

# Gas Industry Standard

GIS/E19:2006

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Specification for

**Primary iris stop bags**

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## Foreword

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## 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

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## Brief history

First published as BG/PS/E19 Amended issue published as GBE/E19 Editorial update to reflect demerger November 2000 Editorial update to comply with GRM Edited by BSI in accordance with BS 0-3:1997 Reviewed on behalf of the Gas Distribution Networks' Technical Standards Forum by BSI Reviewed by TSF	November 1990 August 1993 June 2001 August 2004 August 2006 September 2013  June 2018
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## 1 Scope

This Gas Industry Standard specifies the design, performance and material requirements for inflatable bags for use in the primary (iris supported) position of an iris stop system. Special requirements for bags larger than 36 in are specified in Annex A and test procedures are specified in Annexes B to F.

The bags are intended for insertion from a bag tube into a gas main under pressure when routine maintenance work on a distribution system requires the flow of gas in the main to be temporarily stopped.

The field of application covers steel, cast grey and ductile iron mains in the nominal size range 4 in (100 mm) to 48 in (1 200 mm).

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS ISO 37, *Rubber, vulcanized or thermoplastic. Determination of tensile stress-strain properties.*

BS ISO 188, *Rubber, vulcanized or thermoplastic. Accelerated ageing and heat resistance tests.*

BS ISO 2230, *Rubber products — Guidelines for storage.*

## 3 Design

### 3.1 General

Inflatable bags conforming to this standard shall be capable of insertion into or removal from a main under pressure using the appropriate iris stop bag tube. When inserted in the main and inflated, the bag shall seat against the iris, thus ensuring that the thrust due to the gas pressure is effectively transferred to the iris.

The design requirements may be satisfactorily met by the combination of an inner inflatable component (the bladder) with an outer cover of strong fabric. However, this standard is not intended to preclude other methods of bag construction that may be proposed by the contractor for consideration as a variant by the gas transporter, provided it can be clearly shown that the bag possesses equal or superior qualities to the bladder/outer cover type of construction.

In addition to the other clauses of this standard, bags larger than 36 in shall conform to the requirements of Annex A.

### 3.2 Inner inflatable component (bladder)

The bladder shall be manufactured from a compound that meets the requirements of Table 1.

The finished bladder shall be visually free from any inclusion or defect likely to impair performance.

The bladder shall be sized so that when the finished bag is inflated in its respective maximum tolerance main, the elongation of the bladder shall not exceed 100 %. The bladder shall be sized such that its flaccid diameter is at least 0.5 times that of the finished bag diameter.

All bladder joints shall be visually inspected to ensure that a proper bond has been achieved.

Bladder thickness shall be within the inclusive limits 0.5 mm to 1.5 mm and the thickness of each bladder shall be within  $\pm 30\%$  over its full area, excluding overlapped seams.

### **3.3 Outer cover**

To avoid rotting problems, only materials manufactured from synthetic fibres shall be used. The cover shall be designed and manufactured in such a manner as to provide complete support for the bladder so that no excessive stressing of the bladder material is possible within the cover.

The materials shall neither absorb any significant quantities of aliphatic or aromatic hydrocarbons, nor be dissolved by them. Threads used to stitch all seams shall be of compatible material and stitched seams shall run parallel to, and at least 6 mm from, the free edge to avoid separation when under stress.

### **3.4 Fittings**

All mechanical fittings used in the bag construction such as male-female screwed couplings, compression rings, inflation adapters, support tubes, etc., shall conform to the appropriate British Standard.

The size of the female screw connector at the bag inlet shall be as given in Table 3.

The fittings controlling inflation and deflation shall have the maximum possible internal diameter consistent with adequate strength.

Crimping of compression rings shall not damage the cover material and, if necessary, protective sleeving shall be provided. The crimp shall be positive so that sliding of the ring does not occur when manoeuvring the bag (see 4.3.3). To achieve this, recessed fittings shall be used under all crimped rings. Where the recess is cut in a non-metallic component, the part shall be solid under the recess.

The neck of the bag shall contain a semi-rigid tube which extends 25 mm to 80 mm into the bladder; this is to assist in preventing blockage of the air path into and out of the bag.

## **4 Bladder and finished bag tests**

### **4.1 General**

The tests specified in 4.2 and 4.3 shall be carried out by the manufacturer.

### **4.2 Tests to be carried out on every bag and bladder**

#### **4.2.1 Testing of bladders**

Before assembly into the bags, the bladders shall be inflated to their flaccid diameter and examined thoroughly for inclusions of faults likely to cause rupture. All seams and connections shall also be scrutinized for adhesion.

#### **4.2.2 Free-standing pressure test**

The free-standing pressure test is equivalent to the pre-insertion test carried out by the operator before insertion into the live main. The free-standing test pressure for each nominal diameter shall be as given in Table 2. The test period shall not be less than 5 min, during which time the bag shall be thoroughly examined for defects.

#### **4.2.3 Test for leakage from within the bag**

The test for leakage from within the bag, which shall be for a period of not less than 5 min, detects leakage from the bag to atmosphere when at the test pressure given in Table 2. There shall be no leakage from the bag or its fittings during this test.

NOTE The tests specified in 4.2.2 and 4.2.3 may be carried out simultaneously at the option of the manufacturer.



### **4.3 Tests to be carried out on an agreed sample of completed bags**

#### **4.3.1 Test supervision**

The tests specified in 4.3.2 to 4.3.7 shall be carried out by the manufacturer, or by the gas transporter, to establish the acceptability of the design.

