

# Gas Industry Standard

GIS/F13:2025

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Specification for

**Ductile iron and fabricated steel cap ends for use on  
cast iron, ductile iron and steel gas mains up to 2 bar  
maximum operating pressure**

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**Contents**

	Page
Foreword	iii
Mandatory and non-mandatory requirements	iii
Disclaimer	iii
Brief history	iv
1 Scope	1
2 Normative references	1
3 Construction and materials	1
3.1 Elastomeric materials	1
3.2 Body castings	1
4 Design	2
4.1 General	2
4.2 Coatings	2
4.3 Maximum working pressure	2
4.4 Temperature ranges	2
4.5 Pipe diameters	2
4.6 Bolt head and nut clearances	3
4.7 Excavation	3
4.8 Installation instructions	3
4.9 Pipe surface preparation	3
4.10 Anchorage	3
4.11 Bolt torque	3
4.12 Backfill time	3
4.13 Dimensions	3
5 Type approval tests	4
5.1 General	4
5.2 Safety precautions	5
6 Production testing	6
7 Marking	6
8 Packaging	6
9 Torque setting requirements	7
Annex A (normative) Axial pull test	8
Annex B (normative) Vibration test	9
Annex C (normative) Application test	10
Annex D (normative) Strength and distortion test	11
Annex E (normative) Pressure-life test	12
Annex F (normative) Table of Nominal, Minimum and Maximum Pipe Diameters (Covering cast iron, ductile iron and steel pipes in all known diameters and wall thicknesses).	14
Annex G (normative) End loading test – For fittings (up to 300mm diameter only) where the manufacturer claims end restraint is NOT required for pressures up to a maximum of 75mbar	15
Annex H (Normative) Temperature cycling test	17
Annex I Summary of Rationale for changes to document – September 2024	18
Bibliography	19



## 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 as T/SP/F/13, including editorial update to comply with GRM	October 2004
Edited by BSI in accordance with BS 0-3:1997	August 2006
Review - refer to Annex H Addition of Annex G (normative) end loading test - For fittings (200mm maximum) where the manufacturer claims end restraint is <b>NOT</b> required for pressures up to a maximum of 75mbar	December 2012
Reviewed by the Technical Standards Forum	October 2017
Reviewed by the Technical Standards Forum and corrosion resistance requirements in 4.2 changed to align with these requirements in GIS/PL3	September 2022
Review by Technical Standards Forum. Extend scope to 300mm for self-anchoring cap ends at low pressure. Correct typos. Review temperature ranges for design/testing – align to GIS/LC/1. Introduce thermal cycling test (Annex H).	February 2025

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## 1 Scope

This Gas Industry Standard specifies requirements for the design and performance of bolted cap ends for sealing the open ends of cast iron, ductile iron and steel gas mains for below ground use.

Cap end maximum operating pressure will be up to 2 bar operating within a temperature range of  $-20\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$  for a minimum of 50 years in the internal and external environments present in and around gas mains.

## 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.

### Formal standards

BS EN 682, *Elastomeric seals — Material requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids.*

BS EN 969, *Specification for ductile iron pipes, fittings, accessories and their joints for gas pipelines — Requirements and test methods.*

BS EN 1563, *Founding — Spheroidal graphite cast iron.*

BS EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties.*

BS EN 10217-1, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Part 1: Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties.*

BS EN ISO 2081, *Metallic and other inorganic coatings— Electroplated coatings of zinc with supplementary treatments on iron or steel.*

### Gas Industry Standards

GIS/C6, *Specification for distribution pipe fittings cast in ductile iron for use up to 7 bar maximum operating pressures.*

GIS/LC8-4, *Specification for methods of repairing leaking ferrous gas mains — Part 4: Pipe repair clamps, split collars and under-pressure branch connections.*

GIS/PL3, *Specification for Self Anchoring mechanical fittings for natural gas and suitable manufactured gas*

## 3 Construction and materials

### 3.1 Elastomeric materials

Elastomeric materials shall conform to BS EN 682 for the appropriate hardness class.

### 3.2 Body castings

Ductile iron body castings shall conform to GIS/C6. Coatings shall conform to **4.2**.

## 4 Design

### 4.1 General

Cap ends shall be designed to seal off the open ends of cast iron, ductile iron and steel pipes for a minimum of 50 years in the internal and external environments present in and around gas mains.

