant installations

British Standards	
BS 21	Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions) (obsolescent partially superseded by BS EN 10226-1)
BS 1134	Assessment of surface texture
BS 3799	Specification for steel pipe fittings, screwed and socket welding for the petroleum industry
BS 4368	Metallic tube connectors for fluid power and general use. Part 1 - Split collet compression fittings
BS 4518	Specification for metric dimensions of toroidal sealing rings ('O'-rings) and their housings
PD 5500	Specification for unfired fusion welded pressure vessels

ISO Standards	
BS EN ISO 8434-1	Metallic tube connections for fluid power and general use. 24 degree cone connectors
BS EN ISO 8501	Preparation of steel substrates before application of paints and related products
BS EN ISO 9934-1	Non-destructive testing. Magnetic particle testing. General principles
BS EN ISO 15614-1	Specification and qualification of welding procedures for metallic materials. Welding procedure test. Arc and gas welding of steels and arc welding of nickel and nickel alloys

European Standards	
BS EN 287	Qualification test of welders. Fusion welding. Part 1 – Steels
BS EN 288	Specification and approval of welding procedures for metallic materials: Part 3 - Welding procedure tests for the arc welding of steels (replaced by BS EN ISO 15614-1)
BS EN 1435	Non-destructive examination of welds. Radiographic examination of welded joints
BS EN 1759-1	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, class-designated. Steel flanges, NPS ½ to 24
BS EN 10002	Metallic materials – Tensile testing – Part 1: Method of test at ambient temperatures
BS EN 10045	Charpy impact test on metallic materials – Part 1: Test method (V-and U-notches)
BS EN 10025	Hot Rolled Products of Structural Steels
BS EN 10160	Ultrasonic testing of steel flat product of thickness equal to or greater than 6mm (reflection method)
BS EN 10208	Steel pipes for pipelines for combustible fluids – Technical delivery conditions Part 2 – Pipes of requirement Class B
BE EN 10222	Steel forgings for pressure purposes
BS EN 10226-1	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation (partially supersedes BS 21)
BS EN 14870-2 (ISO 15590-2)	Petroleum and natural gas industrials – Induction bends, fittings and flanges for pipeline transportation systems – Part 2: Fittings

Engineering Equipment and Material Users Association (EEMUA)	
No.101	Lifting points - a design guide

American Standards	
ASME B 16.9	Factory made wrought steel butt-welding fittings
ASME B 16.28	Wrought steel butt-welding short radius elbows and returns
ASME B16.47	Large diameter steel flanges NPS 26 through NPS 60
MSS-SP-44	Steel pipe line flanges

4. Definitions

Contractor	The person, firm or company with whom the Gas Transporter enters into a contract to which this specification applies, including the Contractor's personal representatives, successors and permitted assigns.
Differential Pressure	Difference in the pipeline pressure at the front and the back of a pig, which provides the driving force for the pig.
Engineer	The Engineer appointed from time to time by the Gas Transporter and notified in writing to the Contractor to act as Engineer for the purposes of the contract
Insulation Joint*	a special component consisting of two metal pipes insulated from each other using materials and seals in such a way that the pipes are mechanically connected but electrically insulated from one another. *Hereinafter referred to as 'joint'
Owner of test end	The Gas Transporter or the contractor who will be using the test end for pressure tests and keeping it between tests.
Pipeline Pressure	Overall pressure in a pipeline, as compared with atmospheric pressure.
Pressure containing parts	All those parts subjected to gas under service pressure. In addition to these parts, studs, nuts, bolts and gaskets connecting pressure containing shall also be deemed to be pressure containing parts.
Test end proof pressure	The pressure at which a hydrostatic pressure test is carried out on a new test end or one which is being revalidated (generally 1.25 times the maximum test end working pressure).
Test end working pressure	The pressure (equal to the test pressure for the pipe or filling being tested) applied to a test end while it is being used for a pressure test

5. Variants

5.1 A contractor shall only propose variants to this specification where the text indicates that variants would be considered by the Gas Transporter.

6. Part 1 Pig Traps

1. Field of Application

This Part 1 of the specification specifies the design of pig traps intended to meet a design pressure of up to a maximum of Class 600. (Class ratings refer to those given in BS EN 1759-1 and ASME B16.47).

2. Design

2.1 General Requirements

2.1.1 All pig traps shall be compatible with the requirements of Appendix B, OLI/2 and part 4 of this document. Pig traps shall be of the universal type, i.e. capable of launching and receiving pigs, unless otherwise specified on the Data Sheet (see Appendix A), which shall also state whether the pig trap is to be designed for permanent installation or portable use. If operating outside of the temperature range of -20 to 50°C, this shall be specified on the data sheet.

2.1.2 The pig trap shall be provided with steel supports which shall be welded into position on the barrel. These supports shall be provided with low friction, non-metallic sliding surfaces and shall make allowance for 50 mm transverse movement in either direction in addition to free axial movement.

2.1.3 Details of the handing of the end closure and branch connections shall be as specified on the Data Sheet.

2.1.4 All threaded connections should be BSP taper to BS 21 or to BS EN 10226-1. Where alternative threads are necessary (e.g. pig signalling devices), details shall be supplied to the Gas Transporter at the time of tender.

2.1.5 All nozzle flanges shall conform to BS EN 1759-1 or ASME B16.47 or MSS-SP-44 with class ratings and face types as specified on the Data Sheet. All sizes of flanges shall be fitted so that their bolt holes are off vertical and horizontal centre lines.

2.1.6 Vent, drain and bridle connections shall be flanged.

2.1.7 Portable pig traps shall be provided with lifting lugs which shall be designed in accordance with EEMUA publication No.101.

2.1.8 The detail dimensions shall be either to the Contractor's standard or specified by the Gas Transport on the Data Sheet. If detail dimensions are specified by the Gas Transporter, a general arrangement drawing shall also be supplied by the Gas Transporter giving overall dimensions, the position and size of branch connections, pig signalling devices, etc., together with details of lifting lugs, where required

2.2 Mechanical design

2.2.1 The pig trap shall be designed in accordance with GIS/PV3 to Construction Category 1 and 2.2.2 to 2.2.8 inclusive.

The design pressure for the pig trap shall be as specified on the Data Sheet (see Appendix A).

2.2.2 Additionally, the pig trap shall be designed to meet the requirements of PD 5500, Appendix C with a fatigue life of 1000 cycles over a pressure range equal to the full design pressure (to allow for full depressurization during maintenance) and 15 000 cycles over a pressure range equal to the diurnal pressure variation (taken to be 50% of the design pressure unless specified otherwise on the Data Sheet). The hydrostatic test pressure shall be in accordance with PD 5500, unless otherwise specified on the Data Sheet.

2.2.3 For the ambient temperature range of -20 ^{O}C to 50 ^{O}C, the lower design temperature for the determination of impact properties of metallic materials shall be taken as -10 ^{O}C, in accordance with GIS/PV3. For other operating temperature ranges, the lower design temperature shall be specified on the Data Sheet.

2.2.4 For the purpose of design, the maximum membrane design stress shall be in accordance with PD 5500, unless otherwise specified on the Data Sheet. However, the design shall be such that during the hydrostatic pressure test (see 2.2.2), the general membrane stress shall not be greater than 90% of the specified yield stress.

2.2.5 If a corrosion allowance is required, it shall be specified on the Data Sheet.

2.2.6 Unless otherwise specified, any hinge or hinges for end closures shall be positioned vertically to allow the door to swing horizontally. End closure hinges, where fitted, shall be capable of adjustment in service.

2.2.7 Full details of all end closures shall be submitted at the time of tender, together with details of the effort required for operation. The effort required shall not be greater than 350 N. Where necessary, a suitable operating gear shall be fitted.

The maximum force that may be applied without damaging the end closure in any way shall be declared by the Contractor and shall not be less than 50% in excess of the normal operating force.

2.2.8 The basic design of end closures shall be in accordance with GIS/PV3.

2.3 Pig signalling device

2.3.1 A pig signalling device shall be fitted to the neck pipe of the pig trap, to indicate the passage of the pig, by means of a mechanical indication visible at a distance of 20 m. The design shall be such that the indication is maintained until the signalling device is manually reset.

The signalling device shall be positively retained in a suitable base welded to the pig trap and shall be so designed that it can be removed from the pig trap for maintenance purposes.

Attachment of the pig signalling device base to the pig trap shall be by means of full penetration welds.

2.3.2 The make and type of the pig signalling device shall be specified on the Data Sheet (see Appendix A).

3. Materials

3.1 Materials shall be in accordance with GIS/PV3 and 3.2 and 3.3 of this specification.

3.2 The weldability of weld ends left for welding to by others shall meet the requirements of **/SP/WP/1.

3.3 Branch connections not greater than 50 mm nominal size shall be made using full penetration welding fittings, e.g. Weldolet or Thredolet types. Branch connections greater than 50 mm nominal size shall be made using forged or extruded butt welding fittings, e.g. Sweepolet types. All such fittings shall comply with **/SP/F/1.

4. Manufacture

4.1 Manufacture shall be in accordance with GIS/PV3 and 4.2 to 4.5 inclusive of this specification.

4.2 All weld end preparations left for welding to by the Gas Transporter shall be machined to the form and dimensions for full penetration welding given in GIS/P16. The surface finish of the weld bevel shall not be greater than 3.3 µm Ra to BS 1134.

4.3 All flanges and fittings left for connection by others shall be square to the centre line of the vessel within 0.25 mm per 100 mm of flange outside diameter.

4.4 The peripheries of such flanges shall be machined within the following tolerances:

a) Not greater than 200 mm nominal size ±0.5 mm.

b) Greater than 200 mm nominal size ±1.0 mm.

4.5 Ring type joint groove side faces on flanges shall have a surface finish of 1.6 µm Ra to BS 1134.

5. Inspection and Tests

5.1 Inspection and tests shall be in accordance with GIS/PV3 and 5.2 of this specification.

5.2 Prior to the protective treatment (including shot blasting) in clause 7, the completed pig trap, including the end closure, shall be hydrostatically pressure tested to 2.2.2.

6. Identification

6.1 Identification shall be in accordance with GIS/PV3. Additionally, the information on the nameplate shall include the nominal size of the pig trap.

7. Documentation, Protection, Packing and Transport

7.1 Documentation, protection, packing and transport shall be in accordance with GIS/PV3.

7.2 Internal treatment of the vessel shall be a coating in accordance with **/SP/CM/1 using an epoxy resin to GIS/CM/2, as specified in GIS/PV3, clause 8.12.

7.3 The external surface of the vessel, vessel supports, and attachments shall be painted in accordance with GIS/PA10, as specified in GIS/PV3, clause 8.11

8. Additional Pig Signalling Device

8.1 Unless otherwise specified on the Data Sheet (see Appendix A), an additional pig signalling device for installation below ground shall also be supplied, welded to the mid point of a pipe pup. The additional pig signalling device shall be specified on the Data Sheet.

8.2 The additional pig signalling device shall be designed such that it operates generally as specified in 4.3, except that it shall operate through a ball valve which permits it to be removed from the line whilst under pressure. The ball valve and any other fittings necessary to fit the pig signalling device shall be supplied by the Contractor.

8.3 The pipe pup shall be selected from **/SP/DAT/6 and be free issued by the Gas Transporter or supplied by the Contractor as specified on the Data Sheet in the lengths given in Table 1. The pup shall be in accordance with **/SP/F/6 and shall have ends prepared for welding in accordance with GIS/P16. Care shall be taken not to score, burr or damage the ends in any way or to mark or deface the pipe walls either internally or externally.

Table 1 Pipe Pup Lengths for Additional Pig Signalling Device

Pipe Nominal Size (mm)	Pipe Pup Length (mm)
100	600
150	
200	
250	
300	
400	800
450	900
600	1200
750	1500
900	1800
1050	2000
1200	2400

8.4 Welding of the base or pig signalling device to pipe pups shall be to GIS/P2.

8.5 The assembly shall be hydrostatically pressure tested to a pressure equal to that for the pig trap. Where necessary, the pig signalling device internals shall be removed and any necessary spool piece or other fitting attached. Testing shall include a seat test on the ball valve to the full design pressure of the pig trap.

8.6 Following a satisfactory hydrostatic pressure test, the spool piece or any other attachment shall be removed, the device re-assembled and the pig signalling device and pipe pup assembly protected and packed for dispatch.

Appendix A – Data Sheet

STANDARD DATA SHEET FOR PIG TRAPS TO GIS/E56 PART1 EXTRA INFORMATION MAY BE ON A SEPARATE SHEET	1. Ref 2. Sheet No. of 3. Date 4. Issue No.
5. Checked	Approved
6. Project 7. Location 8. Title 9. Manufacture 10. Design calculation reference	Pig trap number Number off Gas Transporter order No. Gas Transporter drawing No. Gas Transporter flow sheet No.

INFORMATION TO BE SUPPLIED BY THE GAS TRANSPORTER (tick boxes as appropriate)

11. Nominal size mm
12. Design pressure bar
13. Cyclic pressure
    a) 1000 cycles over the design pressure range. ___ or bar range
    b) 15 000 cycles over the diurnal pressure range. ___ or bar range
14. Maximum membrane design stress to PD 5500 ___ or bar range
15. Corrosion allowance if required ___
16. Hydrostatic test pressure to PD 5500 or times design pressure
17. Operating temperature range as clause 1.2 or deg. C maximum °C minimum

Lower design temperature either as GIS/PV3 or °C

19. Flange class rating and facing type:

Class 150 RF	___	Class 300 RF	___
Class 600 RF	___	Class 600 RTJ	___

Type of pig trap: universal ___ or launching ___ or receiving ___

Permanent installation ___ or portable ___

Detailed dimensions: to Contractor's standard ___
or specified by the Gas Transporter ___

Handing (see Note) of the end closure: left ___ or right ___

Handing of the bridle connections: left ___ or right ___ or top ___

*25. Pig signalling device make: type ___

*26. Additional pig signalling device required ___
make: type:

27. Pup supply by the Gas Transporter ___ by Contractor ___

INFORMATION TO BE SUPPLIED BY THE CONTRACTOR

28. Drawing reference
29. Design calculations reference
30. Shell material
31. End closure make: type:
32. End closure operating force N.
33. End closure operating gear type:

NOTE – Handing refers to the view when looking at the end closure.

* An equivalent device may be proposed by the Contractor for consideration as a variant by the Gas Transporter

Appendix B – Recommended Layout and Dimensions for New Pig Traps for On-line Inspection

1. Field of Application

This appendix provides a guide to those dimensions of pig traps and their positions in compounds which affect the use of on line inspection pigs. It refers only to new construction or the installation of new stations on existing lines.

With regard to existing stations, it is important that no new work should be added in such a way that existing traps would be brought outside these recommendations.

2. Trap Dimensions

Table B.1 gives the minimum dimensions for traps to launch or receive inspection pigs. The smaller sizes should be terminated at a flange whose face is positioned at a suitable distance from the main valve on the basis that, when on line inspection is established, portable traps should be available.

3. Access

The size and weight of the pig and portable pig trap dictates vehicle access up to the trap. The launching equipment requires a firm base (ideally concrete, tarmac or well compacted granular sub-base (type 1 material)) laid out as indicated in the Figure. This should be level with the station roadway, though a raised kerb is acceptable if dictated by other considerations. The pig trap door should swing through 180° to clear the launching equipment.

4. Purge Points

Suitable tappings of at least 25 mm nominal size should be provided so that:

a) The trap should be purged in front of and behind the pig.

b) The pressure should be equalised across the pig during pressurisation and depressurisation.