#### **4.3.2 Dimensional tests**

Each inflatable bag shall conform to certain dimensions when inflated in a pipe of maximum tolerance bore and shall not exceed a maximum possible length when deflated. For the dimensional limits for each size of bag, see Annex B.

#### **4.3.3 Lower pressure tests**

Lower pressure tests shall be conducted with the bags free-standing in open-ended pipes of the maximum tolerance bore given in Table 3.

The bags shall be capable of withstanding the test pressures in Table 4 (these are four times the recommended differential pressures). The bags shall not burst or incur serious distortion to seams or panels.

#### **4.3.4 Pull tests for neck assembly**

When the primary bags are inserted or withdrawn from the main, forces are imposed on the neck connection. To simulate these forces, a direct pull of 1.1 kN shall be applied to the end connection and no distortion or disengagement of the neck assembly shall occur when the load is applied for a period of 5 min. Annex C specifies the procedure for carrying out this test.

#### **4.3.5 Tests to measure leakage past the bag**

Leakage past the bag under working conditions shall be tested to ensure that the leakage rate is below the maximum given in Table D.1.

The tests shall be carried out in pipes of maximum tolerance bore and pressurized to the maximum iris stop working pressure given in Table 3. The bags shall be at their recommended working inflation pressures and seated against an iris.

Annex D describes the apparatus and the test method, and Table D.1 gives the maximum allowable leakage for each bag size.

#### **4.3.6 Bag insertion test**

The ability of the completed bag to be entered and expelled from the bag tube shall be tested. The test shall consist of pulling the complete bag, strapped to the bag guide using light elastic bands, into and pushing it out of the appropriate bag tube. It shall also be checked that the bag can be pulled into the bag tube when left hanging free of the guide, as happens at the end of a flow stopping operation. The force exerted on the bag neck shall not exceed 600 N in either direction during these operations. Details of this test are specified in Annex E.

#### **4.3.7 Upper pressure test**

The upper pressure test shall be carried out with the bag inflated inside a pipe of maximum tolerance bore as given in Table 3. The bag shall be supported by an iris. The test procedure and required performance of the bag are specified in Annex F.

## 5 Marking

### 5.1 General

Identification of the bag type and relevant details shall be clearly marked on both the bladder and the outer cover.

All markings shall be made with a suitably coloured indelible ink free from copper or manganese compounds or other compounds likely to accelerate the degradation of either the bladder or the cover.

### 5.2 Bladder markings

Bladder markings shall include the manufacturer's name, reference number or size of bladder and "use-by" date.

### 5.3 Outer covering markings of the completed stop bag

Bags shall be a white-grey colour to identify it as a primary iris stop bag. Marking of outer coverings of a completed stop bag shall include:

- a) the number and date of this standard, i.e. GIS/SP/E19:2006 <sup>1)</sup>;
- b) nominal size of main (in mm or in);
- c) maximum bag differential pressure (DP) in mbar, e.g. "maximum DP (in mbar)";
- d) "use-by" date, e.g. "use-by 01/06";
- e) the name or trademark of the manufacturer or their appointed agent;
- f) the manufacturer's contact details;
- g) where authorized, the product conformity mark of a third party certification body, e.g. BSI Kitemark.

NOTE Attention is drawn to the advantages of using third party certification of conformance to a standard.

The outer cover markings shall be printed on the ends.

### 5.4 Hexagon connectors

The hexagon connectors shall be stamped or vibro-etched with the nominal size of main in mm and "use-by" date, e.g. "400 mm" and "01/06".

## 6 Assembly packaging and storing

**6.1** The rubber bladders used for the bag stopper construction shall be dusted internally and externally with French chalk, polyvinyl chloride dust or similar and carefully packed and stored in the manner specified in BS ISO 2230. When drawing the bladders from storage for final attachment to the outer fabric cover, special reference shall be made to BS ISO 2230, and a similar procedure shall be followed by the contractor when supplying the completed item to the gas transporter. Bladders more than 12 months old shall not be incorporated in any bag stopper.

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<sup>1)</sup> Marking GIS/SP/E19:2006 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

**6.2** After testing of the completed bag stopper and drying if necessary, they shall be stored in boxes out of direct sunlight at a temperature below 25 °C. If bag stoppers are packed in bundles, any ties shall not permanently distort the bladders.

**6.3** The bag stopper and hexagon connector shall be marked with a “use-by” date which shall be 30 months from the date of manufacture.

**6.4** Bag stoppers shall not be supplied to the gas transporter 12 months prior to the “use-by” date.

**Table 1 — Bladder material tensile failure load and elongation requirements**

Tensile failure load	New material		Aged for 168 h at 70 °C b)	
	Parent	Seams	Parent	Seams
	33.4 N min.	4 × 100 % elongation load min. <sup>a)</sup>	20 % reduction max.	20 % reduction max.
<b>Elongation</b>	500 % min.	—	30 % reduction max.	—

<sup>a)</sup> The 100 % elongation load is the average load required to cause 100 % elongation of three specimens of new material. The values shall be determined in accordance with BS ISO 37 using Type 2 dumb-bells. Dumb-bells from seams shall be taken at right angles to the seams.

<sup>b)</sup> The ageing of specimens shall be in accordance with BS ISO 188.