*NOTE: The use of the term 'internal' does not infer application inside a building, however if any caps were to be used inside a building, they would require (depending on the building type) fire testing to the relevant standards within Approved Document B.*

The design shall be capable of tolerating the effects of corrosive environmental conditions inclusive of:

- a. Internal ground conditions
- b. Partial or complete exposure to atmosphere

The design shall not require remediation, repair or replacement within its 50 year design life.

Cap end assemblies shall be constructed from materials and coatings (see Clause 4.2) that ensure a minimum 50 year design life.

Cap ends shall be capable of accommodating specified pipe movements (axial pull in accordance with Table 1 in Clause 5.1.5 and Annex A) and resisting specified loads without failure (vibration in accordance with Table 1 in Clause 5.1.5 and Annex B). Seals shall be of one-piece construction for sizes up to and including 300 mm.

**Cap ends up to a maximum of 300mm diameter shall be designed to ensure safe anchorage without end restraint for pressures up to a maximum of 75mbar. The guidance in section 9 is particularly important for these cap ends.**

Cap ends above 20 kg shall have the facility to allow lifting aids to be used.

*NOTE: Above this size vulcanization can be used to join the seal ends.*

### 4.2 Coatings

Cap Ends and Fasteners shall have factory applied corrosion resistance capable of tolerating the effects of corrosive ground conditions and full or partial exposure to atmosphere.

Cap Ends and Fasteners must undergo 1000 hours exposure to salt spray in accordance with ASTM B117. After exposure, no more than 5% of the surface area of the test samples shall exhibit red rust.

*NOTE: White corrosion deposits are acceptable.*

### 4.3 Maximum working pressure

The cap end shall be designed for a maximum operating pressure of 2 bar.

### 4.4 Temperature ranges

Cap ends shall be designed for the temperature range of  $-20\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$ .

### 4.5 Pipe diameters

Cap ends shall seal on the minimum and maximum outside pipe diameter tolerance range presented in Table 2, Annex F and be suitable for use on:

- a) vertically-cast iron pipe with nominal diameters of (75 mm) 3 in to 1200 mm (48 in) and shall be in accordance with BS EN 969;
- b) grey spun iron pipe with nominal diameters of (75 mm) 3 in to 1200 mm (48 in) and shall be in accordance with BS EN 969;



c) ductile iron pipe with nominal diameters of 80 mm to 600 mm and shall be in accordance with BS EN 969; and

d) steel pipe with nominal diameters of (75 mm) 3 in to (600 mm) 24 in and shall be in accordance with BS EN 10216-1 and BS EN 10217-1.

Cap ends for nominal pipe diameters of 80 mm to 300 mm shall be made from cast ductile material and shall be universal to fit across pipes of all materials (cast iron, ductile iron (spheroidal graphite cast iron) and steel pipes).

*NOTE: Cap ends for nominal pipe diameters of 350 mm to 1200 mm can be made from cast ductile material or fabricated from steel and will not be universal but can be manufactured to fit a particular type of pipe.*

#### **4.6 Bolt head and nut clearances**

Cap ends shall be designed to provide appropriate clearance for ring spanners, socket spanners and torque wrenches to be used for assembly of the particular diameter and type of cap end.

#### **4.7 Excavation**

The cap end assembly overall length and outside dimensions shall be designed to minimize the size of the excavation consistent with safety.

#### **4.8 Installation instructions**

The contractor shall supply the gas transporter with installation procedures.

The contractor shall supply installation guidance instructions and hazard notifications within the delivery package.

#### **4.9 Pipe surface preparation**

The contractor shall provide industry best practice guidelines for the preparation of pipe surfaces, achieved by normal hand cleaning methods prior to installation of the cap end. The preparation shall have no detrimental effect on the integrity of the pipe wall or the leak-tight sealing of the cap end on the main.

#### **4.10 Anchorage**

The design shall incorporate a facility to install, between the cap end and surrounding ground, a restraining strut against end loading caused by internal gas pressure.

*NOTE: This should normally be a flat end surface for struts or to a design agreed with the gas transporter.*

#### **4.11 Bolt torque**

The contractor shall specify bolt torque and bolt tightening sequence within all cap end installation instructions.