Figure B.1 – Layout and dimensions for new pig traps for an on-line inspection

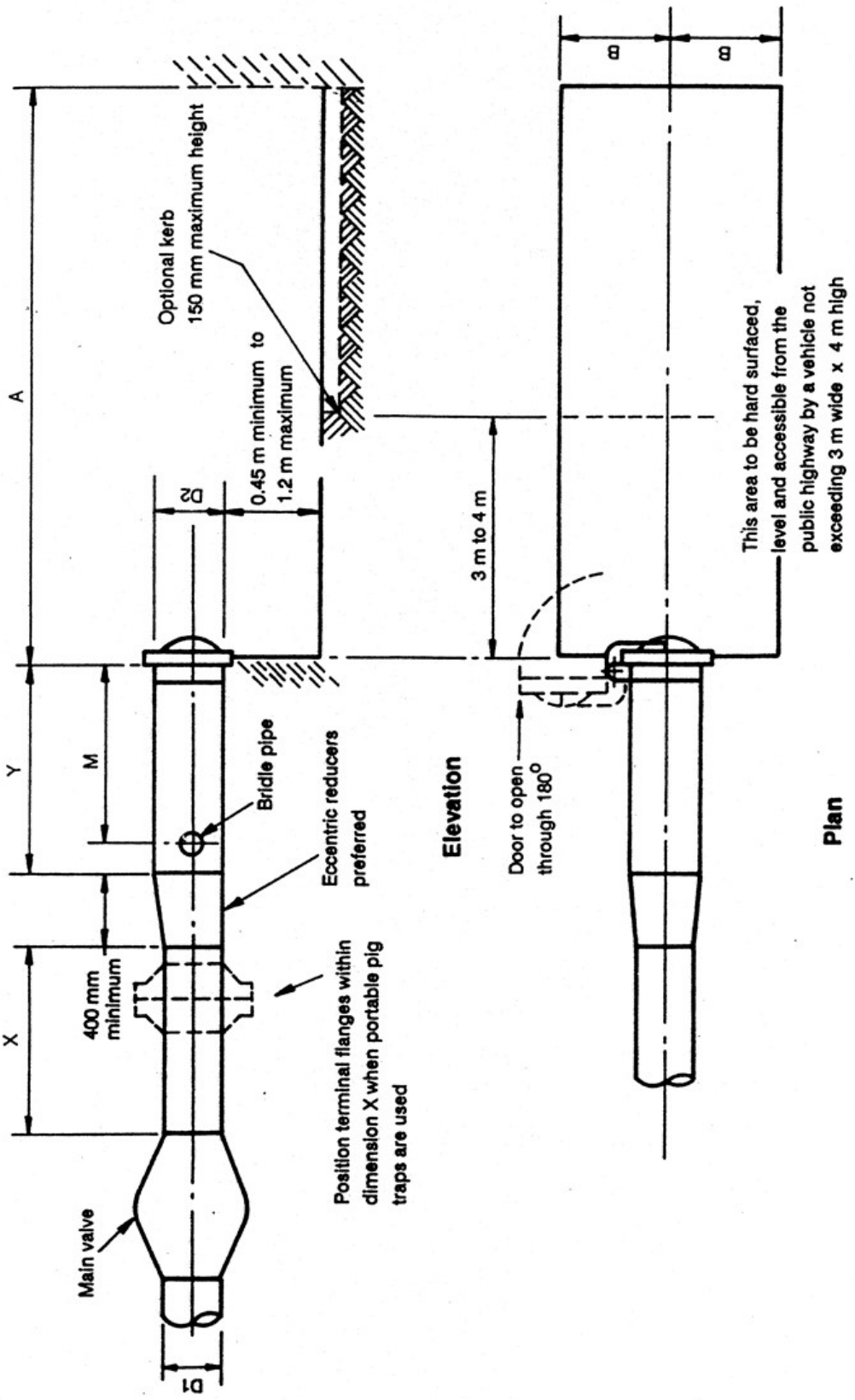


TABLE B.1 - Minimum dimensions for new pig traps

SIZE

Nominal diameter D1	- mm	200	250	300	350	400	450	500	600	750	900	1050	1200
Trap diameter D2	- mm	300	350	400	400	500	500	600	660	864	1015	1220	1380

UNIVERSAL TRAP

Dimension X	- m	4.5	4.6	4.3	4.3	4.1	4.1	4.1	3.9	3.4	4.0	3.8	3.8
Dimension Y	- m	4.9	5.1	4.8	4.8	4.8	4.8	4.8	4.7	4.3	5.2	5.0	5.0
Dimension M	- m	2.5	2.6	2.7	2.7	3.0	3.0	3.0	3.1	3.6	4.1	3.9	3.9

LAUNCH ONLY TRAP

Dimension X	- m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1.3	1.3	1.3	1.3	1.3
Dimension Y	- m	4.9	5.1	4.8	4.8	4.8	4.8	4.8	4.7	4.3	5.2	5.0	5.0

RECEIVE ONLY TRAP

Dimension X	- m	4.5	4.6	4.3	4.3	4.1	4.1	4.1	3.9	3.4	4.0	3.8	3.8
Dimension M	- m	2.5	2.6	2.7	2.7	3.0	3.0	3.0	3.1	3.6	4.1	3.9	3.9

VEHICLE AREA

Dimension A	- m	7.0	7.0	7.0	7.0	7.5	7.5	7.5	7.5	7.5	8.0	8.0	8.0
Dimension B	- m	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5

7. Part 2 Insulation Joints Operating at Pressures Greater than 7 barg for Class Ratings 150, 300 and 600

1. Field of Application

This Part 2 of the specification specifies the requirements for insulation joints for Class ratings 150, 300 and 600.

Insulation joints manufactured to the requirements of this specification are used for the electrical insulation of pipework and/or ancillary equipment, etc., usually but not exclusively, for cathodic protection applications. Insulation joints are not normally designed to withstand torsional stress.

The main text outlines the requirements for proprietary prefabricated insulation joints. The requirements for insulation joints using insulated flanges are specified in Appendix A.

Insulation joints using insulated flanges can be used for electrically insulating one section of pipe from another for cathodic protection and other purposes. However due to their record of electrical unreliability, particularly below ground, joints of this type should only be used when the use of a proprietary prefabricated coupling or insulation joint is precluded.

The maximum operating pressures applicable to the Class ratings are given in Table 1.

2. Materials

2.1 Materials for metallic components

2.1.1 Forgings shall be in accordance with the relevant requirements of **/SP/F/1, BS EN 10222 or equivalent International standard.

2.1.2 Wrought materials shall be in accordance with Appendix B.

2.1.3 Castings shall be in accordance with GIS/C9.

2.1.4 Pipe pups for welding on to the joint, or pipe for joint components, shall be in accordance with **/SP/PIP/1, TS-C4GAS-PIPO or **D/SP/F/6.

2.1.5 Where ends suitable for compression couplings are specified, materials should be selected to meet the requirements of BS 4368 or BS EN ISO 8434-1.

2.1.6 Bolting requirements shall be in accordance with GIS/E55.

2.2 Materials for non-metallic components

2.2.1 All non-metallic materials in the joint shall be capable of withstanding the service conditions specified in clause 1 and the test conditions specified in clause 8.

2.2.2 All materials shall be resistant to the action of water, hydrocarbons, glycols, methanol, natural gas and odorant.

2.2.3 Where toroidal sealing rings ('O'-rings) are used to affect a pressure seal, the 'O'-rings shall be made from an elastomer based material having a high resistance to compression set. The 'O'rings shall be of moulded construction and preferably continuous. A scarfed joint is permissible provided it is adequately bonded, and the manufacturer proves that the required 'O'-ring tolerances specified in Appendix C are maintained throughout.

The Contractor shall submit details of the dimensions and tolerances of the associated grooves, for the approval of the Gas Transporter.

Tolerances on 'O'-ring flash, mismatch, offset and flats shall not exceed the limits specified in BS 4518 (see Appendix C).

2.2.4 All elastomers contained in the joint shall be of ageing resistant material having a permanent residual elasticity suitable for ensuring permanent leak tightness (see 2.2.3 and Appendix C).

2.2.5 The insulating materials and seals in the joint shall be suitable for resisting the electrical test voltage specified in 8.2 and shall not degrade when subjected to the temperatures which may occur temporarily during manufacture and welding of the joint or when subjected to the continuous operating temperature of the pipework (50°C). The insulating materials and seals shall also be capable of withstanding normal field welding conditions including 100^{o}C preheat local to the end preparations (100 mm band) prior to welding.

3. Design

3.1 The joint shall be designed to provide an effective electrical barrier in service.

3.2 The maximum design stress shall not exceed 50% specified minimum yield stress (SMYS) at the maximum operating pressure in accordance with the Class ratings specified on the Data Sheet (see Appendix D, Section One).

3.3 The joint shall be adequate to withstand the tests specified in clause 8 and be suitable for cyclic pressure operation giving a maximum hoop stress range of 125 N/mm^2 in the adjoining pipe for a minimum endurance of 15000 cycles.

3.4 The design shall be based on a minimum number of welds and shall take into account the requirement for adequate accessibility for the application of non-destructive testing (NDT) techniques to all weld seams (see clause 6).

3.5 The design of the joint shall be such that the seals are contained within the joint in such a way as to prevent:

a) Damage to the seals during assembly.

b) Damage to the seals by extrusion during the pressure test specified in 8.1.

c) Leakage during the pressure test specified in 8.1.

d) Leakage during the tests specified in 8.3.

3.6 The Contractor shall state on the Data Sheet (see Appendix D, Section Two) the overall length of the joint for the type of end preparation so specified. Overall lengths of Class 600 joints equal to or greater than 80mm nominal size shall comply with the dimensions given in Table 2.

When pipe pups are specified on the Data Sheet, the overall length of the component, comprising joint and associated free issue pipe, shall be stated on the Data Sheet.

3.7 When the joint is assembled, there shall be no recesses or protrusions within the bore. Compliance with this requirement shall not be achieved by the use of additional applied fillers.

All inner cavities of the joint shall be filled with low viscosity dielectric materials, such as rubber and epoxy resins which solidify on curing. Precautions shall be taken to prevent the inclusion of air and foreign bodies in the dielectric materials.

3.8 The bore of the joint shall be lined with an approved coating having high electrical and abrasive resistance to prevent a reduction in electrical resistance across the joint through debris bridging the joint insulation ring.

The coating shall extend the full length of the joint (including pups where fitted) or 250 mm either side of the ring faces, whichever is the lesser. The coating shall not bridge the insulation ring of the joint bore and should preferably be applied before assembly of the joint.

3.9 The internal diameter of the joint shall be in accordance with **/SP/F/1.

The internal diameter shall be measured at each end of the joint. The method and equipment to be used shall be subject to the approval of the Gas Transporter.

3.10 The ends of the joint shall be as specified on the Data Sheet. The requirements for the certain types of end shall be as follows:

a) Weld end preparations shall be in accordance with the requirements of GIS/P16.

b) Screwed ends shall be BS 21 or BS EN 10226-1 taper (unless otherwise specified for particular applications in accordance with GIS/E55).

c) Integral compression couplings shall comply with BS 4368: Part 1 or BS EN ISO 8434 Part 1. Maximum sizes for compression couplings are covered in these specifications.

d) Plain ends for use with compression couplings shall be as specified in accordance with BS 4368 or BS EN ISO 8434-1

e) Socket weld ends shall be suitable for connection to fittings to BS 3799.

3.11 Joints shall not be fitted with adapters in order to meet specified size requirements.

3.12 Where pressure retaining parts or assemblies are held together by means of screwed components, the joint shall be designed to prevent accidental disassembly under pressure.

3.13 Where required diverter or cable/instrument connections shall be attached in accordance with Figures 1 and 2. The weld shall be deposited using a minimum of two runs.

4. Manufacture

4.1 The manufacturer shall be responsible for the integrity of the manufacturing procedures and the suitability of the joint for its intended use.

4.2 At the time of tendering the Contractor shall supply:

a) Two sets of general arrangement drawings, showing overall dimensions.

b) Two sets of completed data sheets (see Appendix D).

4.3 When a joint has not received prior the Gas Transporter design approval, or at the request of the Gas Transporter, the Contractor shall supply the following additional information at the time of tendering:

a) Detailed sectional arrangement drawings showing all parts with reference numbers and materials identified.

b) Design drawings and relevant calculations for pressure containing parts only.

c) Full details of manufacturing procedures, including levels of end loads, if appropriate.

d) Fabrication details.

e) Welding and testing procedures.

f) Installation and maintenance recommendations.

4.4 Once a joint has received the Gas Transporter design approval, any changes in materials, design or manufacture shall be notified to the Gas Transporter and written approval obtained prior to tendering.

4.5 The manufacturing procedure to be followed in the production of the joints shall be recorded and submitted to the Gas Transporter for approval. The Gas Transporter shall be informed when there are any future proposed changes to materials or design.

The manufacturing procedure shall be qualified by the production of completed joints (of a suitable size and pressure rating) to that procedure and the joints shall be assessed on their ability to meet the materials, design, manufacturing, testing and inspection clauses of this specification.

The manufacturing procedure shall include, but not necessarily be limited to, the following:

a) Manufacturing processes and grades of steel for plate, pipe, forgings and castings.

b) All non-metallic components used in construction, including coating.

c) Welding and heat treatment.

d) Machining and surface finishes.

e) Assembly techniques, including end loading pressures.

f) Manufacturer's stage inspection and test procedures.

g) Protection and packing for dispatch.

h) Detail drawings.

4.6 For connections to be welded by the Gas Transporter, the weld end preparations shall be in accordance with GIS/P16 for transmission fittings.

4.7 When pipe pups are specified on the Data Sheet (see Appendix D, Section One) they shall be fitted so that they are coaxial with each other and the axis of the joint.

5. Welding

5.1 General

Welding procedure and welder qualification shall comply with BS EN ISO 15614 (replacing BS EN 288-3) and BS EN 287 or any recognized National or International standard.

5.2 Welding, welding consumables and equipment

5.2.1 Welding shall be as specified in GIS/P2 but with the following amendment:

'Arcs shall be struck only where weld metal is to be applied or in the fusion path'.

5.2.2 Welding consumables and equipment shall be as specified in GIS/P2.

5.3 Welding procedure approval

Production welding shall not be commenced until the proposed welding procedures have been approved by the Gas Transporter. The approval testing of these procedures shall be conducted, recorded and reported in accordance with BS EN ISO 15614-1 with the following additional qualifications:

a) The welding tests shall be conducted at room temperature.

b) The preheat and interpass temperature, intermediate and post weld heat treatment of the test plates shall be the same as for production welding, except that preheat temperature used during the fabrication may be increased up to 100 degrees C without re-approval.

5.4 Welder qualification

5.4.1 Approval testing of welder and operators shall be conducted, recorded and reported in accordance with BS EN 287: Part 1, except as specified in 5.3.

5.4.2 All welders and welding machine operators engaged on the welding of the joint shall pass welder approval tests which are designed to demonstrate their competence to make sound welds of the types on which each is to be employed.

5.4.3 Welders who have successfully passed the prescribed tests shall be approved for welding on all joints within the limits of the procedure provided they remain in the employ of the same manufacturer. A welder who successfully welds all the test pieces required for the welding procedure tests to the requirements of 5.3 should not normally be required to undertake separate welder approval tests. If a welder has not been engaged on the fabrication of the joints, using the process and equipment appropriate to the procedure, during the preceding six months, he/she shall normally be required to undertake the whole of the approved test. He/she shall also be required to undertake the approved test if there is any reason to doubt his/her ability to make satisfactory production welds.

5.5 Production welding

Prior to production welding, the areas to be welded shall be prepared as specified in GIS/P2 with the following additional requirements:

a) When butt welds are required between materials of unequal thickness, the thicker material shall be reduced in thickness using one of the weld end preparations detailed in GIS/P16.

b) Permanent backing strips shall not be permitted.

5.6 Alignment

The alignment of welds shall be as specified in GIS/P2.

5.7 Attachments and removal of attachments

5.7.1 Attachments (permanent)

The welding of attachments shall be carried out by an approved method. Welds of permanent attachments shall be examined by the appropriate NDT technique.

5.7.2 Attachments (temporary)

Temporary attachments shall be kept to a practical minimum.

5.7.3 Removal of attachments

Where constructional attachments are to be removed, techniques shall be used which do not impair the integrity of the joint.

5.8 Preheat

Preheat treatment of the joint shall be as specified in GIS/P2.

5.9 Repair welding

Repair welding shall be as specified in GIS/P2.

5.10 Surface dressing

Areas of weld resulting from the removal of temporary attachments, or from accidental arc strikes, shall be ground smooth and the area subjected to crack detection. Care shall be taken to ensure that the wall thickness is not reduced below the specified minimum design thickness.

5.11 Stress relief

The requirements for stress relief shall be in accordance with PD 5500. Account shall be taken of the effects of stress relief on materials, which have enhanced properties due to controlled rolling (e.g. pipe pups), to ensure that unacceptable reduction in yield strength does not occur.

6. Non-Destructive Testing Procedures and Acceptable Levels

6.1 General requirements

The following applies to joints where welding is used in the manufacture and/or when weld ends are specified on the Data Sheet (see Appendix D, Section One).

Unless otherwise specified, all NDT shall be carried out after all processing and heat treatment, including final stress relieving and machining, where applicable.

The Contractor shall submit procedures, based on applicable NDT techniques, on the appropriate Gas Transporter forms, for approval by the Gas Transporter before production commences. These procedures shall be based on ultrasonic and/or radiographic techniques together with magnetic particle flaw detection, as specified in the relevant clauses.

All operators of NDT equipment shall have a thorough knowledge of the operation of the equipment to be used and shall be required to demonstrate their ability to carry out the agreed procedures.

If the Contractor can show that, having applied the requirements of 3.4, one of the techniques specified in 6.2, 6.3 and 6.4 is not practicable as specified for a particular application on his product, an alternative technique approved by the Gas Transporter should be used for that application.

6.2 Ultrasonic testing

All welds shall normally be examined by the approved ultrasonic method.

Ultrasonic testing of the circumference of pipe pups shall be carried out for a distance of 50 mm from each weld end prepared for welding on to by the Gas Transporter.

6.3 X-radiography

All welds shall be X-radiographed in accordance with BS EN 1435. Technique 2 (X-radiography, single wall using fine grain, high contrast direct type film) shall be used with the following additional requirements:

a) The source to film distance shall be governed by the requirements of BS EN 1435.

b) Image quality indicators (IQI) of the appropriate size shall be used. These shall be placed at the extremity of each film and located on the source side of the weld. IQI sensitivity shall be not less than 1.5% and the density of the X-radiographs shall be between 2 and 3 in the region of the weld.

c) All X-radiographs shall be indexed, and a record kept which shows clearly the relationship between X-radiographs and the identity of individual joints. The records shall be retained for a period of five years.