**Table 2 — Free-standing test pressures**

Pipe nominal size		Test pressure mm
mm	(in)	
100 to 300	(4 to 15)	200
400 and 450	(16 and 18)	140
500 to 900	(20 to 36)	70
1200	(42 and 48)	35

**Table 3 — Main maximum tolerance bore, bag and iris stop working pressures and bag end connection size**

Main dimensions		Maximum tolerance bore	Maximum mains pressure	Maximum bag differential pressure	Maximum bag inflation pressure (mains pressure + bag differential pressure)	Threaded female inflation connection on bag
Pipe nominal size						
mm	in.	mm	mbar	mbar	mbar	
100	4	112	2000	200	2200	1/4 in. BSP x 3/8 in. tail 1/4 in. BSP x 3/8 in. tail
150	6	168	2000	200	2200	
200	8	224	2000	200	2200	)
	9	245	2000	200	2200	
250	10	276	2000	200	2200	)
300	12	324	1700	200	1900	) 3/8 in. BSP cone
	14	368	1200	200	1400	
	15	403	1200	200	1400	
400	16	417	950	140	1090	)
450	18	481	700	140	840	)
500	20	520	700	70	770	)
	21	559	700	70	770	
600	24	637	700	70	770	) 3/4 in. BSP cone
	27	698	200	70	270	
	28	737*	200	70	270	
	30	788	200	70	270	
900	36	943	140	70	210	)
	42	1098	70	35	105	)
1200	48	1252	35	35	70	)

\* Non-standard pipe, value interpolated.

**Table 4 — Lower test pressures**

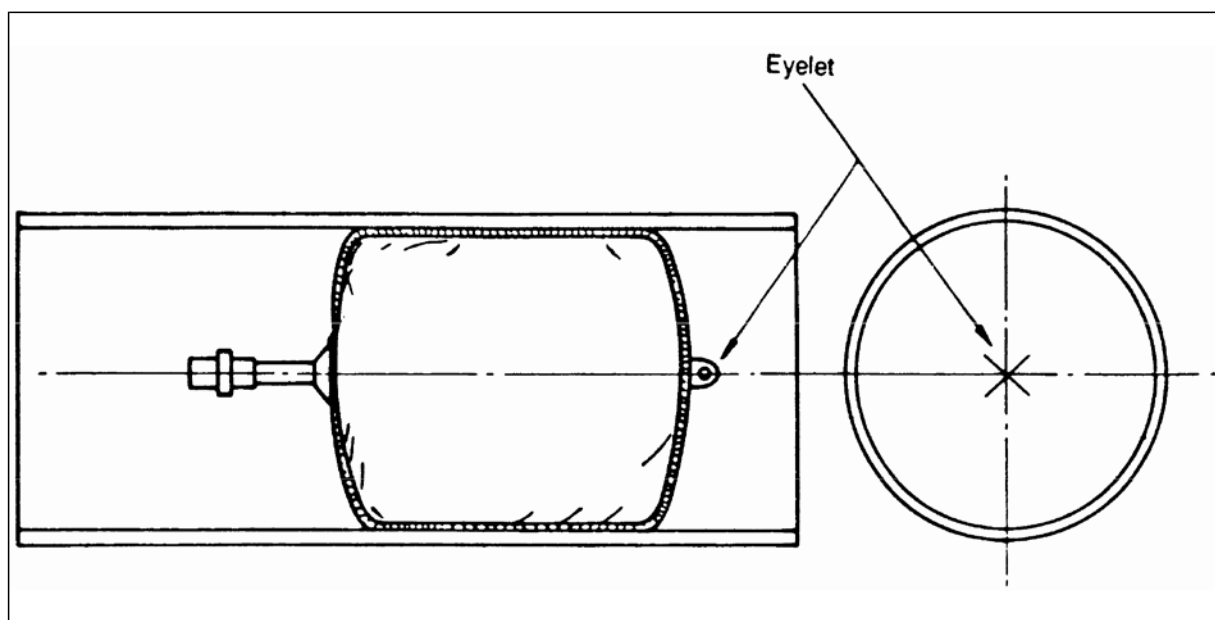
Pipe nominal size		Lower test pressure
mm	(in)	mbar
100 to 300	(4 to 15)	800
400 and 450	(16 and 18)	560
500 to 900	(20 to 36)	280
1200	(42 and 48)	140

**Annex A (normative)****Special requirements for bags larger than 36 in**

**A.1** An eyelet shall be provided on the nose of the bag, i.e. at the centre of the panel on the opposite end of the bag to the inflation connection (see Figure A.1). This eyelet shall take the breakable link used to ensure correct positioning of the bag in the main.

**A.2** The breakable link shall be 680 mm long and shall break at a load of  $90\text{ N} \pm 10\text{ N}$ ; a suitable material for this is fishing line. These links shall be provided with each bag larger than 36 in.

**A.3** The eyelet on the bag shall be capable of taking a load of 360 N without causing any visible damage to the bag.

**Figure A.1 — Position of eyelet on bags larger than 36 in**

**Annex B (normative)****Bag dimension tests****B.1 Inflated bag dimensions****B.1.1 Principle**

This test is to establish whether the bag falls within the correct dimensional limits when inflated in a pipe of maximum tolerance bore.

**B.1.2 Apparatus**

**B.1.2.1** *Completed stop bag.*

**B.1.2.2** *Pipe, of appropriate maximum tolerance bore pipe (see Table 3).*

**B.1.2.3** *Equipment for inflating the stop bag, and measuring the inflation pressure.*

**B.1.3 Procedure**

For the inflated bag dimension tests, the bag shall be inflated to its differential pressure within its appropriate maximum tolerance bore pipe (see Table 3). The pressures and bore sizes are given in Table 3. The bag shall remain inflated for no less than 5 minutes before dimensions are measured.

**B.1.3.1 Results**

All bag dimensions shall be within the limits shown in Figure B.1. The minimum contact length shall be the average of eight readings taken at regular intervals around the bag circumference.