#### **4.12 Backfill time**

The design of the cap end shall be such that an excavation can be safely backfilled and the normal gas mains operating pressure applied immediately after installation.

#### **4.13 Dimensions**

Dimensions and general design of the cap end shall be sufficient to allow easy connection to the ends of the pipe and allow enough pipe penetration length to avoid pull-off of the cap end in service. This penetration length shall allow for any cut methods that may not leave the pipe with square ends such as on large diameter pipes. The tolerance range for sealing on the minimum and maximum outside pipe diameters is presented in Table 2, Annex F.

## 5 Type approval tests

### 5.1 General

#### 5.1.1 Test pipes

The test pipes shall be manufactured from steel pipe of adequate wall thickness to withstand all forces and pressures applied during testing

Pipe wall thickness shall be capable of incorporating surface defects as shown in Figure.1 and withstand all forces and pressures applied during testing.

Test pipes shall be dry and free of any surface contamination.

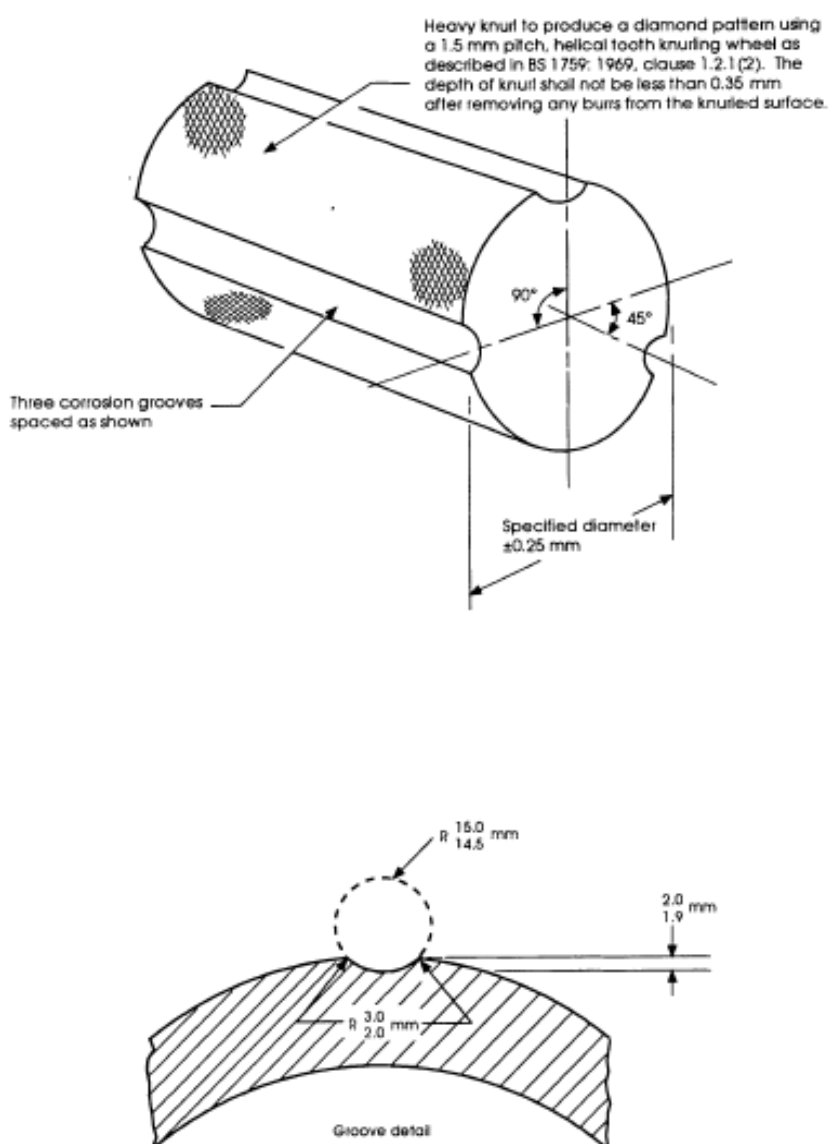


Figure 1. Surface defects of test piece

### 5.1.2 Test batch

Each of the specified tests shall be carried out on three cap ends assembled on maximum diameter test pipes and three cap ends assembled on minimum diameter test pipes, with the exception of the optional pressure life test, where the number of cap ends is specified in the appropriate clause. The tolerance range for minimum and maximum outside pipe diameters is presented in Table 2, Annex F.