6.4 Magnetic particle flaw detection

The external and internal surfaces of all weld seams shall be inspected using the approved magnetic particle flaw detection methods.

The weld end preparations of the completed joints shall be inspected. The surface finish of the weld end preparations shall be such as to permit detection of the unacceptable defects given in Appendix E.

6.5 Unacceptable defects

Faults disclosed by NDT and exceeding the limits specified in Appendix E shall be deemed unacceptable. Any repairs shall be in accordance with 7.5.

7. Workmanship, Visual Inspection and Repair of Defects

7.1 Compliance

The Contractor shall maintain continuous supervision of its inspection procedures, including those in clause 6, by supervisors directly responsible to the management.

7.2 Workmanship

7.2.1 Weld end preparations

All surfaces to be welded shall be free from moisture and thoroughly cleaned of scale, oil and other foreign matter before welding is started.

7.2.2 Linear misalignment

Linear misalignment of plate edges shall be not greater than 1.5 mm for joints not greater than 600 mm nominal size. For joints greater than 600 mm nominal size, linear misalignment not greater than 3 mm is allowed.

7.2.3 Height of outside and inside weld beads

The weld shall be of uniform width and profile and shall merge smoothly into the surface of the plate without appreciable deviation from the line of the joint. The heights of weld beads shall not be greater than 3 mm.

7.3 Overflow

Overflow shall be dressed out to give a smooth contour. Minimum specified wall thickness shall be maintained.

7.4 Visual inspection

A visual inspection shall be made for surface defects and scoring. If found, these shall be treated in accordance with the requirements of Tables in Appendix E.

7.5 Repair of injurious defects

All repair procedures shall be submitted to the Gas Transporter for approval.

All repairs shall be inspected by X-radiography, ultrasonic and magnetic particle flaw detection (see clause 6) after stress relief.

8. Testing

8.1 Pressure testing

8.1.1 Prior to the hydrostatic pressure test, a low pressure pneumatic leak test shall be carried out at a pressure in accordance with Table 3 for a period of between 5 min and 10 min. There shall be no visible leakage when examined using normal leak detection techniques.

8.1.2 All joints shall be hydrostatically pressure tested at the test pressure appropriate for the Class rating of the joint (see Table 3). For joints equal to or greater than 80 mm nominal size the specified pressure shall be held for a period of not less than 1 h and the test shall be witnessed by a representative of the Gas Transporter. For joints less than 80 mm nominal size the specified pressure shall be held for a period of not less than 3 minutes and sample testing should be acceptable when an approved quality control system is in operation.

There shall be no signs of water leakage or any drop in pressure during the test period. Failures shall be investigated and rectified before retesting.

The joint shall be thoroughly dried out after hydrostatic pressure testing.

8.1.3 Joints shall be tested either individually or connected together in any number. End sealing methods that subject the joint to axial compression shall not be used, but suitable end closures shall be secured to each end of the joint/joint string.

8.1.4 All equipment used for pressure measurement shall be covered by a current test certificate.

8.2 Electrical testing

8.2.1 General

Joints shall be subjected to the insulation and resistance tests specified in 8.2.2 and 8.2.3 respectively and in accordance with the sequence given in Table 4. Joints should be dried before carrying out electrical testing.

Care shall be taken to ensure contact is made on bare metal during electrical testing.

8.2.2 Insulation test

An insulation test of the joint shall be applied at a voltage of not less than 2 kV (peak) using a voltage of substantially sine waveform at a frequency of 50 Hz to 60 Hz for a period of 1 min. No flashover or breakdown shall occur during the test.

8.2.3 Resistance tests

A resistance test using a 500 V insulation tester shall be applied. The resistance shall be not less than 5 M.

The resistance test, carried out subsequent to hydrostatic pressure testing, shall be carried out within 24 hrs of the hydrostatic pressure test specified in 8.1.2, but forced means of drying the joint shall not be used.

8.3 Prototype testing

8.3.1 Class 600 joints

8.3.1.1 General

Where prototype tests are specified on the invitation to tender and/or the Contract, they shall be carried out as specified in 8.3.1.2 and 8.3.1.3. The purpose of these tests is to prove that the joint design is adequate to ensure that the joint will withstand the hydrostatic test pressure and limited external loadings without detriment to its electrical resistance, pressure sealing or mechanical strength. It is intended that these tests should be required for initial evaluation of the joint and should be repeated only if a change in design or manufacture is made.

The pressure testing, and electrical testing specified in 8.1 and 8.2 respectively shall be carried out after the tests specified in 8.3.1.2 and 8.3.1.3. Disassembly for examination may also be necessary.

8.3.1.2 Combined internal pressure and externally applied bending test

The joint shall be loaded with an internal pressure of 108 bar together with an externally applied bending load sufficient to induce a bending stress of 75% of the SMYS of the adjoining pups.

The bending load shall be applied by four-point loading such that a constant bending moment is applied throughout the length of the joint and joint pups.

In cases where a bolted yoke is used in the construction of the joint, this test shall be carried out with the bolts in the plane of bending and also with the bolts at 90^{o} to the plane of bending.

The test shall be considered satisfactory if there is no loss of water and no permanent distortion of the joint.

8.3.1.3 Torsional resistance test

The joint shall be subjected to torque sufficient to induce a torsional stress of 5% SMYS in the adjoining pups. This torque shall be calculated, using the SMYS of the pup material as the limited torsional stress in the following formula:

$$T = \frac{(D^4 - d^4) \times 10^{-8}\, SMYS}{D}$$

Where:

T = torque required to induce a torsional stress of 5% SMYS in the pup material, in kNm.

D = outside diameter of pipe pup, in mm.

d = inside diameter of pipe pup, in mm.

SMYS = specified minimum yield strength of pipe material, in N/mm2.

The test shall be considered satisfactory if there is no relative rotational movement of the end pups on completion of the test.

8.3.2 Class 150 and 300 joints

Where specified on the invitation to tender, prototype tests shall be carried out as specified in 8.3.1.2, except that the test pressure for the appropriate Class shall be used (see Table 3).

9. Marking

9.1 All joints supplied in accordance with this specification shall be suitably and individually identified using methods of marking approved by the Gas Transporter.

9.2 The information to be given to identify the joints shall be as follows:

a) Relevant Gas Transporter order number.
b) Designation of this Specification.
c) Manufacturer's name.
d) Serial number and date.
e) Class rating.
f) Nominal size.
g) Type of end connection.
h) Maximum design pressure.
i) Hydrostatic test pressure.
j) Quality Assurance engineer's acceptance stamp.
k) Items c), e), f) and g) above shall be recorded on each joint.

9.3 For joints which, due to their size or number, cannot be individually identified as specified above, a tagging/bagging identification method shall be used.

9.4 The Contractor shall reinstate, on pups, any colour band and/or identification marking of the original pipe from which the pup was made.

10. Painting and Protection

10.1 After the satisfactory completion of all electrical and pressure testing, all external surfaces of the complete assembly shall be protected as specified on the Data Sheet (see Appendix D, Section One) using non-electrical conducting primers unless otherwise specified by the Gas Transporter.

Where the internal coating of the joint (see 3.8) does not cover the full length of the joint, the remaining surfaces shall be wire brushed and coated with an approved epoxy resin paint to **/SP/CM/1.

10.2 Machined faces shall be protected with an approved rust preventative or approved corrosion inhibitor, which can easily be removed on site, i.e. by non-toxic solvents or wire brushing.

11. Handling and Transport

11.1 It is the Contractor's responsibility to ensure that packaging is adequate to prevent mechanical damage during handling and transport. The weld end preparations shall be fitted with an approved protective device to prevent mechanical damage when loading, unloading and in transit. The ends of all joints shall be sealed to prevent the ingress of dirt or moisture.

11.2 Care shall be taken to ensure that wire ropes or chains, etc., do not come into metallic contact with the joint. It is recommended that broad band non-metallic slings be used to load, unload and support joints when in transit.

11.3 During transit, joints shall be adequately supported and, where chains or wire ropes are used to secure the joint, they shall not come into contact with the joint or pups. Damage to joints by the use of chains or wire ropes, etc., shall be cause for rejection.

Joints equal to or greater than 300 mm nominal size shall be adequately supported on pallets. Smaller joints shall be suitably packaged. In all instances, joints shall be prepared for transit so that they are not in direct contact with one another

12. Documentation

Records shall be retained by the manufacturer for five years from the date of manufacture. These records shall include the following:

a) Details of heat treatment.

b) Details of chemical analysis and mechanical test results.

c) Sketches indicating the position and extent of any major weld rectification.

d) Records relating to ultrasonic and X-radiographic examination.

e) Manufacturing and welding procedures.

TABLE 1 - Maximum operating pressure ratings for weld end insulation joints

Class	Max operating pressure (barg) at operating temperature -20°C to 50°C
150	19.3
300	50.0
600	100.1

TABLE 2 - Overall length of Class 600 joints including two equal length pipe pups

Nominal Size of Joint mm	Overall Length of Joint mm	Tolerance mm
□ 80	500	
100	500	
150	500	
200	1000	10
250	1000	
300	1000	
400	1000	
450	2600	
600	2600	
750	2600	25
900	2600	
1050	2600	
1200	2600	

TABLE 3 - Test pressures for weld end insulation joints

Class	Hydrostatic test pressure (minimum), bar	Pneumatic low pressure leak test pressure, bar
150	29	2
300	75	5
600	150	5

TABLE 4 - Sequence of electrical testing

Test Sequence	Action
1	Prepare the joint for hydrostatic pressure test.
2	Carry out a hydrostatic pressure test in accordance with 8.1 and an electrical resistance test* in accordance with 8.2.3.
3	Fully assemble the joint.
4	Carry out an insulation test in accordance with 8.2.2 and an electrical resistance test in accordance with 8.2.3.
* The electrical resistance test specified in 8.2.3 shall be carried out within 24h of the hydrostatic pressure test in 8.1 but forced means of drying the joint shall not be used.	

FIGURE 1 - Attachment of diverter or cable/instrument connection to joint

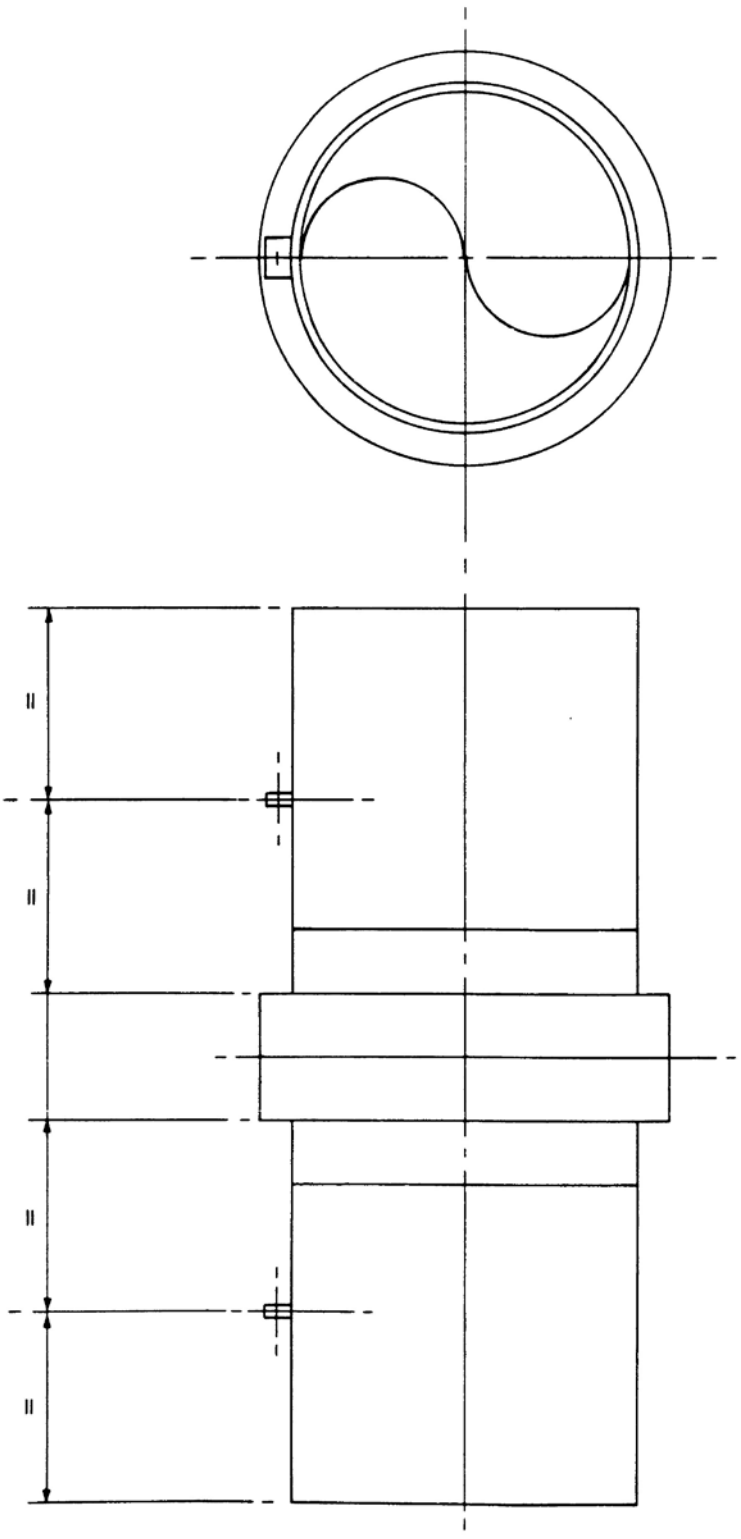
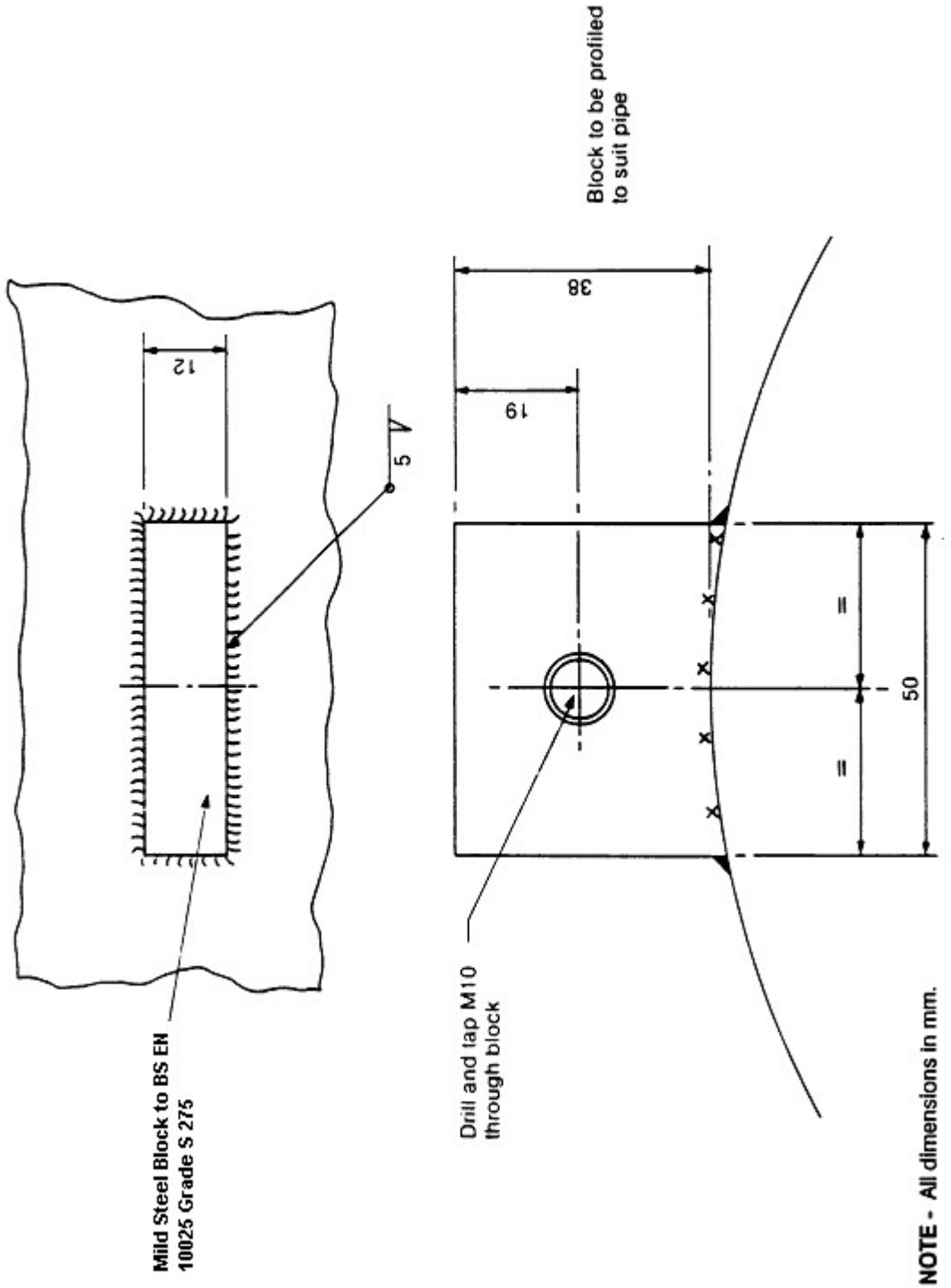


FIGURE 2 - Blocks for diverter or cable/instrument connections to joint



Appendix A – Insulation Joints Using Insulated Flanges

A.1. Field of Application

A.1.1 Insulation joints using insulated flanges may be used for electrically insulating one section of pipe from another for cathodic protection and other purposes. However due to their record of electrical unreliability, particularly below ground, joints of this type should only be used when the use of a proprietary prefabricated coupling or insulation joint is precluded.