**B.2 Deflated bag dimensions**

The maximum overall deflated bag lengths shall be measured by pulling the bag material away from the inflation adapter (see Figure B.2). This deflated length shall not exceed the values given in the table in Figure B.2.

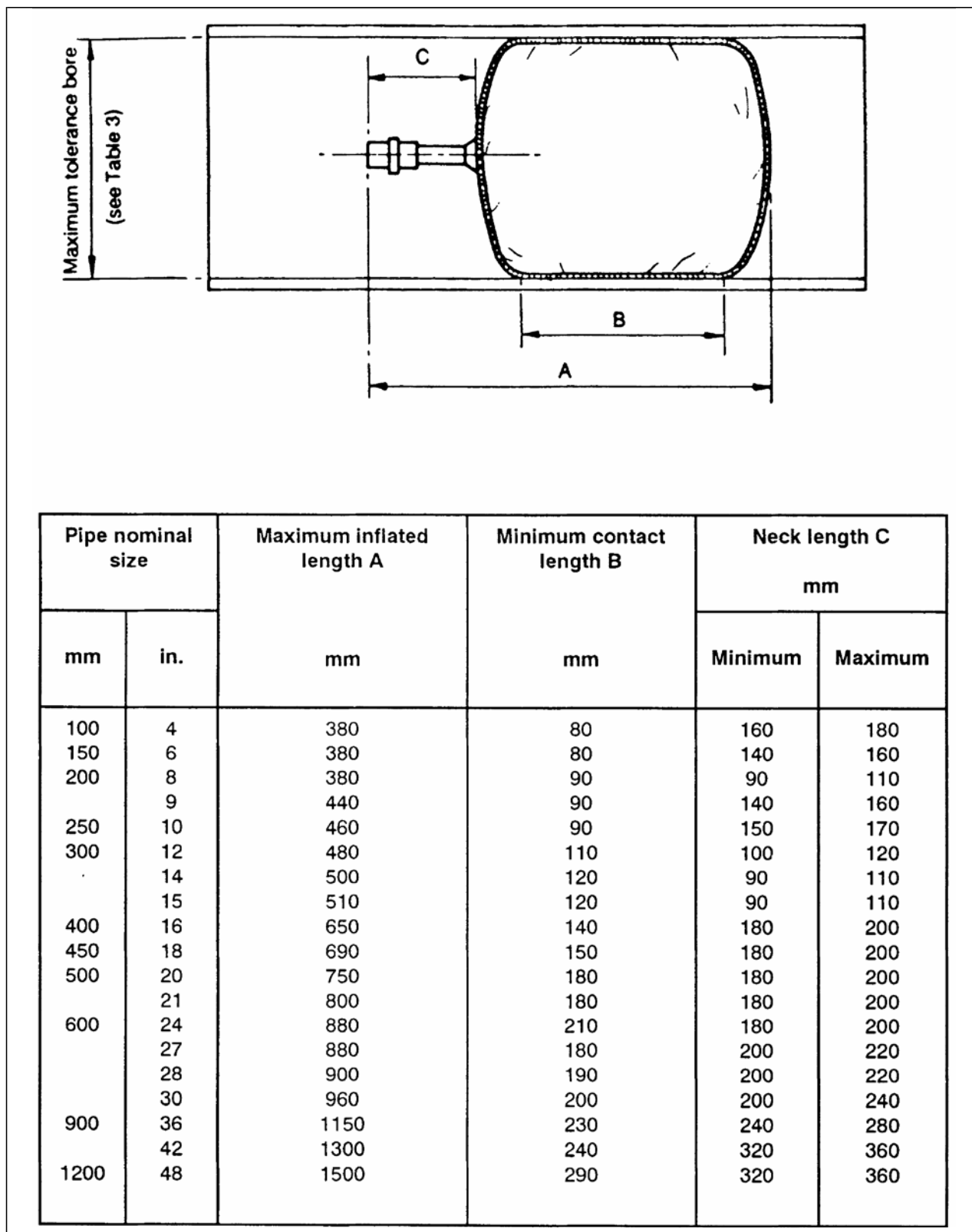
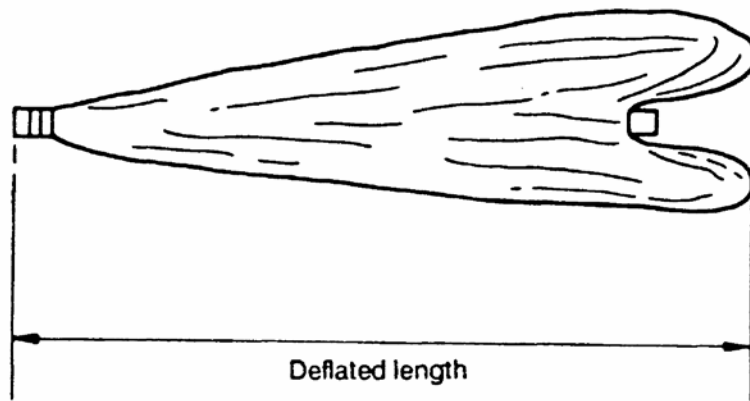


Figure B.1 — Dimensions of inflated bag inside test pipe for dimension test



Pipe nominal size		Maximum deflated length
mm	in.	
100 and 150	4 to 7	430
200 and 250	8 to 10	570
300	12 to 15	690
400 and 450	16 and 18	1225
500	20 and 21	1225
600	24	1225
	27	1270
	28	1330
	30	1430
900	36	1690
1200	42 and 48	2200

Figure B.2 — Deflated bag length



## **Annex C (normative)**

### **Neck pull tests**

#### **C.1 Principle**

This test simulates the forces that act on the neck assembly when the secondary bags are inserted or withdrawn from the main.