### 5.1.3 Test pipe sizes

All tests shall be carried out using 150 mm (6 in) nominal size test pipes for the sizes up to 300 mm diameter for the cast product, provided that the gas transporter is satisfied that the design is suitable for the whole range of sizes 80 mm to 300 mm offered by the contractor.

Application tests shall be carried out on other sizes of cap ends specified by the gas transporter, and this will normally be a 450 mm mandrill or alternative arrangement as agreed with the gas transporter. Satisfactory performance shall then qualify the other sizes of cap ends in the particular range.

All tests shall be conducted with equipment which simulates actual working recommendations such as thrust blocks and restraining struts.

### 5.1.4 Number of cap ends and test time-scale

The number of cap ends and the time-scale for each test shall be in accordance with Table 1.

### 5.1.5 Assembly of cap ends

For each test, the cap end shall be assembled in accordance with the contractor's installation instructions on test pipes.

**Table 1** Summary of type approval tests

Test method	Parameter tested	Number of cap ends	Conditioning time	Approximate test duration
Annex C	Application	6	—	1 day
Annex D	Strength and distortion	6	—	1 day
Annex A	Axial pull	6	4 weeks	1 week
Annex B	Vibration	6	4 weeks	3 weeks
Annex E	Pressure/ life	24	—	6 months
Annex G	End Loading – 375 mbar	6	—	24 hours
	End Loading – 1 bar	6	—	1 hour

*NOTE 1: 5.1 and 5.2.*

*NOTE 2: The total test time is the sum of the test duration plus the conditioning time, where applicable.*

*NOTE 3: The times above apply to each test specimen. The total time will depend on the number of cap ends under test concurrently.*

## 5.2 Safety precautions

### 5.2.1 Responsibility

The contractor shall ensure that the specified system performance tests can be carried out with safety.

*NOTE: This standard calls for the use of substances and/or 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.*

### **5.2.2 Hydrostatic pressure test**

Before commencing the system performance tests, the pressure testing of all cap ends and test equipment to be used at 1.5 times the test pressure shall be conducted if agreed between the supplier and purchaser.

*NOTE: If necessary, the sealing components of cap ends may be replaced after the pressure test.*

### **5.2.3 Test precautions**

Care shall be exercised when an assembly for a performance test is pressurised and during the inspection of the pressurised assembly.

## **6 Production testing**

**6.1** Uncoated cap ends shall be pneumatically or hydraulically tested at 1.5 times the designed maximum operating pressure (MOP) for a minimum of 2 minutes to verify that pressure retaining components are fit for purpose and free from porosity, blow holes and inclusions.

## **7 Marking**

Products conforming to GIS/F13 shall also be permanently marked with the following information:

- a) the number and date of this standard, i.e. GIS/F13:2024 <sup>1)</sup>;
- b) the name or trademark of the manufacturer or their appointed agent (on end cap);
- c) the manufacturer's contact details;
- d) production date;
- e) production batch identification number (on end cap);
- f) model and serial number;
- 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.*

- h) pressure rating (on end cap);
- i) use by date;
- j) weight of fitting;
- k) nominal size; (on end cap);
- l) "ductile", "duct" or "S.G." (on end cap).

## **8 Packaging**

Packaging of cap ends shall be provided to prevent damage during storage, transit, and handling in the field. Constituents of cap end packaging shall not create contamination which can compromise normal anchorage procedure.

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<sup>1)</sup> Marking GIS/F13:2024 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.

NOTE: *Cap ends should be stored in their original packing. They should only be removed before installation in order to avoid contamination.*

### **9 Torque setting requirements**

The manufacturer shall ensure that sufficient information regarding the required torque settings for the cap ends are provided to users. In turn, Companies purchasing the cap ends shall ensure that procedures for installation expressly state the torque requirements and that appropriate tooling, to ensure this can be achieved and measured, is provided.

## **Annex A (normative)**

### **Axial pull test**

#### **A.1 Principle**

Ensure fitting can resist any axial pull that may be encountered in service by simulation methods of axial extension and pipe displacement.