A.1.2 Insulated flange type joints shall not be used either as a final tie-in or where any external loads could induce bending.

A.2.3 Where insulated flange type joints are required, they should preferably be sited above ground and in vertical pipes where possible (see A.6.4.).

A.2. Design

The design of the flanged joint shall be adequate for the maximum temperature and pressure conditions to be encountered in service under both normal and fault conditions.

A.3. Materials

A.3.1 Gasket materials shall be compatible with the medium to be carried at the relevant operating temperatures and shall have suitable dielectric strength and pressure rating. Graphite jointing compounds shall not be used.

A.3.2 Sleeving materials for bolts shall be of suitable mechanical and dielectric strength. The sleeve length shall be equal to the length of the compressed assembly less 1 mm and shall fit over the bolt and inside the clearance hole and shall extend into the insulating washer.

A.3.3 Bolting materials and washers shall be suitable for use with the relevant standards for the flanges to be used. Where it is necessary to use undersized bolts, care should be taken to ensure they are of adequate strength.

A.3.4 Flanges shall be in accordance with **D/SP/F/1.

Any spot facing shall be adequate to accommodate both steel and fibre washers in such a manner that sufficient clearance is maintained between the steel washer and the flange to ensure the electrical insulation is not bridged.

A.4. Assembly

A.4.1 The flanged joint shall be assembled in accordance with Figure A.1.

A.4.2 The bolting sequence shall be in accordance with **/PM/MSL/1 or GIS/E55.

A.4.3 The joint shall be made up in clean conditions, above ground, preferably in a workshop off the site. It should be electrically tested before installation (see clause A.5).

A.4.4 Site assembly is not recommended for the following reasons:

a) Misalignment of bolt holes may cause sleeve damage.

b) Difficult to keep clean and dry.

c) Difficult to correctly assemble the joint in confined spaces.

A.5. Testing

A.5.1 After assembly the joint should be subjected to at least the following electrical tests:

a) electrical resistance test between bolt and adjacent flange on one side of the assembly;

b) electrical resistance test between each bolt and the flange on the opposite side of the assembly (where applicable);

c) electrical resistance test across both flanges.

Tests shall be made using a 500 V resistance meter and for acceptance the values obtained shall be a minimum of 10 k.Ω

The electrical resistance tests across both flanges usually cannot be satisfactorily carried out after installation into the pipework due to ground loops. However, an adequate cathodic protection difference should be shown.

A.5.2 The installation pressure test on the pipework shall be used to finally prove the integrity of the joint assembly.

A.6. Coating

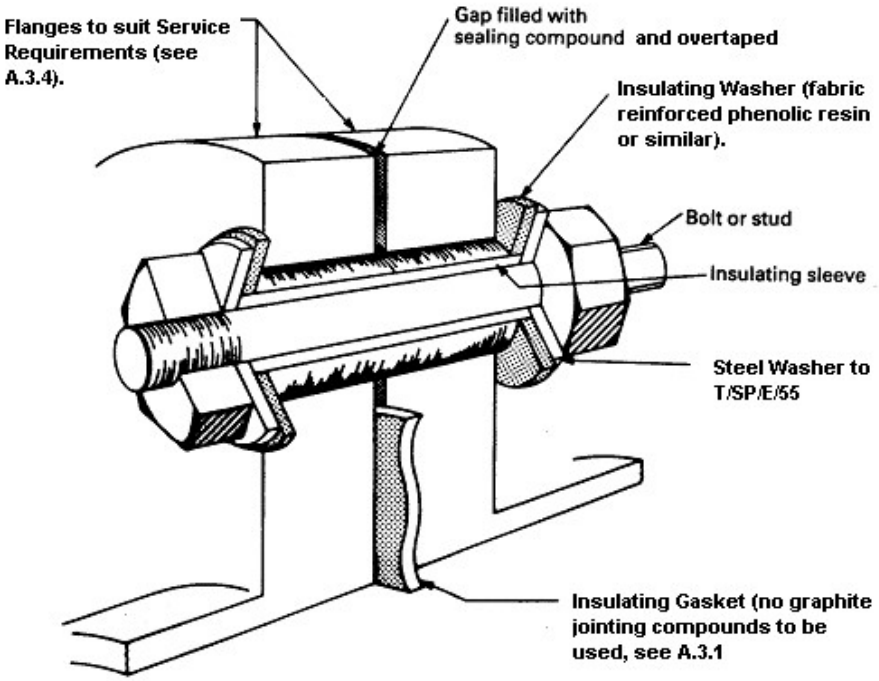
A.6.1 Where metallic bridging is possible, it is recommended that the bore surfaces are coated with nonconductive paint.

A.6.2 Where sited above ground, the joint should be painted to an appropriate specification. The gap shall be filled with suitable sealing compound and taped over to the flange periphery using a suitable tape.

A.6.3 Where sited below ground, the joint should be coated in accordance with the appropriate specification, e.g. GIS/CW5. The gap shall be filled with suitable sealing compound and taped over to the flange periphery using a suitable tape.

A.6.4 The requirements of **/SP/EL/13 shall be complied with by suitable extension of the coating where joints are sited above ground.

FIGURE A.1 - Typical insulated flange joint assembly details



NOTE: When sited below ground, provisions shall be made for the connection of test cables to both sides

Appendix B – Requirements for Plate Material

B.1 Material Grade

The steel from which the steel plate is manufactured shall have been made by the open hearth process, one of the electric processes or the basic oxygen process. Only fully killed steel shall have been used.

Allowance shall be made on the steel plate for any degradation of material properties which may occur during the manufacture of the joint.

The grade of the steel plate shall be such that the properties of the finished material at least match those of the highest grade of pipe to be attached to the joint (see Table B.1).

B.2 Composition

Chemical composition by product analysis shall be in conformance with **/SP/B/12 and BS EN 14870-2 (equivalent to ISO 15590-2) for forged fittings.

Certificates of check analysis shall be furnished to the Gas Transporter before dispatch of the joints from the Contractor. Check analysis shall be at a minimum frequency of one per cast and shall include analysis for C and Mn.

B.3 Inspection of Plate

The quality of the steel plate shall be determined by ultrasonic testing and shall meet the requirements of BS EN 10160 except that testing for edge discontinuities is not required.

B.4 Mechanical Properties and Tests

B.4.1 Tensile tests and impact tests shall be carried out for joints greater than 150 mm nominal size. Impact tests shall also be carried out for joints not greater than 150 mm nominal size where the plate thickness is greater than 12 mm and stress relief is not carried out after welding. The tests shall be carried out in accordance with B.4.2 to B.4.5 inclusive and shall show that the properties of the finished joint meet the requirements of Table B.1.

Where tests are not required by this clause, the plate shall have test certificates to show that it can be used to produce joints meeting the requirements of Table B.1.

B.4.2 Test plates for the production of plate tensile and Charpy V-notch test pieces shall be provided at a rate of one test plate for each cast per heat treatment batch. Weld test plates shall be produced at a rate of at least one for each batch of joints manufactured during an uninterrupted production run, and shall give one transverse weld tensile, one all-weld tensile and one set of all-weld Charpy Vnotch test pieces.

B.4.3 Tensile tests shall be carried out in accordance with the general requirements for tensile testing given in BS E 10002-1, on specimens taken transverse to the axis of the joint. Where appropriate, specimens should be taken transverse to the principal direction of rolling of the plate.

B.4.4 Charpy impact tests shall be carried out in accordance with BS EN 10045-1, on specimens taken with their axes longitudinal to the axis of the joint and notched normal to the original plate surface. Where appropriate, specimens should alternatively be taken with their axes longitudinal to the principal direction of rolling and notched normal to the surface of the plate.

The tests shall be carried out at -20o on full size Charpy V-notch specimens. Where the thickness of the plate does not permit the preparation of full size specimens, the largest possible subsidiary size given in Table B.1 shall be used.

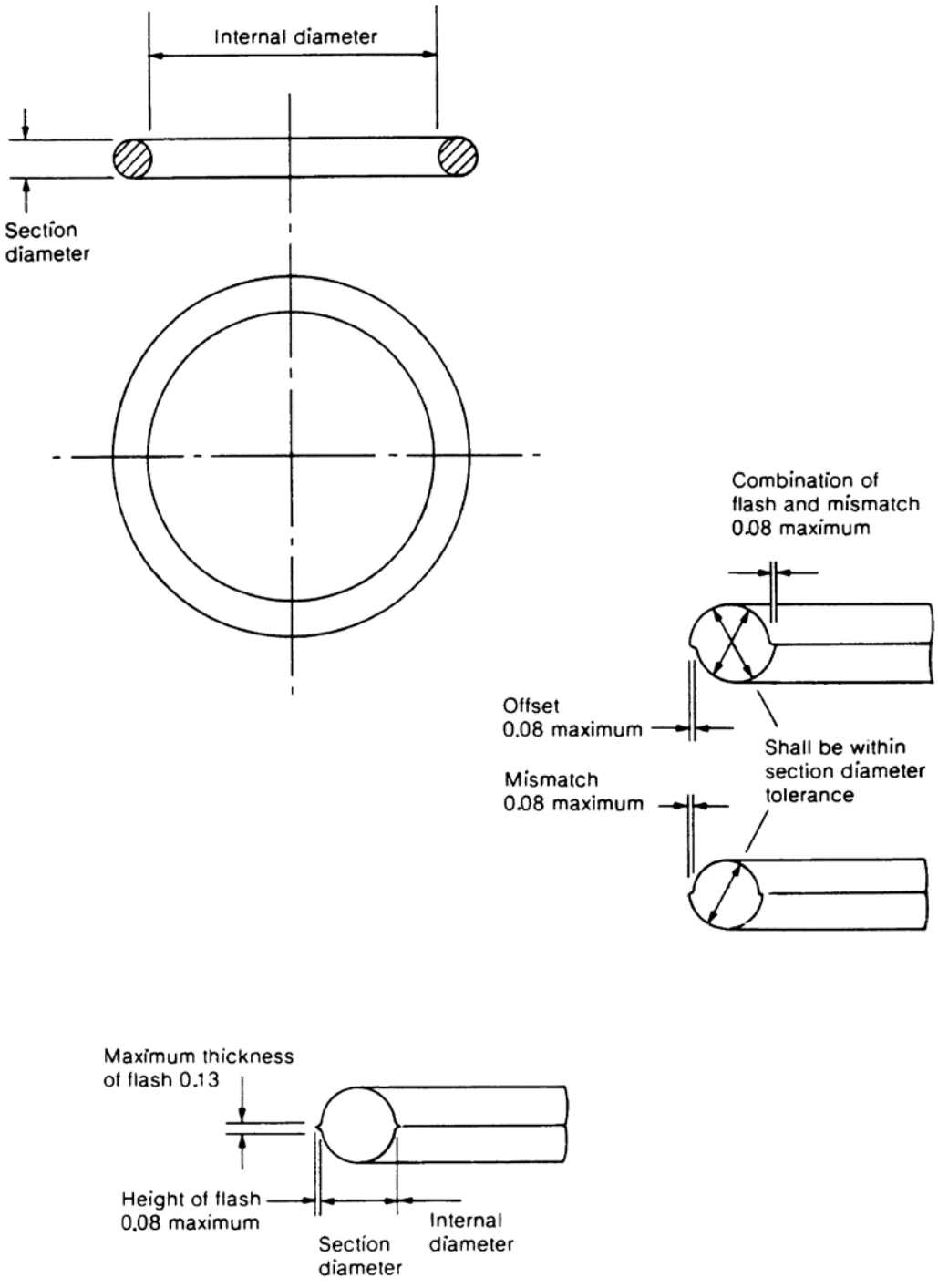
B.4.5 If any of the tests fail to meet the requirements of Table B. 1, the joints which the specimens represent shall be set aside for investigation as to the reason for failure. Two further specimens should be taken. If either of these fails to meet the specified requirements, it shall be investigated whether the failure can be attributed to deficiency in either material or manufacturing process and whether additional testing is necessary.

TABLE B.1 - Minimum mechanical properties of the finished joint

Test	**Location**	**Highest grade of EN 10208-2 pipe to which the joint will be attached. (API 5L nearest equivalent grades shown in brackets)**					
		L245 (Grade B)	L290 (X42)	L360 (X52)	L415 (X60)	L450 (X65)	L555 (X80)
Yield Strength, minimum N/mm^2	Plate All weld	245	290	360	415	450	555

Tensile Strength, minimum N/mm^2	Plate Trans weld All weld	415	415	460	520	535	625
*Minimum elongation %	Plate All weld	22	21	20	18	18	18
Minimum average value (J) for 3 charpy specimens at -20 ^0C	Full size ¾ size $^2/_3$ size ½ size	27 25 23 17	30 28 25 19	36 34 30 23	42 39 35 26	45 42 38 28	56 44 42 39
Minimum individual value (J) for 3 charpy specimens at -20 ^0C	Full size ¾ size $^2/_3$ size ½ size	22 21 18 14	24 23 20 15	30 28 25 19	35 33 29 22	38 36 32 24	45 42 38 28
* Calculated on a gauge length equal to $5.65 \sqrt{S_0}$ (where S_0 = original cross-section area)							

Appendix C – Torodial Sealing Rings ('O' Rings) to BS 4518



NOTE - All dimensions in mm.

Appendix D – Typical Data Sheet for Insulation Joints

STANDARD DATA SHEET FOR INSULATION JOINTS

SECTION ONE – TO BE COMPLETED BY THE GAS TRANSPORTER

1. Gas Transporter enquiry / order number _____ Lot number_____
2. Joint manufacturer_____
3. Joint nominal size _____ mm

8. If no specify grade _____ wall thickness _____ mm
9. Weld end preparation type on free end of pipe pup (GIS/P16)

   _____

10. Paint finish: GIS/PA10 Other* *Specify _____
11. Cable/Instrument connections required Yes No
12. Joint end preparation. Please tick one box for each end in the following table:

	End 1	End 2
Weld end GIS/P16 Transmission fitting		
Weld end GIS/P16 Distribution fitting		
BS 21. Screwed externally		
BS 21. Screwed internally		
Screwed other – specify		
Integral compression coupling to BS 4368 Part1		
Integral compression coupling to BS EN ISO 8434		
Plain end for use with couplings to BS 4368 or BS EN ISO 8434		
Socket weld end suitable for fittings to BS 3799		

SECTION TWO – TO BE COMPLETED BY THE CONTRACTOR

13. Overall length of joint (if different to Table 2) _____mm
14. Length of component (joint without pups) _____mm
15. Actual internal diameter of joint _____mm
16. Manufacturer's standard drawing number _____
17. Has a prototype of this joint been previously tested and approved by the GT?

YES NO

PLANT/PROJECT	DATA SHEET No.	SHEET OF

4. Class rating 150 300 600
5. Operating pressure (maximum) _____ barg
6. Pipe pups required YES NO
7. Pipe for pups to be free issued YES NO

Appendix E – Defect Acceptance Levels for the Finished Product

The defect acceptance levels for the finished product given in Tables E.1, E.2 and E.3 are generally in accordance with PD 5500, but with certain alterations or additions.

Defects exceeding the limits, or different from types given, should be subject to agreement after due consideration of material, stress and environmental factors.

TABLE E.1 - Defects in welds

Defect Type	Details	Permitted Maximum
Planar	Surface breaking cracks and lamellar tears, lack of root, side inter-run fusion and root penetration.	Not permitted
Cavities	Isolated buried indications	1.25 mm maximum length
	Isolated pores	Diameter 3 mm but not more than 0.25 x parent metal thickness*
	Uniformly distributed, localized porosity	2% by area seen on X-radiograph
	Linear porosity (continuous)	Not permitted
Slag inclusions	Individual inclusions parallel to major weld axis of butt welds (separated from any other inclusion by a distance not less 2 x length of longest of the two inclusions)	Length – less than parent metal thickness*. Width or depth – the lesser of 0.1 x parent metal thickness* or 4 mm.
	Groups of inclusions parallel to major axis of butt welds (separated from each other at different lengths)	The sum of individual lengths not to exceed 0.1 x weld length. Where the separation of adjacent inclusions is less than 2 x length of longest inclusion, total lengths of such pairs shall not exceed the parent metal thickness*. The width or depth shall not be limited to the lesser of 0.1 x parent metal thickness* or 4 mm.
	Random oriented individual or overlapping inclusions	To be contained within a cylindrical envelope of 3mm diameter and separated from any other such envelope by at least 0.25 x parent metal thickness*. Cylindrical envelope length shall not exceed parent metal thickness*. Total projected area to be limited to 2% by area as seen on X-radiograph.
Solid inclusions	Tungsten inclusions isolated or grouped	As for porosity
	Copper inclusions	Not permitted
* In the case of dissimilar metal thicknesses, the applicable parent metal thickness shall be that of the thinner component.		