#### **C.2 Apparatus**

**C.2.1** *Completed stop bag.*

**C.2.2** *Test plate, as shown in Figure C.1.*

**C.2.3** *Equipment for inflating the stop bag, and measuring the inflation pressure.*

#### **C.3 Procedure**

**C.3.1** Inflate the bag to the pressure given in Figure C.1.

**C.3.2** Exert pulling load of 1.1 kN on the neck connection for no less than 5 min.

#### **C.4 Results**

The neck connection shall withstand the load without any distortion or disengagement of the end connection.

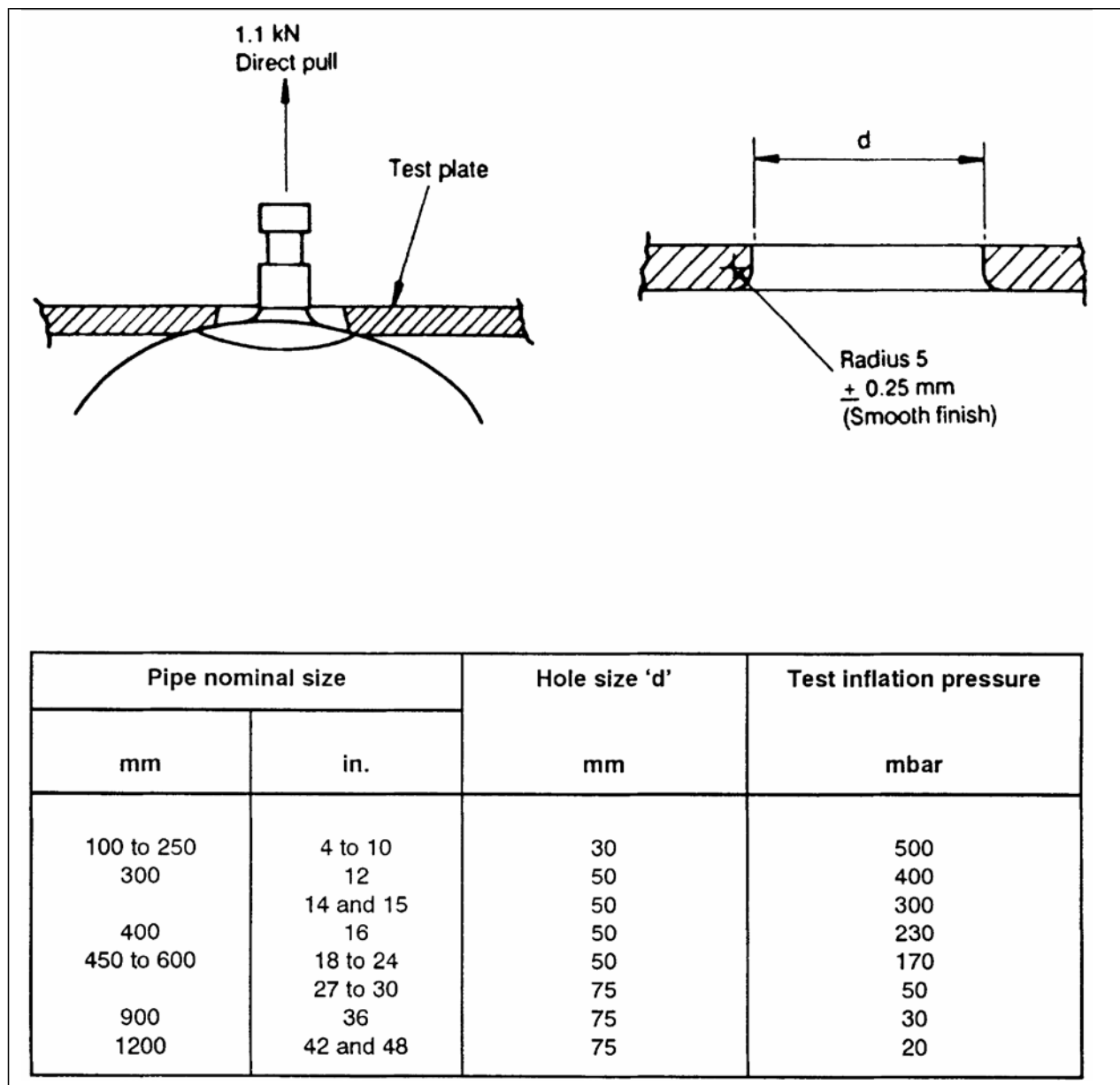


Figure C.1 — Test plate dimensions and bag pressures for neck pull tests

## **Annex D (normative)**

### **Leakage past the bag**

#### **D.1 Principle**

This test investigates acceptable leakage past the bag under working conditions.

#### **D.2 Apparatus**

**D.2.1** *Completed stop bag*, at recommended working inflation pressure.

**D.2.2** *Iris-shaped support plate*, appropriate for the size of bag being tested as specified in Figure D.2.

**D.2.3** *Pipe of appropriate maximum tolerance bore*, for the bag being tested, as specified in Table 3.

**D.2.4** *Flow meter*.

**D.2.5** *Air supply inlet*.

**D.2.6** *Pressure gauges*, to measure bag pressure and pipe pressure.

#### **D.3 Procedure**

**D.3.1** Set up the apparatus as illustrated in Figures D.1 and D.2 and Table D.1.

**D.3.2** Inflate bag and ensure that it is seated against the iris-shaped support plate as illustrated in Figure D.1.

**D.3.3** Ensure that the pipe is pressurized to the maximum mains pressure (P1) given in Table 3.

**D.3.4** Inflate the bag to the maximum bag inflation pressure (P2) given in Figure D.1.

#### **D.4 Results**

The leakage rate shall be below the maximum given in Table D.1.