#### **A.2 Apparatus**

**A.2.1** Test pipes, manufactured from steel pipe of adequate wall thickness to incorporate the surface defects as shown in Figure 1 and withstand all forces and pressures applied during testing and in test pipe sizes for diameters specified in Clause 4.5 and Annex F.

**A.2.2** Three cap ends, assembled on maximum diameter test pipes and three cap ends assembled on minimum diameter test pipes.

#### **A.3 Procedure**

**A.3.1** The standard test temperature for system conditioning and performance testing shall be  $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . The standard test pressure shall be 1.5 times maximum operating pressure (MOP).

**A.3.2** Assemble each cap end on a test pipe section and condition for four weeks at the standard test pressure. Pressurise with air or nitrogen through test pipe.

**A.3.3** Axially extend the test pipe and cap end, at atmospheric pressure, at a rate of  $1\text{ mm/min} \pm 0.1\text{ mm/min}$  until the displacement reaches 6.5 mm.

**A.3.4** Apply the standard test pressure and maintain the pressure and displacement for a period of seven days.

**A.3.5** Leakage shall be determined by checking with leak detection fluid or by immersion of the assembly in clear water.

#### **A.4 Test results**

No visible leakage shall be detected or any visible detrimental effect on the cap end assembly shall occur when the standard test pressure, axial pull and pipe displacement are maintained for a period of seven days.

## **Annex B (normative)**

### **Vibration test**

#### **B.1 Principle**

The ability of the cap end fitting to withstand vibration without any leakage or detrimental effect to actual cap end or its installation method is determined.

#### **B.2 Apparatus**

**B.2.1** *Test pipes*, manufactured from steel pipe of adequate wall thickness to incorporate the surface defects as shown in Figure 1 and withstand all forces and pressures applied during testing and in test pipe sizes for diameters specified in Clause 4.5 and Annex F.

**B.2.2** Three cap ends, assembled on maximum diameter test pipes and three cap ends assembled on minimum diameter test pipes.

#### **B.3 Procedure**

**B.3.1** The standard test temperature for performance testing shall be  $20\text{ °C} \pm 5\text{ °C}$ . The standard test pressure shall be 1.5 times maximum operating pressure (MOP).

**B.3.2** Assemble each cap end on a test pipe section and condition for four weeks at the standard test pressure. Pressurise with air or nitrogen through test pipe. Maintain the standard test pressure throughout the periods of vibration.

**B.3.3** Continuously vibrate the test pipes at a frequency of  $1\text{ Hz} \pm 0.1\text{ Hz}$  and peak to peak amplitude of  $0.25^\circ \pm 0.025^\circ$  between limits of  $3^\circ$  and  $3.24^\circ$  to the axis.

**B.3.4** With the cap end anchored, continuously vibrate the test pipes at a frequency of  $0.5\text{ Hz} \pm 0.05\text{ Hz}$  and peak to peak amplitude of  $0.75^\circ \pm 0.075^\circ$ , between limits of  $3^\circ$  and  $3.75^\circ$  to the axis.

**B.3.5** Maintain the standard test pressure after the period of vibration for a period of three weeks.

**B.3.6** Leakage shall be determined by checking with leak detection fluid or by immersion of the assembly in clear water.

#### **B.4 Test results**

The cap end assembly shall withstand  $40 \times 10^3$  cycles and no visible leakage shall be detected, or any visible detrimental effect on the cap end assembly shall occur, during these vibration tests.

**Annex C (normative)****Application test****C.1 Principle**

The leak tightness of the cap end at the required maximum or minimum operational pressures is verified. Also, the installation instructions for assembly and installation can be checked.

**C.2 Apparatus**

**C.2.1** *Test pipes*, manufactured from steel pipe of adequate wall thickness to incorporate the surface defects as shown in Figure 1 and withstand all forces and pressures applied during testing and in test pipe sizes for diameters specified in Clause 4.5 and Annex F

**C.2.2** Three cap ends, assembled on maximum diameter test pipes and three cap ends assembled on minimum diameter test pipes.

**C.3 Procedure**

**C.3.1** The standard test temperature for performance testing shall be  $20\text{ °C} \pm 5\text{ °C}$ . The standard test pressure shall be 1.5 times maximum operating pressure (MOP) and for low pressure application test a special test pressure of 20 mbar shall be used.