TABLE E.2 - Defects at weld end preparations and weld profiles

Defect Area	Details	Permitted Maximum
Weld and Preparation	Lamination at weld end preparation individual or isolated.	Nominal size ≤ 100 mm: Lamination 6 mm length Nominal size > 100 mm: Lamination 13 mm length
	Laminations in line or separated.	Separation between adjacent laminations shall be not less than the longest lamination. The sum of lamination lengths shall be less than 10% of total weld end preparation.
	Weld end preparation shape and finish.	To allow relevant NDT application.
Weld Profiles	Undercut, shrinkage grooves, root concavity, excess penetration and overlap.	Not permitted, shall be dressed smooth with parent plate (or forging) provided that the wall thickness is not reduced to below the specified minimum.
	Reinforced shape.	It shall blend smoothly with the parent material. Dressing not necessary unless required by relevant NDT.
	Linear misalignment	Accepted within the requirements of 10.2.2 with correct tapering and blending.

TABLE E.3 - Defects on finished product

Defect Location	Details	Permitted Maximum
At welded seams or body	Dents.	All dents shall be reported to the Gas Transporter for evaluation of their significance.
	Scores, pitting, corrosion, finish and workmanship.	Shall not affect the intended service duty within the specification.
	Surface laps and gouges.	Not permitted. Can be ground smooth provided that the wall thickness is not reduced to below the specified minimum.

8. Part 3 Test Ends 300mm to 1200mm Inclusive Nominal Size

1. Field of Application

This Part 3 of the specification specifies the materials, design, manufacture, testing and application of steel test ends for the pressure testing of pipework and pipelines, and for the pre-installation testing of pipes and fittings.

Test pressures calculated according to procedure **/PM/PT/1 shall be used to select suitable test ends from this specification. Most of the test ends specified in this specification have been designed so that they can be fabricated from standard sizes of line pipe used by the Gas Transporter. The design criteria are based on well-established fatigue data and rely on the test ends being revalidated after a specific number of tests. Because of these limitations to their use, the test ends have not been treated as pressure vessels conforming to pressure vessel codes.

2. Materials

2.1 Test ends shall use unpierced ellipsoidal 2:1 ratio end caps to **/SP/B/12, with the relevant material grade and thickness given in Tables 2 to 6 inclusive (see Table 1 for recommendations on the appropriate table). If other types of end cap which meet the requirements of **/SP/B/12 are used, their design shall take account of the fatigue conditions experienced by test ends.

2.2 Pipe shall be to **/SP/PIP/1 or TS-C4GAS-PIPO, as appropriate, with the relevant material grade given in Tables 2 to 5. Where specific details are not covered by the relevant specification, supplementary requirements shall be specified on the purchase order.

2.3 Plate for use in test ends shall meet the requirements of Appendix A. Pipe sections made from plate shall be to **/SP/PIP/1 or TS-C4GAS-PIPO, except as required by Appendix A.

2.4 Flanges and welding fittings shall be to **/SP/F/1, except as required by Appendix B.

2.5 Other materials may be proposed for consideration as a variant by the Gas Transporter.

3. Design

3.1 The Gas Transporter shall specify on the purchase order the arrangement from Figures 1 or 2 and the dimensions from Tables 2 to 6 inclusive that are required for the test end. Before the start of manufacture, the Contractor shall supply detailed drawings and calculations to the Gas Transporter.

3.2 The pipe section of test ends covered by Tables 2 to 5 inclusive shall be fabricated from the pipe specified in 2.2, and the pipe section of test ends covered by Table 6 shall be fabricated from the plate specified in 2.3.

For all test ends the outside diameter of the pipe section shall be that given for the relevant nominal size in **/SP/DAT/6.

3.3 Flanges and welding fittings shall meet the requirements of Appendix B and, unless otherwise specified by the Gas Transporter, they shall be in the positions shown in Figures 1 or 2. If pigs are to be used, extruded welding fittings shall be fitted flush with the bore of the test end (see also 9.1).

3.4 If required, test end supports shall be specified on the purchase order. Supports shall be of the clamp-on saddle type (see Figures 1 and 2).

3.5 If required, pig stoppers shall be specified on the purchase order.

4. Manufacture and Inspection

Test ends shall be manufactured in accordance with the procedures specified in GIS/P2 concerning fabrication, welding (including procedure approval, qualification and production), inspection and standards of acceptability. If stress relief heat treatment is considered necessary for test end fabrication from plate, the Gas Transporter shall be informed before treatment.

5. Proof Test

5.1 On completion of manufacture, and as part of the revalidation specified in clause 10, test ends shall be subjected to hydrostatic pressure proof tests. The tests shall be made in accordance with the test procedures given in **/PM/PT/1, except that the test pressure shall be the test end proof pressure given in Tables 2 to 6 inclusive.

5.2 Proof tests should be carried out on two similar test ends welded together. Alternatively, a single test end (closed by welding on an end cap to **D/SP/B/12 of the same nominal dimensions and material grade as the end cap on the test end) should be proof tested.

6. Weld End Preparation

6.1 The open end of test ends shall be prepared for welding by machining to the appropriate weld end preparation given in GIS/P16.

6.2 Weld end preparations shall be inspected to the requirements of **/SP/PIP/1 or TS-C4GASPIPO (see sections D.2.4, D.5.4 and D.5.5.2).

7. Marking

7.1 Test ends shall be suitably and individually identified using an identification plate attached to the pipe section of the test end. Marking shall be on a stainless steel plate welded on to a larger mild steel plate. The mild steel plate shall be compatible with the material of the pipe section of the test end. The mild steel plate shall be welded to the pipe section of the test end using a procedure approved by the Gas Transporter.

7.2 The information given to identify the test end shall be as follows:

a) Relevant Gas Transporter order number.

b) Designation of this specification.

c) Nominal size.

d) Nominal wall thickness and material grade of pipe section.

e) Class of flanges.

f) Maximum test end working pressure.

g) Test end proof pressure.

h) Maximum number of tests before revalidation.

i) Contractors name and serial number.

j) Date of manufacture.

k) A warning that 'test records for the test end shall be consulted before it is used, to ensure that it is not due for revalidation'.

8. Protection

8.1 Unless otherwise specified by the Gas Transporter, test ends shall be coated internally in accordance with **/SP/CM/1 and painted in accordance with GIS/PA10 (SPA1 unless otherwise specified). The outside surface of the test end and any supports shall be painted before attachment of the supports. Unless otherwise specified by the Gas Transporter, the colour of the outside surface shall be yellow.

8.2 All test ends shall be packed so as to avoid damage during transport and storage. Openings shall be sealed against the weather

9. Use of Test Ends.

9.1 Test ends shall only be used where the test pressure (as determined by **/PM/PT/1) will not be greater than the maximum test end working pressure given in Tables 2 to 6 inclusive. The recommended test ends for specific tests are given in Table 1. (If pigs are to be used, it should be noted that many of the recommended test ends will have inside diameters smaller than those of the pipe to be tested, due to their greater nominal wall thicknesses - see also 3.3).

9.2 The owner of a test end shall keep a record showing:

a) The information specified in 9.2;

b) The results of non-destructive tests on each fabrication weld;

c) The number of times and dates when the test end has been used;

d) The maximum test pressure attained in each test;

e) The total number of pressure cycles for each test (see Table 7);

f) The results and dates of any revalidation of the test end;

g) Any damage, repairs or changes to the test end, including the addition of new lengths of pipe (see 10.4).

Copies of final approval drawings and calculations for the test end and all relevant test certificates shall be kept with the test record.

9.3 Test ends shall be limited to the maximum number of cycles between atmospheric pressure and maximum test end working pressure given in Tables 2 to 6. Where test ends are cycled through a smaller pressure range than the maximum test end working pressure, they shall be considered to have undergone a fraction of a cycle in accordance with Table 7.

Test ends shall only be used for more than the specified number of cycles after being revalidated in accordance with clause 10. Repeated use and revalidation is permitted.

9.4 Before a test end is used, any weld metal and heat-affected zone from a previous use shall be removed. To achieve this, not less than 12 mm of pipe should be removed from the cut end before re-welding. Welding shall then be carried out in accordance with GIS/P2.

If removal of weld metal and heat-affected zone causes the length of the end of the pipe section to fall below the minimum dimension shown in Figures 1 and 2, a new length of pipe section which meets all the requirements of this specification should be welded to the test end. After any such modification the test end shall be revalidated in accordance with clause 10 before it is used.

9.5 The owner shall ensure that, between tests, test ends are protected against damage during transport and storage.

10. Revalidation

10.1 Test ends which have experienced the maximum number of cycles given in Tables 2 to 6 inclusive shall be revalidated before being used for further tests (see 10.3). However, at the discretion of the owner, test ends may be revalidated after any number of cycles less than the specified maximum.

10.2 Revalidation shall consist of a repeat of the proof test specified in clause 5.

10.3 After a revalidation proof test, the test end shall be inspected in accordance with the requirements for inspection on completion of welding specified in GIS/P2.

10.4 The weld end preparation on a revalidated test end shall be produced in accordance with clause, and the test end shall be protected in accordance with clause 8. Appropriate modifications shall be made to the record specified in 9.2.

TABLE 1 - Recommended use of test ends in Tables 2 to 6 Inclusive

** /PM/PT/1 section	Table 2	Table 3	Table 4	Table 5	Table 6
1- Pipework	-	-	Station pipe	Station pipe	Station pipe
2 - Pipelines	In-ground pipe tested up to 50 bar	In-ground pipe tested to above 50	In-ground pipe	a) 3m proximity pipe b) 30% stress pipe c) In -ground pipe	a) 3m proximity pipe b) 30% stress pipe c) In-ground pipe

NOTE – **The recommendations in this table only apply if the maximum test pressure will not exceed the maximum test end working pressure given in Tables 2 to 6 inclusive** . In particular, the recommendations in this table may not be appropriate if the pipes or pipelines to be tested will operate to pressures greater than 70 bar.

TABLE 2 - Test ends using In-ground pipe and Class 300 fittings

Test end nominal size (mm)	Pipe section of test end		End cap of test end		Class of flanges for test end	Maximum test end working pressure (bar)	Test end proof pressure (bar)
	Nominal wall Thickness (mm)	EN 10208-2 grade (API 5L grade)	Nominal wall Thickness (mm)	EN 10208-2 grade (API 5L grade)			
300	7.1	L360 (X52)	9.5	L360 (X52)	300	50	62
400	8.7	L360 (X52)	10.3	L360 (X52)	300	50	62
450	9.5	L360 (X52)	11.9	L360 (X52)	300	50	62
600	9.5	L360 (X52)	14.3	L360 (X52)	300	50	62
750	11.9	L360 (X52)	16.5	L360 (X52)	300	50	62
900	12.7	L415 (X60)	17.0	L415 (X60)	300	50	62
1050	14.3	L415 (X60)	19.5	L415 (X60)	300	50	62
1200	19.1	L450 (X65)	26.0	L450 (X65)	300	50	62
NOTE: Test ends shall not be used for more than 100 cycles without being revalidated. The total number of cycles recorded for a test end shall include full cycles up to the maximum test end working pressure and fractions of cycles for every time the test end is cycled through a smaller pressure range (see Table 7).							

TABLE 3 - Test ends using in-ground pipe and Class 600 fittings

Test end nominal size mm	Pipe section of test end		End cap of test end		Class of flanges for test end	Maximum test end working pressure bar	Test end proof pressure bar
	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)			
300	7.1	L360 (X52)	9.5	L360 (X52)	600	70	88
400	8.7	L360 (X52)	10.3	L360 (X52)	600	77	97
450	9.5	L360 (X52)	11.9	L360 (X52)	600	75	94
600	9.5	L360 (X52)	14.3	L360 (X52)	600	70	88
750	11.9	L360 (X52)	16.5	L360 (X52)	600	70	88
900	12.7	L415 (X60)	17.0	L415 (X60)	600	70	88
1050	14.3	L415 (X60)	19.5	L415 (X60)	600	70	88
1200	19.1	L450 (X65)	26.0	L450 (X65)	600	90	113
NOTE: Test ends shall not be used for more than 100 cycles without being revalidated. The total number of cycles recorded for a test end shall include full cycles up to the maximum test end working pressure and fractions of cycles for every time the test end is cycled through a smaller pressure range (see Table 7).							

TABLE 4 - Test ends using station pipe

Test end nominal size **mm**	**Pipe section of test end**		**End cap of test end**		**Class of flanges for test end**	**Maximum test end working pressure** **bar**	**Test end proof pressure** **bar**
	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)			
300	9.5	L360 (X52)	10.0	L360 (X52)	900	144	180
400	10.3	L360 (X52)	11.5	L360 (X52)	900	124	156
450	11.9	L360 (X52)	12.5	L360 (X52)	900	128	160
600	14.3	L360 (X52)	15.0	L360 (X52)	900	115	144
750	15.9	L415 (X60)	16.5	L415 (X60)	900	118	148
900	15.9	L450 (X65)	16.5	L450 (X65)	900	107	133
1050	17.5	L450 (X65)	18.0	L450 (X65)	900	101	126
1200	22.4	L450 (X65)	23.0	L450 (X65)	900	113	142

NOTE: Test ends shall not be used for more than 100 cycles without being revalidated. The total number of cycles recorded for a test end shall include full cycles up to the maximum test end working pressure and fractions of cycles for every time the test end is cycled through a smaller pressure range (see Table 7).

TABLE 5 - Test ends using 3 m proximity pipe or 30% stress pipe

Test end nominal size **mm**	**Pipe section of test end**		**End cap of test end**		**Class of flanges for test end**	**Maximum test end working pressure** **bar**	**Test end proof pressure** **bar**
	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)			
300	12.7	L360 (X52)	13.5	L360 (X52)	1500	193	241
400	14.3	L360 (X52)	15.0	L360 (X52)	1500	173	216
450	15.9	L415 (X60)	16.5	L415 (X60)	1500	197	246
600	19.1	L415 (X60)	20.0	L415 (X60)	1500	177	222
750	19.1* 22.2	L415 (X60) L415 (X60)	20.0 23.0	L415 (X60) L415 (X60)	900 1500	142* 165	177* 206
900	19.1* 25.4	L415 (X60) L450 (X65)	20.0 26.0	L415 (X60) L450 (X65)	900 1500	118* 173	148* 216.
1050	28.7	L450 (X65)	29.5	L450 (X65)	1500	168	210
1200	25.4	L450 (X65)	26.0	L450 (X65)	900	129	162
	22.9	L555 (X80)	23.5	L555 (X80)	900	143	179

NOTES:

1. Where there are two test ends given for the same nominal size, those marked* are nonpreferred test ends which should only be used where pipe is not available for the manufacture of the preferred test ends. If it is necessary to manufacture a non-preferred test end, the 19.1 mm nominal wall thickness pipe section should, where possible, use pipe with an actual wall thickness near the upper limits specified in **/SP/PIP/1 or TS-C4GAS-PIP0, i.e. greater than 19.1 mm.

2.The test ends marked* shall not be used for more than 50 cycles without being revalidated. All other test ends shall not be used for more than 100 cycles without being revalidated. The total number of cycles recorded for a test end shall include full cycles up to the maximum test end working pressure and fractions of cycles for every time the test end is cycles through a smaller pressure range (see Table 7).

TABLE 6 - Test ends not based on standard line pipe

Test end nominal size mm	**Pipe section of test end**		**End cap of test end**		**Class of flanges for test end**	**Maximum test end working pressure bar**	**Test end proof pressure bar**
	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)	Nominal wall thickness mm	EN 10208-2 grade (API 5L grade)			
400	17.9	L360 (X52)	18.5	L360 (X52)	1500	216	271
600	30.2	L415 (X60)	31.0	L415 (X60)	2500	286	357
750	25.4	L415 (X60)	26.0	L415 (X60)	1500	239	298
1200	27.0	L450 (X65)	27.5	L450 (X65)	900	138	172
	30.2	L450 (X65)	31.0	L450 (X65)	1500	155	194
	25.4	L555 (X80)	26.0	L 555 (X80	1500	160	200
			30.0	L 485 (X70)			
			32.0	L450 (X65)			
NOTE: These test ends shall not be used for more than 100 cycles without being revalidated. The total number of cycles recorded for a test end shall include full cycles up to the maximum test end working pressure and fractions of cycles for every time the test end is cycled through a smaller pressure range (see Table 7).							

TABLE 7 - Fractions of pressure cycles to be recorded for test ends

Pressure range of cycle as a percentage of maximum test end working pressure	**Number of cycles to be recorded (see 12.2 e)**
≤ 5	0
>5, ≤ 25	0.01
>25, ≤ 50	0.1
>50, ≤ 75	0.5
>75, ≤ 100	1
NOTE – A Single pressure test may include several cycles or fractions of cycles. And these shall be added to give a total number of cycles for the test. This can occur if the pressure falls and rises again before or after the maximum test pressure is reached. These fluctuations in pressure shall be recorded as fractions of cycles even if they do not involve a fall to atmospheric pressure.	