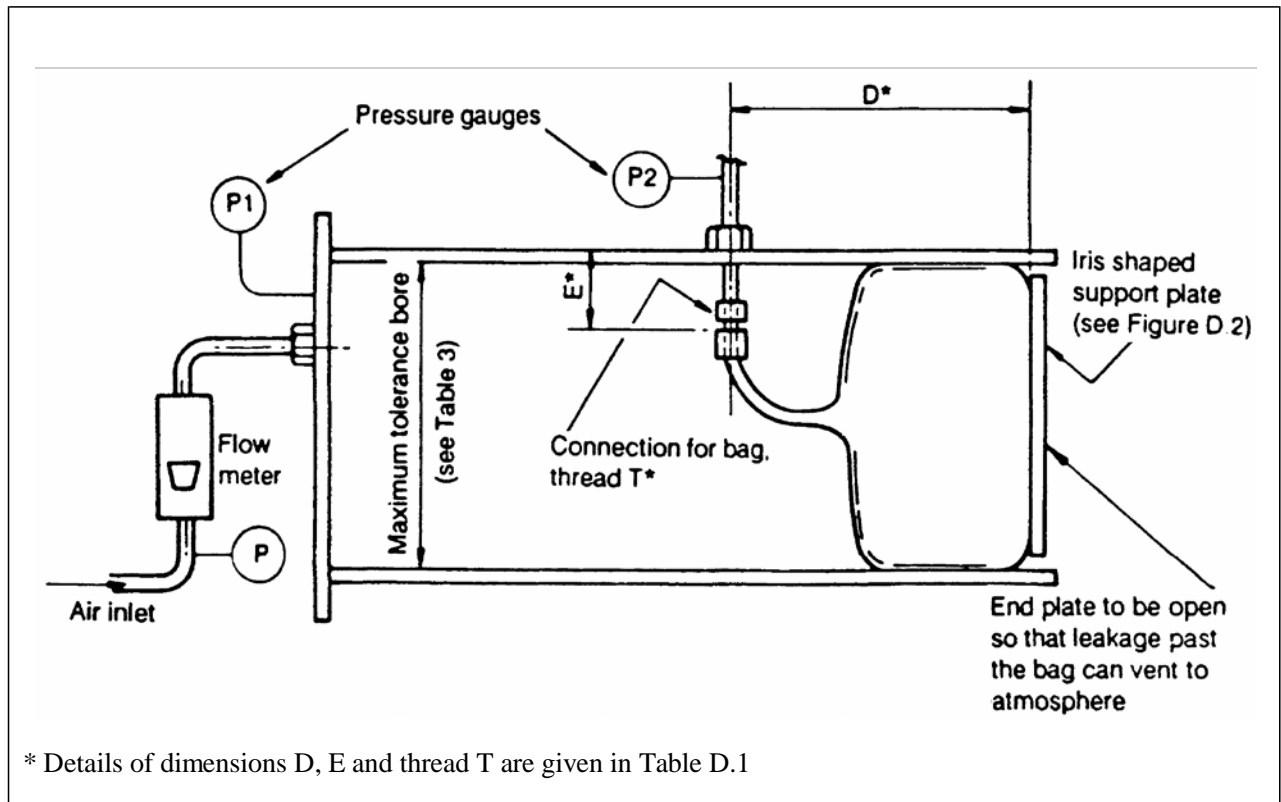
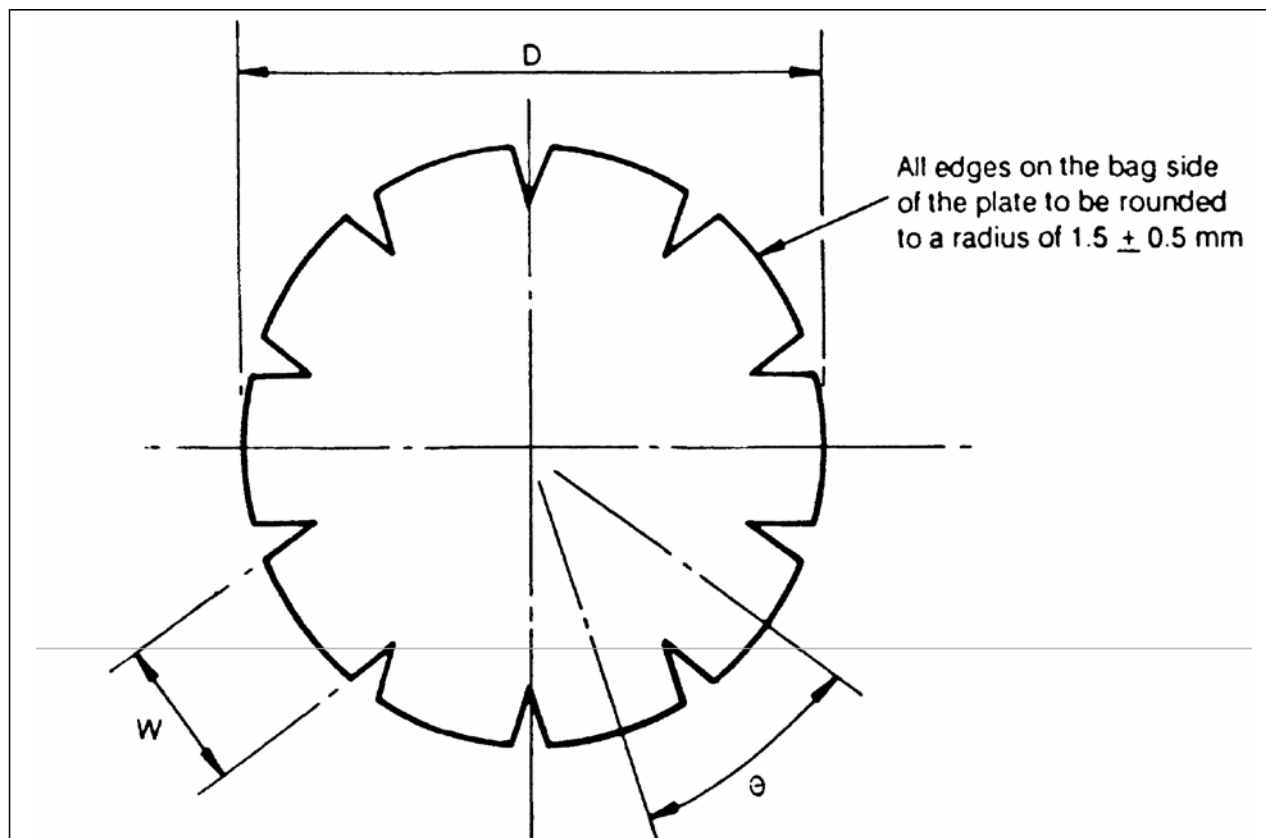