**C.3.2** Assemble each cap end, in accordance with the installation instructions, onto the test pipe.

**C.3.3** Pressurise with air or nitrogen through test pipe. Test each cap end using the standard test pressure for at least 24 h. During this test, assess the general practicability of the cap ends for site use.

**C.3.4** Test each cap end using the special test pressure of 20 mbar for the minimum operational pressure application test.

**C.3.5** Leakage shall be determined by checking with leak detection fluid or by immersion of the assembly in clear water.

**C.4 Test results**

**C.4.1** Each fitting shall pass both the standard test pressure and low minimum operational pressure test with no leakage detectable or any visible detrimental effect on any of the cap end assembly being tested.

**C.4.2** The fitting shall be deemed practicable for site use (see **C.3.3**).



## **Annex D (normative)**

### **Strength and distortion test**

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

The ability of the cap end to cope with the MOP and applied torques without leakage, distortion or other damage is determined.

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

**D.2.1** *Test pipes*, manufactured from steel pipe of adequate wall thickness to incorporate the surface defects as shown in Figure 1 and withstand all forces and pressures applied during testing and in test pipe sizes for diameters specified in Clause 4.5 and Annex F.

**D.2.2** *Three cap ends*, assembled on maximum diameter test pipes and three cap ends assembled on minimum diameter test pipes.

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

**D.3.1** The standard test temperature for system conditioning and performance testing shall be  $20\text{ °C} \pm 5\text{ °C}$ .

**D.3.2** Assemble each cap end on the pipe test section and tighten the bolt to a torque of 150 Nm. If the use of torque limiting devices is specified, the bolts shall be tightened to 1.5 times the contractor's recommended torque values.

**D.3.3** Pressurize with air or nitrogen through test pipe. Apply the standard test pressure of 1.5 times maximum operating pressure (MOP) and maintain for a period of 24 h.

**D.3.4** Leakage shall be determined by checking with leak detection fluid or by immersion of the assembly in clear water.

#### **D.4 Test results**

**D.4.1** No component of the fitting shall break, show evidence of any damage or have severe distortion.

**D.4.2** Each fitting shall pass both the torque test and standard pressure test with no detectable leakage and no visible detrimental effect on the cap end assembly being tested.

## **Annex E (normative)**

### **Pressure-life test**

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

The useful working life of a cap end is determined by conducting the pressure-life test.

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

**E.2.1** *Test pipes*, manufactured from steel pipe of adequate wall thickness to incorporate the surface defects as shown in Figure 1 and withstand all forces and pressures applied during testing and in test pipe sizes for diameters specified in Clause 4.5 and Annex F.

**E.2.2** Cap ends, twelve assembled on maximum diameter test pipes and twelve assembled on minimum diameter test pipes.

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

**E.3.1** The standard test temperature for performance testing shall be  $20\text{ °C} \pm 5\text{ °C}$ . The standard test pressure shall be 1.5 times maximum operating pressure (MOP).

**E.3.2** The test shall be carried out on twelve cap ends assembled on maximum diameter straight test pipes and twelve cap ends assembled on minimum diameter straight test pipes.

*NOTE: All 24 cap ends need not necessarily be under test simultaneously.*

**E.3.3** Apply the test procedure specified in **E.3.4** to **E.3.8** inclusive to each set of twelve cap ends.

**E.3.4** Subject three cap ends to a pressure which will ensure failure within 1 h. Pressurise with air or nitrogen through test pipe. Note the pressure at which failure occurs,  $P$ , and the time to failure,  $T_p$ . Plot the results on a log/log plot of pressure against time in minutes of the type shown in Figure 2.

**E.3.5** Pressurise three cap ends and hold at a pressure  $P_1$ , a second set of three cap ends at a pressure  $P_2$  and a third set of three cap ends at a pressure  $P_3$ .

**E.3.6** Establish pressure  $P_1$  by drawing a straight line joining the initial point ( $T_p, P$ ) to the 50 year/1.5 times specified maximum working pressure point.  $P_1$  shall be the pressure corresponding to six months on the time axis.

**E.3.7** Pressures  $P_2$  and  $P_3$  shall be determined to give points equidistant on a logarithmic scale between  $P_1$  and  $P$ .

**E.3.8** The duration of the tests shall be either six months or until failure occurs, whichever is the shorter period. Leakage shall be determined by checking with leak detection fluid or by immersion of the assembly in clear water.