FIGURE 1 - Arrangement of test end suitable for pre-installation testing

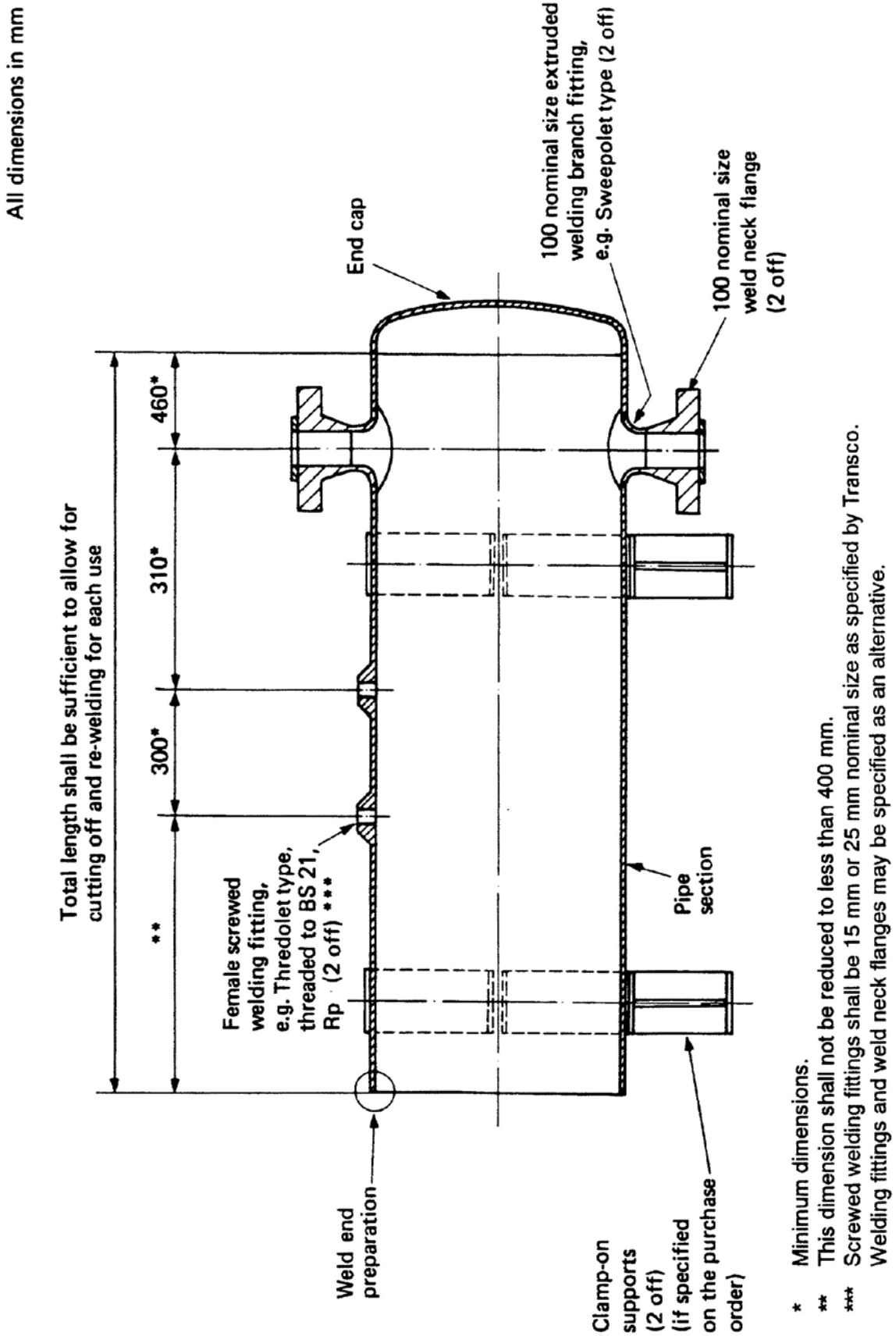
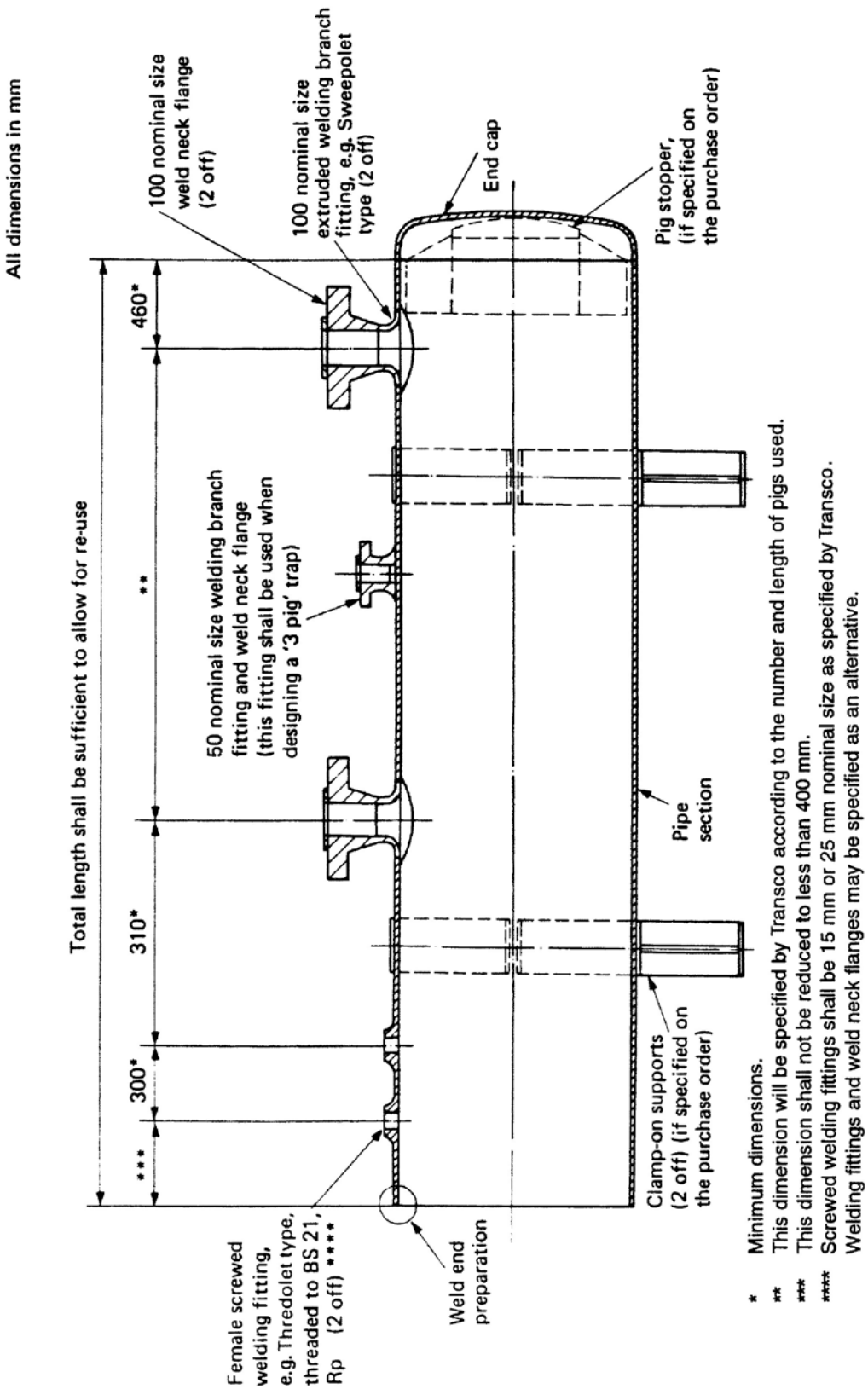


FIGURE 2 - Arrangement of test end suitable for testing pipelines



Appendix A – Requirements for Plate Material

A.1 Material Grade

The steel from which the steel plate is manufactured shall have been made by the open-hearth process, one of the electric processes or the basic oxygen process; only fully killed steel shall have been used.

Allowance shall be made when selecting the steel plate for any degradation of material properties which may occur during the manufacture of the test end.

The grade of the steel plate shall be such that the pipe section of the finished test end is of the grade given in Tables 2 to 6 inclusive.

A.2 Composition

A.2.1 Chemical composition, by product analysis, shall be in conformance with **/SP/B/12 and BS EN 14870-2 (equivalent to ISO 15590-2) for forged fittings.

A.3 Inspection of Plate

The quality of steel plate shall be determined by ultrasonic testing and shall meet the requirements of BS EN 10160 except that testing for edge discontinuities is not required.

A.4 Heat Treatment

Plate material shall be normalized unless otherwise agreed by the Gas Transporter.

A.5 Mechanical Properties and Tests

A.5.1 Mechanical tests shall be carried out in accordance with A.5.2 to A.5.5 inclusive and shall show that the properties of the finished pipe section will meet the requirements of Table A.1.

TABLE A.1 - Minimum mechanical properties of the finished pipe section made from plate

Test	Location	EN 10208-2 Material Grade (API 5L nearest equivalent grades shown in brackets)			
		L360 (X52)	L415 (X60)	L450 (X65)	L555 (X80)
Yield Strength Minimum N/mm^2	Plate All weld	360	415	450	555
Tensile Strength Minimum N/mm^2	Plate Trans weld All weld	460	520	535	625
* Minimum elongation %	Plate All weld	20	18	18	18
Minimum average value (J) for three charpy specimens at -20 ^{0}C		36	42	45	56
Minimum individual value for three charpy specimens at -20 ^{0}C		30	35	38	45
* Calculated on a gauge length equal to 5.65 $\sqrt{S_0}$ (where S_0 = original cross-section area)					

A.5.2 Test plates for the production of plate tensile and Charpy V-notch test pieces shall be provided at a rate of one test plate for each cast per heat treatment batch. Weld test plates shall be produced at a rate of not less than one for each batch of test ends manufactured during an uninterrupted production run, and shall give one transverse weld tensile, one all-weld tensile and one set of all weld Charpy V-notch test pieces.

A.5.3 Tensile tests shall be made in accordance with the general requirements for tensile testing given in BS EN 10002-1, on specimens taken transverse to the axis of the test end. By agreement with the Gas Transporter, specimens should be taken transverse to the principal direction of rolling of the plate.

A.5.4 Charpy impact tests shall be made in accordance with the recommended practice given in BS EN 10045-1, on specimens taken with their axis longitudinal to the axis of the test end and notched normal to the original plate surface. By agreement with the Gas Transporter, specimens should be taken with their axes longitudinal to the principal direction of rolling and notched normal to the surface of the plate. The tests shall be carried out at -20 on full size Charpy V-notch specimens.

A.5.5 If any of the tests fail to meet the requirements of Table A 1, the test end which the specimens represent shall be set aside for investigation as to the reason for failure. Two further specimens should be taken. If either of these fail to meet the specified requirements, it shall be investigated whether the failure can be attributed to deficiency in either material or manufacturing process.

Having established the most likely cause of failure, the need for additional testing should be jointly agreed between the Gas Transporter and the Contractor.

Appendix B Requirements for Flanges and Welding Fittings

B.1 Flanges

B.1.1 Flanges shall be to BS EN 1759-1 to the class given in Tables 2 to 6 inclusive.

B.1.2 Flanges for test ends given in Tables 2 and 3 shall be to **/SP/F/1.

B.1.3 Flanges for test ends given in Tables 4, 5 and 6 shall have the dimensions given in BS EN 1759-1: Part 3: Section 3.1 for the relevant class. Otherwise they shall be to the relevant requirements of **/SP/F/1 for Class 600 flanges, except as specified in C.1 .4.

B.1.4 For Class 1500 and Class 2500 flanges of 100 mm nominal size, the dimensions given for Class 600 flanges in **/SP/F/1 shall be amended as follows:

a) Inside diameter (D) - 90.5mm.

b) Thickness at weld end (B) - 12 mm.

B2 Welding Fittings

B.2.1 Welding fittings for test ends given in Tables 2 and 3 shall be to **/SP/F/1.

B.2.2 Welding fittings for test ends given in Tables 4, 5 and 6 shall have dimensions and material to suit the pipe section of the test end. The material grade of the fittings shall be equal to or better than that specified for the pipe section, except that for X65 pipe the fittings should be X60 if suitable compensation is made on the thickness.

The compensation available from fittings shall be sufficient for the requirements of PD 5500 (issue February 2003), clause 3.5.4 for a single branch, assuming that the design pressure in the pipe section is that required to give a hoop stress of 50% specified minimum yield stress (SMYS). The test end proof pressure given in Tables 4, 5 and 6 shall also be considered when designing fittings.

B.2.3 Where welding fittings are to be used with flanges, the dimensions shall suit the flange to be used.

9. Part 4 Pigs for use in Gas Transmission Pipelines

1. Filed of Application

This Part 4 of this specification specifies the requirements for the design and manufacture of pigs for the cleaning, gauging, purging and swabbing of gas transmission pipelines during testing, commissioning, operation and de-commissioning.

2. Design

2.1 General

2.1.1 This Specification allows for different designs of pig to be used for different operations and different pipeline configurations.

2.1.2 Specific pig details required by the Gas Transporter shall be given in Part 1 of the Data Sheet, (see Appendix A). Design details shall be submitted by the Contractor to the Engineer and shall include:

a) Completed Part 2 of the Data Sheet.

b) A fully dimensioned drawing.

c) Details of all materials.

d) Details of the method of assembly and any locking device if appropriate.

e) Additional information required by pressure vessel standards, where appropriate.

f) Details of calculations concerning the structural parts of the pig.

Once the design of a pig has been approved, any changes in design, materials or manufacture shall be proposed as a variant for consideration by the Gas Transporter.

2.1.3 The approval of a particular pig should be taken by the Gas Transporter as applying to other pigs of the same size and design. The Contractor shall agree with the Engineer whether the pigs he intends to use are in this category.

2.1.4 The pig shall be suitable for passing through pipelines of the range of inside diameters specified in Part 1 of the Data Sheet (see Appendix A). The specified range of inside diameters takes account of the effects of fittings, internal protrusions, etc. Information on the inside diameters of pipelines of standard Gas Transporter dimensions is given in Table 1.

Pigs used for on line pigging shall be capable of passing a dent which would be passed by a gauging pig with a gauge plate. The gauge plate diameter of the gauging pig shall be in accordance with Pl0 or as otherwise appropriate for the pigging operation concerned.

2.1.5 Where pigs are not supported by other means, pig cups shall be sufficiently rigid and designed in such a way that they hold the pig centrally within the pipe. Frictional resistance of pig cups can have a significant effect on the differential pressure across the pig, so materials with a high frictional resistance should be avoided. Care shall be taken to ensure that the blow over/relief pressure specified for the pig (see 2.1.11) is greater than the differential pressure required to drive the pig under normal pigging conditions.

Pig cups shall be capable of withstanding a pigging run of the distance specified in Part 1 of the Data Sheet (see Appendix A). This distance should not normally be greater than 100 km.

2.1.6 Where the design of the pig body involves an enclosed vessel, the vessel shall be capable of withstanding the external forces likely to be encountered during the particular operation for which the pig is designed. These forces shall include those resulting from maximum pipeline pressure outside the vessel with atmospheric pressure inside the vessel. The design of such pigs shall meet the requirements of GIS/PV3.

It is recognized that, in certain circumstances, the propelling medium might leak into the enclosed vessel. Provision shall be made for checking for any build-up of pressure and for safely releasing it, if necessary.

2.1.7 Sections of the pig forming part of the driving system shall be capable of withstanding the forces generated by the maximum differential pressure that could occur across the pig, as specified in Part 1 of the Data Sheet. Guidance on differential pressures is given in **/SP/PC/2.

2.1.8 The distance between the trailing edges of the front and back cups should not be less than 1.4 times the outside diameter of the pipeline to ensure satisfactory negotiation of tees and to prevent the pig from twisting or jamming in the pipeline. The maximum length of pigs is governed by the requirement to negotiate bends (see 2.2.1). For specific applications, where it has been established after reference to **/SP/PC/2 that the pipeline configuration will accept shorter pigs, these may be used provided that they are at least 1.2 times the outside diameter of the pipeline.

2.1.9 If specified in Part 1 of the Data Sheet, gauge plates shall be located on pigs at the front of the rear cup. Details of a typical gauge plate are shown in Figure 1.

2.1.10 Where specified in Part 1 of the Data Sheet, a permanent bypass hole of diameter between 2% and 5% of the pipeline nominal size shall be provided on the pig.

2.1.11 When pigging pipelines which are in service, it shall be considered important to maintain the gas flow if the pig becomes jammed. Where specified in Part 1 of the Data Sheet (see Appendix A), the pig shall be designed so that the drive cups will blow over at the differential pressure given, or a reseating relief system shall be fitted in the body of the pig. Where cup blow over is chosen, the Contractor shall provide results of blow over tests carried out in accordance with Appendix C. The results shall be recorded in Part 2 of the Data Sheet (see Appendix A).