Figure D.1 — Equipment for leakage past the bag test



NOTE This diagram is typical of an iris with five support blades.

Pipe nominal size		Plate diameter D	Blade width W	Angle between blades	Number of support blades
mm	in.				
100	4	92	25	36	5
150	6	143	32	36	5
200	8	194	44	36	5
	9	219	63	36	5
250	10	244	63	36	5
300	12	295	73	36	5
	14	346	73	36	5
	15	371	73	36	5
400	16	397	92	36	5
450	18	447	92	36	5
500	20	498	117	36	5
	21	524	117	36	5
	24	600	139	36	5
600	27	652	130	30	6
	28	680	130	30	6
	30	735	130	30	6
	36	889	130	30	6
900	42	1043	130	30	6
	48	1197	130	30	6

Figure D.2 — Dimensions of iris-shaped support plate

Table D.1 — Pressures and acceptable leakage rate for leakage past the bag test

Pipe nominal size		Dimensions mm		Maximum Mains Pressure (P1) mbar	Maximum Bag Inflation Pressure (p2) mbar	Maximum Acceptable Leakage Rate scmh	Connection to take Bag Thread T* male BSP
Mm	in.	D*	E*				
100 and 150	4 and 6	254	25	2000	2200	6.0	¼ in.
200	8	254	50	2000	2200	8.0	3/8 in., 60° coupler
250	9 and 10	356	60	2000	2200	10.0	
300	12	356	80	1700	1900	11.0	
	14	356	90	1200	1400	11.5	
	15	381	100	1200	1400	11.5	
400	16	406	100	950	1090	12.0	¾ in., 60° coupler
450	18	407	120	700	840	12.0	
500	20	508	130	700	770	13.5	
	21	533	140	700	770	13.5	
600	24	609	160	700	770	13.5	
	27	689	170	200	270	15.0	
	28	711	180	200	270	15.0	
900	30	762	200	200	270	15.0	
	36	914	235	140	210	15.0	
	42	914	240	70	105	18.0	
1200	48	914	250	35	70	18.0	

\* See Figures D.1 and F.1.

## **Annex E (normative)**

### **Bag insertion test**

#### **E.1 Principle**

This test investigates the ability of the primary bag to be pulled into the appropriate bag tube whilst strapped to the bag guide and pushed out again. The test also ensures that the bag can be pulled back into the bag tube when the bag is hanging free from the guide, as happens at the end of a flow stopping operation.

#### **E.2 Apparatus**

**E.2.1** *Completed stop bag.*

**E.2.2** *Appropriate size iris stop bag tube, for the pipe size conforming to dimensions of Table E.1.*

#### **E.3 Procedure**

**E.3.1** Attach bag to bag tube and strap to bag guide using light elastic bands.

**E.3.2** Pull bag fully into the bag tube whilst measuring the applied force.

**E.3.3** Push bag fully from bag tube whilst measuring the applied force.

**E.3.4** Remove the elastic bands from the bag so that it is hanging free from the guide.

**E.3.5** Pull bag fully into the bag tube whilst measuring the applied force.

#### **E.4 Results**

The above procedure shall be carried out without the force exerted on the bag neck exceeding 600 N in either direction, and without any damage occurring to the bag.

**Table E.1 — Drawing numbers for iris stop bag tube**

<b>Pipe size (nominal)</b>		<b>Bagtube internal diameter</b>	<b>Max. deflated length of bag</b>
in	(mm)	mm	mm
4	100	35	430
5	125	35	430
6	150	35	430
7	175	35	430
8	200	51	570
9	225	51	570
10	250	51	570
12	300	76	690
14	350	76	690
15	375	76	690
16	400	76	1 225
18	450	102	1 225
20	500	114	1 225
21	525	114	1 225
22	550	114	1 225
24	600	114	1 225
27	700	114	1 270
28	725	114	1 330
30	800	114	1 430
36	900	114	1 690
40	1 000	140	2 200
48	1 200	140	2 200



## **Annex F (normative)**

### **Upper pressure test**

#### **F.1 Principle**

This test is to ensure that the stop bag will remain in position without bursting, or seriously distorting at the seams or panels or being pushed past the iris-shaped support plate.

#### **F.2 Apparatus**

**F.2.1** *Completed stop bag*, at recommended working inflation pressure.

**F.2.2** *Calibrated pressure transducers*, with suitable ranges.

**F.2.3** *Two-channel chart recorder*.

**F.2.4** *Iris-shaped support plate*, as detailed in Figure D.2.

**F.2.5** *Pipe of appropriate maximum tolerance bore*, for the bag being tested, as specified in Table 3, including a drilled hole of dimensions specified in Table D.1.

**F.2.6** *Air pressure source*, to provide required test pressure.

#### **F.3 Procedure**

**F.3.1** Set up the apparatus as illustrated in Figure F.1.

**F.3.2** The upstream pressure  $P_{us}$  and bag pressure  $P_b$  shall be recorded against time on the chart recorder for a permanent record of each test.

**F.3.3** The pressure in the bag  $P_b$  and the pressure upstream of the bag  $P_{us}$  shall be increased incrementally keeping the value of  $P_b - P_{us}$  to within  $\pm 50\%$  of the recommended differential pressure for the size of bag under test. Recommended differential pressures are given in Table 3.

#### **F.4 Results**

The bag shall withstand the pressures given in Table F.1 without bursting, or seriously distorting at the seams or panels.

Table F.1 — Upper test pressures

Pipe nominal size		Upstream pressure ( $P_{us}$ )	Bag pressure ( $P_b$ )
mm	(in)	mbar	mbar
100 to 250	(4 to 10)	8 600	8 800
300	(12)	7 400	7 600
	(14 and 15)	5 400	5 600
400	16	4 220	4 360
450	18	3 220	3 360
500 and 600	(20 to 24)	3 010	3 080
	(27 to 30)	1 010	1 080
900	36	770	840
	42	385	420
1 200	48	245	280

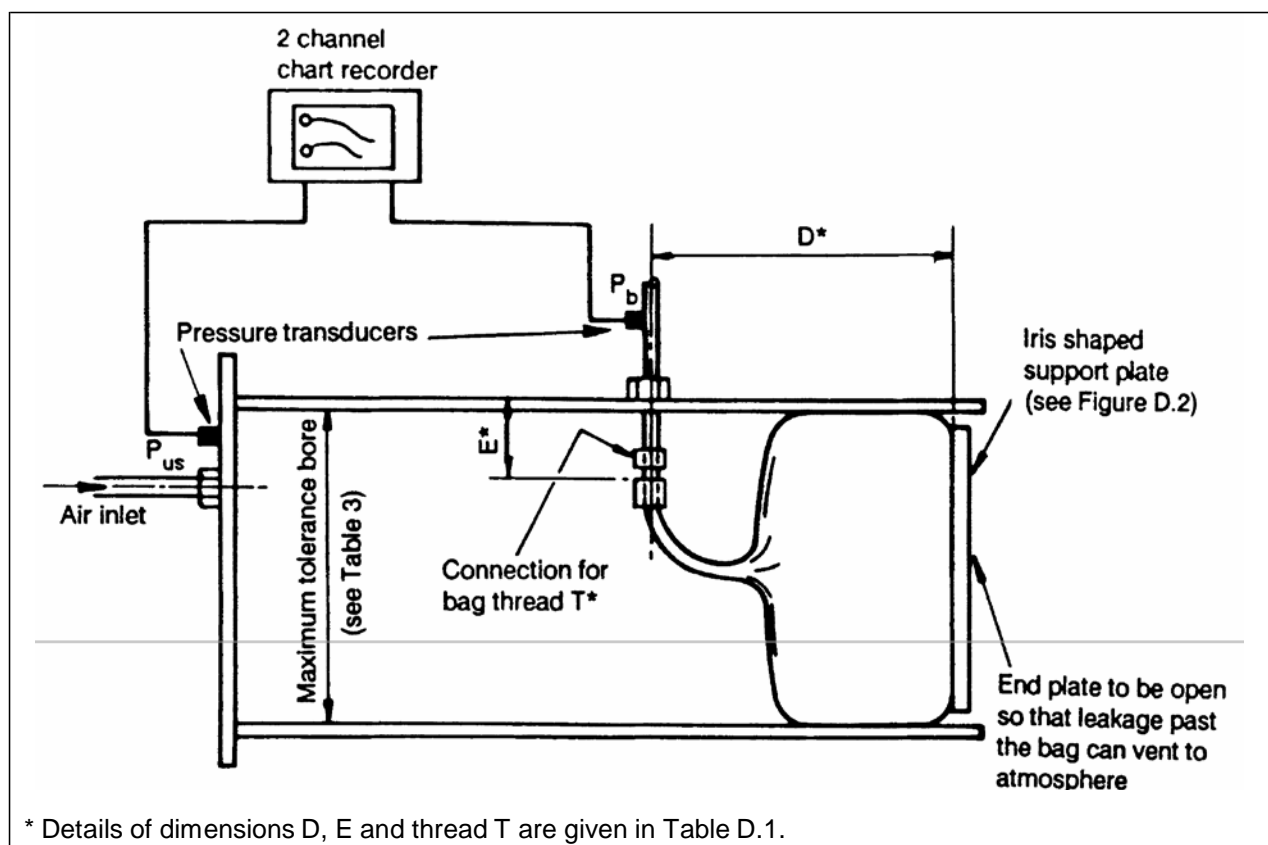


Figure F.1 — Upper pressure test equipment