2.2 Metal and rigid bodied pigs

2.2.1 Rigid metal parts of the pig, except the gauge plate when fitted, shall at all times maintain a clearance from the wall of 25 mm or 5% of the minimum pipeline inside diameter (see 2.1.4), whichever is the greater. Attention is particularly drawn to this requirement at bends (see Figure 2).

The leading edges of the pig cup clamping plates shall be machined to a radius of 6 mm.

2.2.2 Pig cups shall be positioned so as to minimize the stresses and distortion in the pig when negotiating bends. Pig cups shall be located at each end of the pig. Pig cups located in the centre of the body are not permitted.

2.2.3 The nose of a mono-directional pig, or both noses of a bi-directional pig, shall be suitably protected to preclude metal to metal contact with equipment such as valves and bends which may be installed in the pipeline.

The protective material shall allow a clearance of at least 10 mm above any fixing bolts (see Figure 3). Its method of attachment to the pig shall be adequate to ensure that when the material is compressed, metal to metal contact cannot occur.

Adhesives or other methods of bonding shall not be used alone to secure the protective material to the pig but shall be supported by mechanical means, e.g. bolts.

2.2.4 A fitting shall be incorporated into the pig nose to permit the remote attachment of a hook. This method should be used to extract a pig from a pig trap under operational conditions when physical entry into a pig trap would be undesirable. Any metallic fitting shall meet the requirements of 4.2.3. A similar fitting shall be incorporated in the rear of the pig to enable the pig to be withdrawn if a run is aborted. The fittings shall also be suitable for lifting purposes.

2.2.5 Earthing devices shall be incorporated on pigs used for operational, commissioning or decommissioning runs. Three earthing contacts spaced radially shall be used. A typical earthing contact is shown in Figure 4. Trailing devices such as chains shall not be used.

Where bi-directional pigs are used for the applications given above, special consideration shall be given to the design of earthing devices.

2.2.6 If specified in Part 1 of the Data Sheet, provision shall be made for the attachment of a pig location device. Types of pig location devices are given **/SP/PC/2.

2.3 Non-metallic pigs

2.3.1 Where metallic parts are added to pigs that are otherwise non-metallic, the relevant requirements of 2.2 shall apply.

2.3.2 The pig nose shall be so designed as to permit the remote attachment of a hook to extract the pig from a pig trap. This feature of the pig nose shall not interfere with the normal operation of the pig. A similar facility shall be provided at the rear of the pig.

3. Materials

3.1 It is important to ensure that pig components shall not fracture during a pigging run. Therefore, care shall be taken to select metallic materials capable of giving a minimum average impact energy of 20 J at 0 ^{o}C on full size Charpy V-notch specimens, unless it is agreed by the Gas Transporter that the component will not be subjected to stress or impact. Materials of thickness 6 mm and below need not be impact tested.

3.2 Metallic material which will normally come into contact with the pipe wall shall have a maximum hardness of 130 HV, unless it is agreed that the mass and design of the component is such that it cannot cause damage to the pipeline or leave significant amounts of material in the pipeline. The materials not covered by this hardness limit should include earthing contacts, which shall meet the requirements of 2.2.5.

Metallic material forming the outer envelope of the pig, such as body and nose fabrications and cup mounting flanges, which may come into contact with the pipe wall in the event of excessive wear or failure of a pig cup, shall have a maximum hardness of 170 HV, provided that the shape of the component is chosen to minimize damage to the pipe wall. In some circumstances, a lower maximum hardness level may be appropriate, and this should be specified in Part 1 of the Data Sheet (see Appendix A).

3.3 All steels shall be to an appropriate British Standard.

3.4 Materials shall not be subject to significant deterioration due to attack by water, methanol, hydrocarbon condensates and natural gas.

3.5 The protective material on the nose of the pig shall be non-metallic but shall be sufficiently robust to withstand the arduous conditions encountered during pigging, especially the initial swabbing of a newly constructed pipeline.

3.6 The magnesium content of aluminium based materials shall not exceed 6%.

3.7 Closed cell foam material shall not be used, due to the possibility of this material containing pressurized gas on removal from a pipeline.

4 Manufacture

4.1 Parts of pigs that are enclosed vessels shall be manufactured in accordance with GIS/PV3.

For steel parts of pigs that are not enclosed vessels, welding shall be to BS 2971 for tubular components and to a similar standard for non-tubular components. Welders shall be approved to BS 4872: Part 1 or better, and the welding procedure shall be approved to BS EN 288: Part 3 Completed welds shall be magnetic particle inspected to BS EN ISO 9934-1.

4.2 All bolts and nuts shall be locked. Body clamping bolts and nuts shall use castellated nuts and split pins. Other bolts and nuts, including those securing pig cups, should be locked using other proprietary systems.

4.3 All tightening of nuts and bolts shall be against a mechanical stop, not the compression of elastomer or plastics. Metal inserts for pig cups shall be designed to give optimum compression of the elastomer.

4.4 Paint Systems used on pigs shall be free of lead and aluminium. If specified in Part 1 of the Data Sheet, the following procedure shall be used for painting:

a) All ferrous surfaces shall be blast cleaned to ISO 8501, surface preparation SA 2½ to give a peak-to-trough height of between 30 µm and 75 µm.

b) Two coats of a two pack epoxy high build paint shall be applied in accordance with the manufacturer's instructions, to give a total dry film thickness of at least 150 µm

c) The paint used shall not be softened by methanol, (see 3.4).

5. Marking

5.1 All equipment supplied in accordance with this Specification shall be suitably and individually identified.

5.2 Each pig assembly shall be identified by means of a plate attached to the pig which shall bear the following information:

a) Relevant Gas Transporter order number (if ordered by the Gas Transporter).

b) Designation of this specification.

c) Name of Contractor.

d) Intended use of pig.

e) Pig nominal size in mm.

f) Maximum pipeline pressure in bar.

g) Maximum differential pressure in bar.

h) Minimum permissible bend radius.

i) Pig weight in kg.

j) Pig serial number.

TABLE 1 - Inside diameters for pipelines of standard GT dimensions

Inside Diameter (mm)	Pipe Nominal Size – mm											
	100	150	200	250	300	400	450	600	750	900	1050	1200

Line pipe inside diameter *	90.5	142.9	193.7	247.7	298.5	377.8	425.2	571.8	717.6	863.2	1009.6	1168.2 (3)
Maximum inside diameter for line pipe in DAT 6 **	106.7	159.3	209.5	263.9	313.9	392.0	441.2	595.0	743.2	894.4	1043.8	1195.8 (4)
Minimum inside diameter for line pipe in DAT 6 ***	86.1	137.9	188.3	241.9	292.3	373.0	419.8	565.0	709.8	854.7	1001.6	1160.2 (4)
Minimum gauging mandrel/gauge plate diameter for Tees & Bends	86.1	137.9	187.9	240.3	289.6	366.5	412.5	554.7	696.1	837.4	979.4	1133.2 (5)
Minimum pipeline inside diameter (lowest of above)	86.1	137.9	187.9	240.3	289.6	366.5	412.5	554.7	696.1	837.4	979.4	1133.2

* The line pipe inside diameter has been calculated from the outside diameter and nominal wall thickness of 30% stress pipe given in DAT 6. Where a pipeline does not include any 30% stress pipe, larger inside diameters (and hence larger gauge plate diameters may be appropriate if the bends and tees in the pipeline are of adequate bore.

** The maximum inside diameter for line pipe has been calculated from the maximum outside diameter and minimum wall thickness of in-ground pipe by applying the appropriate tolerances to the values given in DAT 6

*** The minimum inside diameter for line pipe has been calculated from the minimum outside diameter and maximum wall thickness of 30% stress pipe by applying the appropriate tolerance to the values given in DAT 6.

GENERAL NOTES

1, The dimensions given do not include features such as pipe ovality & dents which are allowed for in the clearances specified in 4.2.1.

2. The dimensions given will not apply to all pipelines and are only intended as a general guide. Old pipelines in particular may not be of the standard dimensions given here.

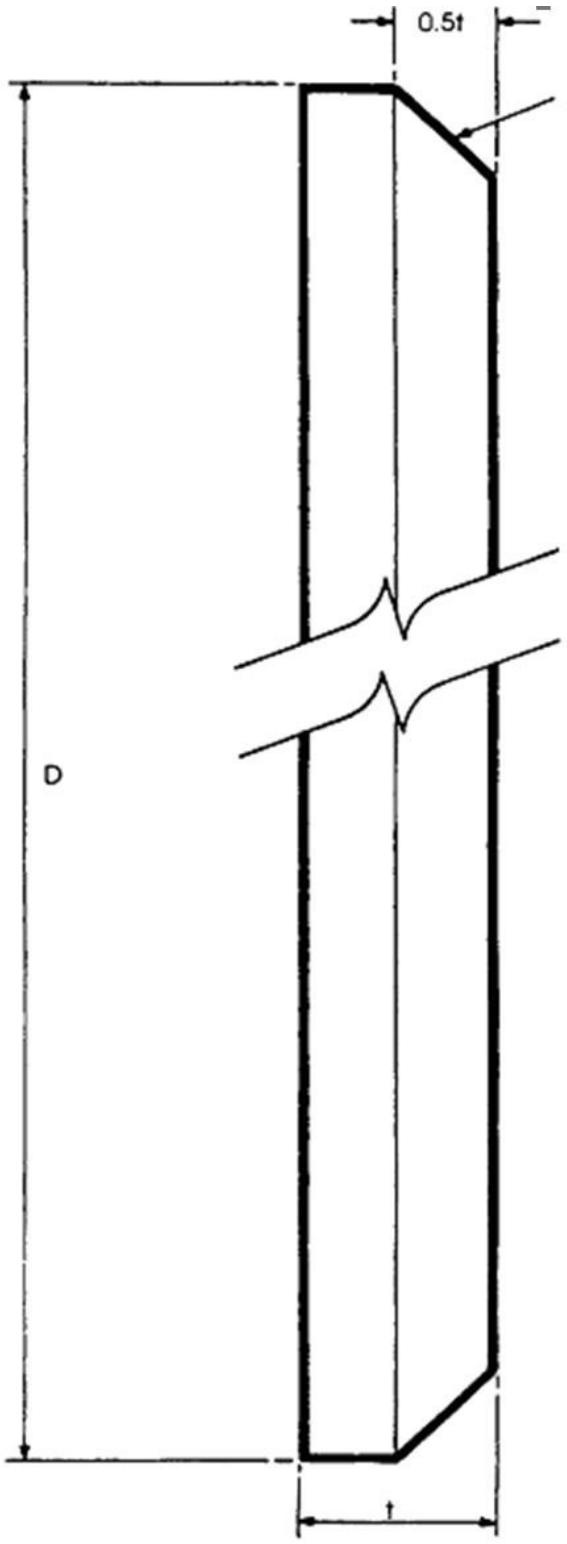
SPECIFIC NOTES

(3) Based on wall thickness of 50% stress pipe.

(4) Based on TS-C4GAS-PIP0 tolerances in accordance with BS EN 10208-2.

(5) Based on **/SP/B12 and TS-C4GAS-PIP0 tolerances in accordance with BS EN 10208-2.

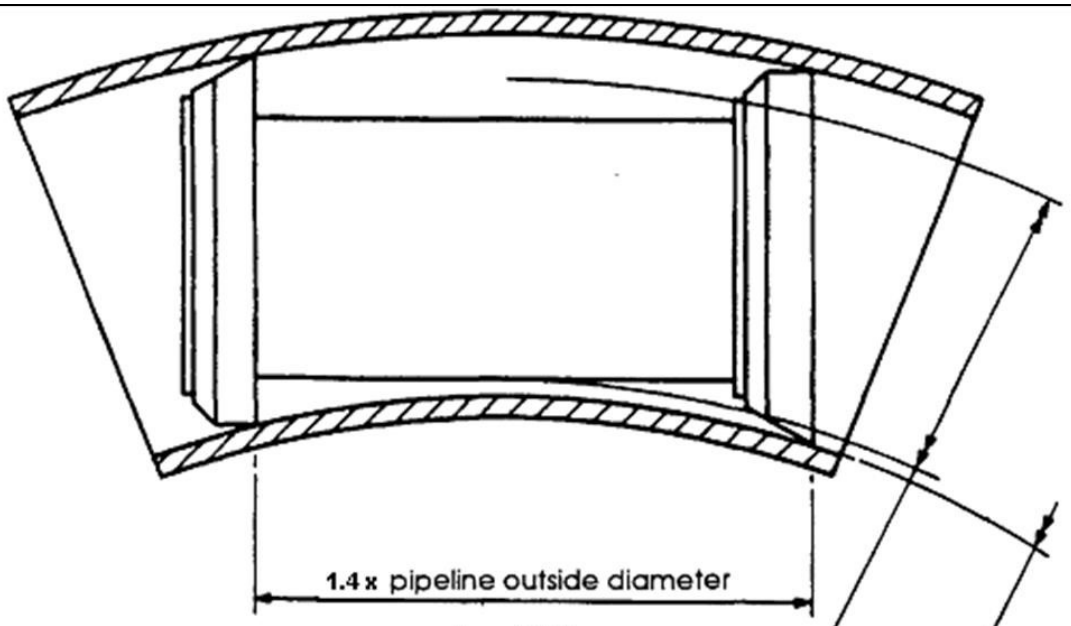
Figure 1 – Gauge plate details



Dimensions: t = 13 mm
D = Gauge plate diameter
(see 2.1.4)

Material: **Aluminium to BS EN 485 Pt 2, Alloy EN AW 3103. (Temper required to comply with requirement of a maximum tensile strength of 400 N/sq.mm).**

Figure 2 – The passage of a pig through a bend



Minimum clearance

The pig body, metal end plates, cup retainers, etc., shall at all times maintain a clearance from the wall of 25 mm or 5% of minimum pipeline inside diameter, whichever is the greater. This clearance shall be maintained during passage through any bend for which the pig is designed.

Minimum pipeline inside diameter

Minimum inside diameter of pipeline to be pigged, including any fittings, etc., in the pipeline.

Figure 3 – Sketch showing protection against metal to metal contact (see section 2.2.3)

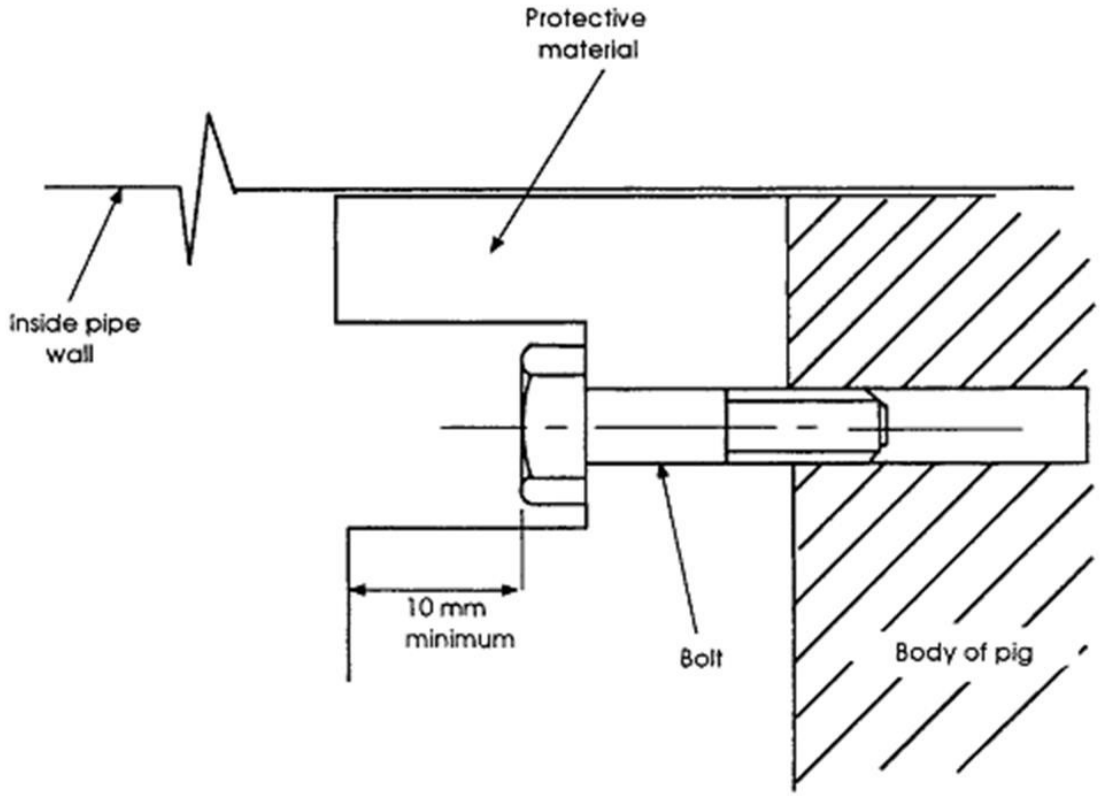
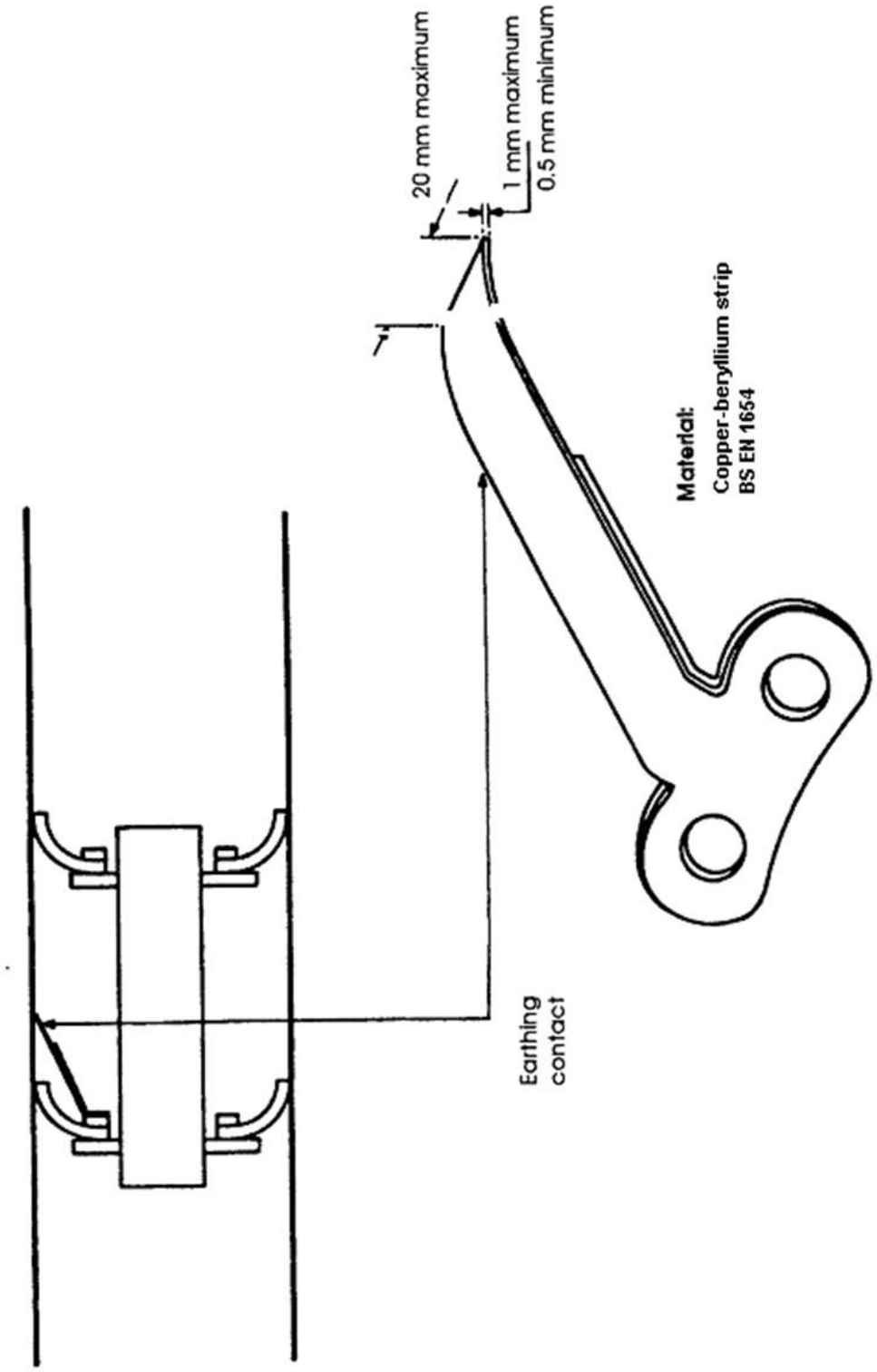


Figure 4 – Typical earthing contact



Appendix A – Typical Data Sheet

STANDARD DATA SHEET FOR PIGS

Part 1 – To be completed by the Gas Transporter

1. Data Sheet Number:_____
2. Contract or order number:_____
3. Project:_____
4. Intended use of pig:_____
   _____
5. Pipeline inside diameters to be pigged (see 2.1.4):
   a) Maximum pipeline inside diameter_____mm
   b) Minimum pipeline inside diameter_____mm
6. Minimum bend radius to be pigged (see Appendix B)_____
7. Distance to be pigged (see 2.1.5)_____km
8. Maximum pressure pig will have to withstand:

   Pipeline pressure (see 2.1.6)_____bar

   Differential pressure (see 2.1.7)_____bar
9. Gauge plate required (see 2.1.9) yes/no
10. Bypass required (see 2.1.10) yes/no
11. Cup blow over relief system required (see 2.1.11) yes/no

    Operational blow over/relief differential pressure_____bar
12. Provision for pig location device required (see 2.2.6) yes/no
13. Maximum hardness of outer envelope material (see 3.2)_____HV
14. Painting procedure required (see 4.4) yes/no
15. Other requirements_____

Part 2 – To be completed by the Contractor

Data Sheet Number (see part 1)_____

16. Name of Contractor:_____

17. Pig type:_____

18. Pig number:_____

19. Pig dimensions:

a) length_____mm

b) diameter_____mm

20. Pig weight_____kg

21. Maximum permissable bend radius (see Appendix B)_____

22. Maximum pressure pig body is designed to withstand:

a) Pipeline pressure _____bar

b) Differential pressure _____bar

23. Has design been given type approval by the Gas Transporter (see 2.1.3) yes/no

24. Pig body material_____

25. Elastomer hardness_____

26. Have pig cup blow over tests been carried out as per Appendix C ?_____YES/NO

If YES state the test blow over pressure_____bar

Type/Serial number of cup tested_____

Additional requirements for metal bodied pigs only

27. Pig cup diameter_____Number of pig cups_____

28. Material of pig cups_____Protective material for pig nose_____

Appendix B – Definitions of the Centre Line Radius of Bends

B.1 For the purposes of this Specification, the definition of bend radius given in **/SP/B/12 is used. This gives the centre line radius F in terms of the outside diameter of the bend at the weld end preparation D (see Figure B.1). In most cases, D is equal to the outside diameter of the pipe to which the bend will be welded, as specified in **/SP/DAT/6. Therefore:

For a 3D bend, F = 3D

For a 1.5 D bend, F = l.5D

B.2 Other terms are used in standards and specifications to describe the radius of a bend. For

example, ANSI B 16.9 and ANSI B 16.28, the terms long radius and short radius are used. These should be described in terms of the description given in clause B.1 as follows:

For pipe nominal sizes greater than 300 mm:

Long radius	1.5 D
Short radius	1D.

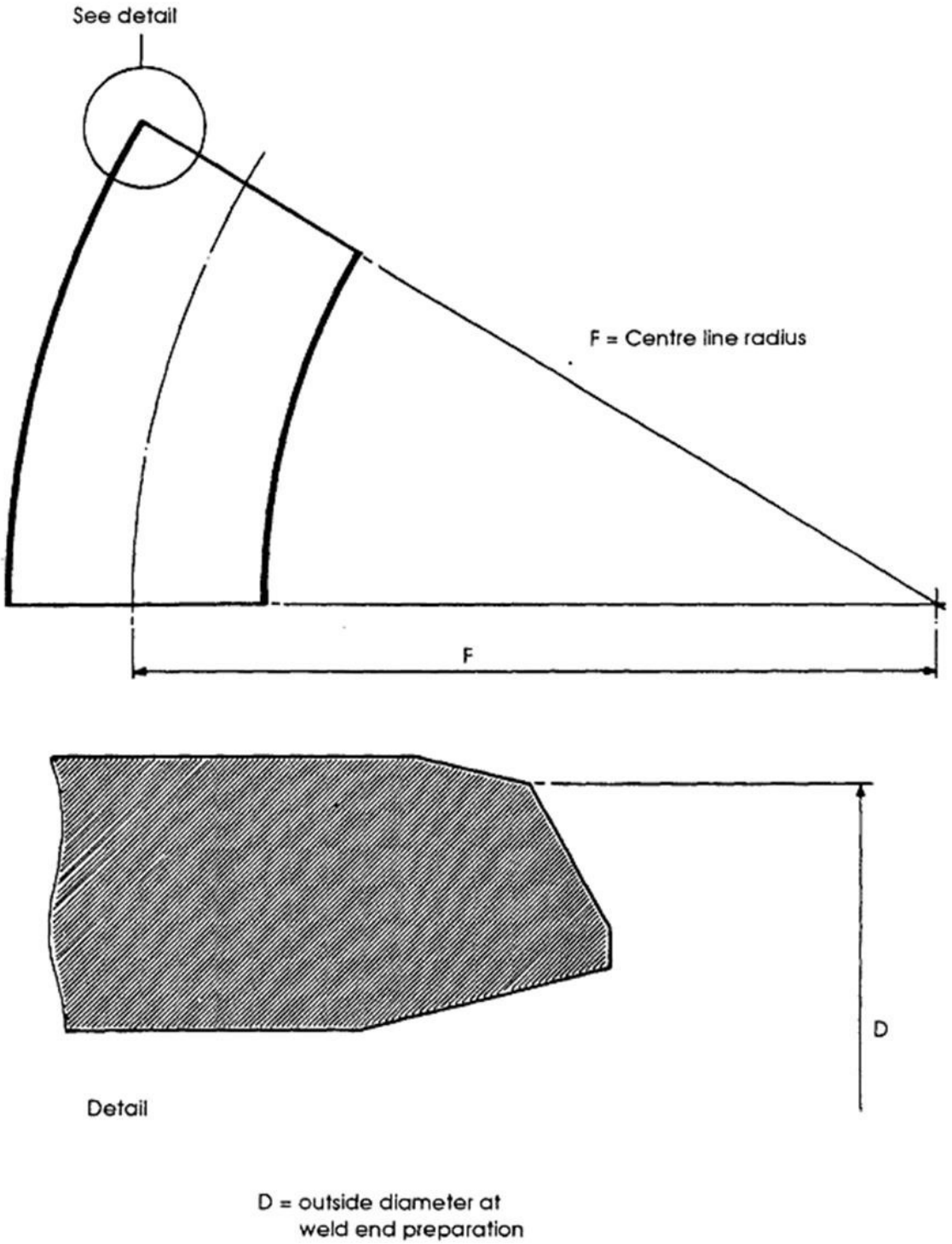
For smaller sizes, the actual radius becomes less than the above values, because the calculation is based on pipe nominal size rather than outside diameter, e.g. for 150 mm pipe nominal size, approximate values are:

Long radius	1 .35D
Short radius	0.9D

This method of calculating the radius of a bend applies to the bends specified in B4, and so the terms ‘3D’ and ‘1.5D’ used in that standard are descriptions of nominal bend radius which do not conform strictly to the definition given in B.1.

B.3 Some terms in common use by pig manufacturers in the United States of America differ from those given in clauses B.1 and B.2. For example, the term ‘extra long radius’ is often used to describe 3D bends. Also there is widespread use of ‘R’ instead of ‘D’ to describe the bend radius. Generally a 1.5R or 3R bend should be taken as meaning a 1.5D or 3D bend as defined in clause B.1.

Figure B-1 – Radius of Bends



Appendix C – Pig Cup Blow Over Tests

C.1 One pig cup blow over test shall be carried out for each type and size of cup. For the test,

the cup need not be mounted on a pig, but the mounting arrangement shall reproduce that used on the pig for which the cup is intended. Unused pig cups shall be used for the test.

C.2 The cups shall be tested in the pipe of the dimensions given in Table C. 1 for the appropriate nominal size. The pipe used shall have a maximum ovality of 1%.

C.3 The centre line of the pig cup shall be offset by 2% from the centre line of the pipe, so that its distance from one wall is 0.52 times the measured inside diameter of the pipe at that point (see Figure C.1). The offset shall be towards any seam weld in the pipe.

C.4 The plane of the pig cup shall be perpendicular to the axis throughout the test.

C.5 A general purpose lithium based, or similar grease shall be applied liberally between the pig cup and the pipe wall.

C.6 The test blow over pressure shall be applied using a suitable compressed gas such as air or nitrogen.

C.7 The test blow over pressure shall be measured by a certified pressure gauge, which records pressure in the test chamber, not on the gas supply line.

C.8 The pressure shall be raised at approximately 1 bar per minute until blow over occurs.

C.9 The test blow over pressure shall be recorded and reported to the Gas Transporter in Part 2 of the Data Sheet (see Appendix A). It should be noted that the test blow over pressure achieved in this test is not expected to be the same as the operational blow over pressure specified by the Gas Transporter in Part 1 of the Data Sheet (see Appendix A). This test is only for comparison of the performance of the different cups. The operational test blow over pressure experienced in a pipeline will be higher than the test blow over pressure. Under normal pigging conditions, the operational blow over pressure may be of the order of twice the test blow over pressure, and even higher figures may occur for certain pipeline configurations. e.g. thick wall pipe transitions.

TABLE C.1 - Test pipe dimension for pig cup blow over tests

Nominal size mm	Outside diameter mm	Nominal wall thickness mm
40	48.3	5.1
50	60.3	5.5
80	88.9	5.5
100	114.3	4.8
150	168.3	5.6
200	219.1	6.4
250	273.1	6.4
300	323,9	7.1
400	406.4	8.7
450	457.0	9.5
600	610.0	9.5
750	762.0	11.9
900	914.0	12.7
1050	1067.0	14.3
1200	1219.0	14.3
NOTE – This Table is an extract from **/SP/DAT/6		

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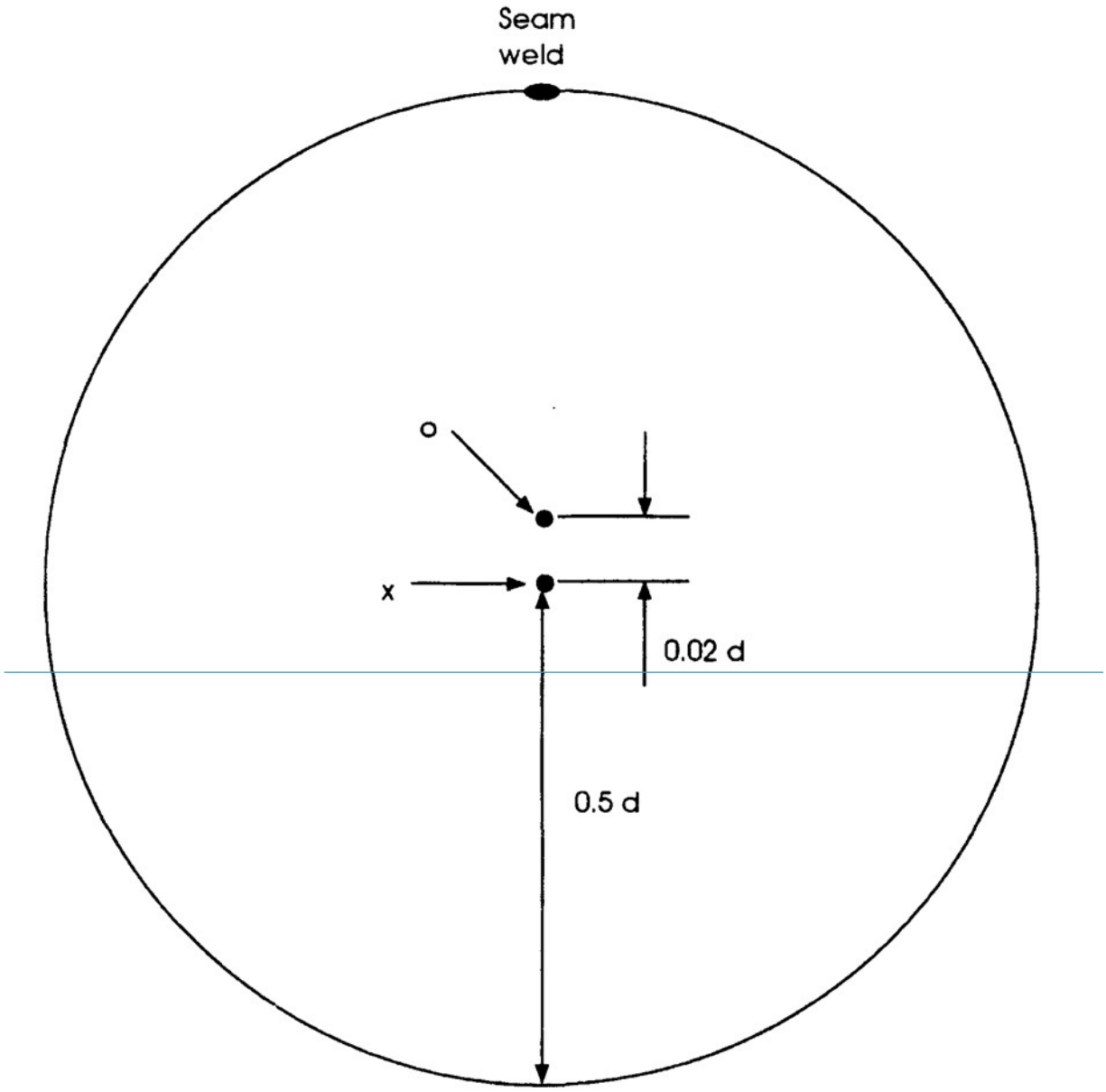
Figure C.1 - Offset of centre line of pig cups for blow over tests



o = pig cup centre line

x = pipe centre line

d = measured inside diameter of the pipe

f