#### **E.4 Expression of results**

The results obtained shall be plotted on the graph to show the failure band.

#### **E.5 Test results**

When the lower edge of the failure band is extrapolated to 50 years on the results graphs (see **E.3.4**), the corresponding pressure read off the graph shall not be less than 1.5 times the designed maximum recommended working pressure for the cap end assembly.

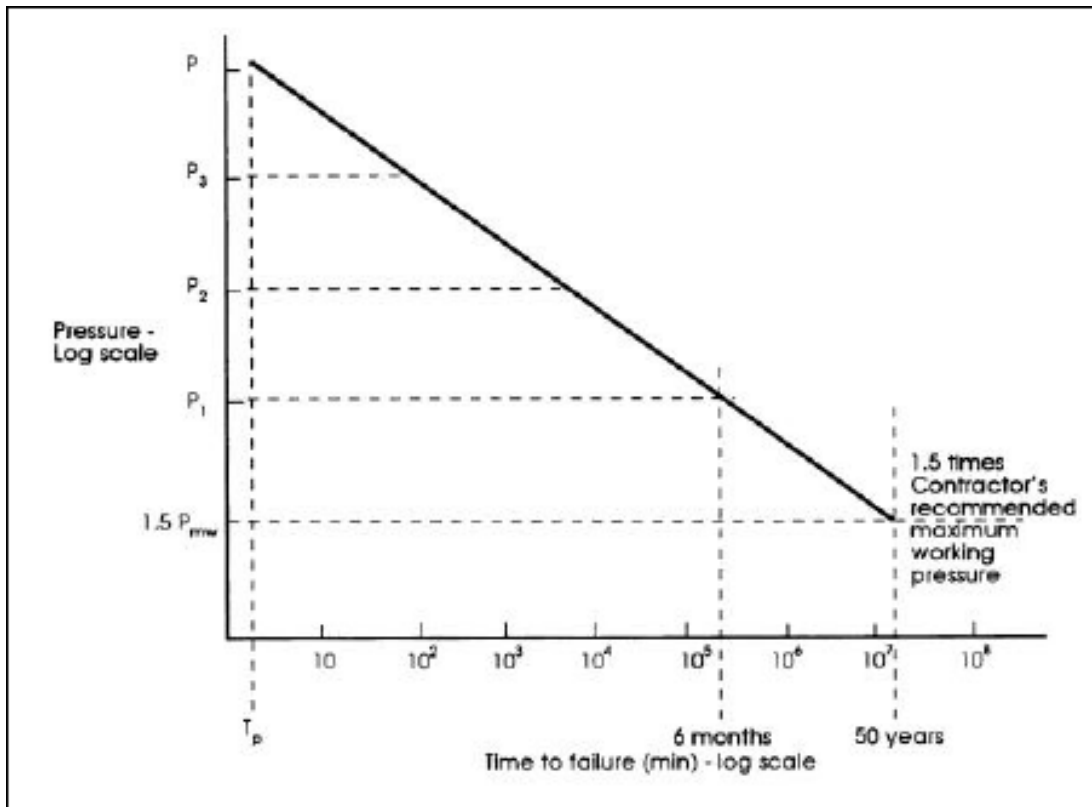


Figure 2 Pressure-life testing

**Annex F (normative)****Table of Nominal, Minimum and Maximum Pipe Diameters (Covering cast iron, ductile iron and steel pipes in all known diameters and wall thicknesses).**

In using Table 2 the following manufacturing tolerances shall be taken into account:

- Maximum pipe type is cast iron with a manufacturing tolerance of Nominal dia + or – 2mm.
- Minimum pipe type is steel with a manufacturing tolerance of + or – 1%.

Sealing Range on universal cast fittings up to 12in should ideally accommodate these manufacturing tolerances. Sealing range on fabricated fittings above 12in will be more restricted and will have dedicated sealing range to suit a callipered main size.

**Table 2** Nominal, Minimum and Maximum Pipe Diameters

<b>Pipe Nominal Diameter</b>	<b>Minimum Pipe Diameter</b>	<b>Maximum Pipe Diameter</b>		<b>Pipe Nominal Diameter</b>	<b>Minimum Pipe Diameter</b>	<b>Maximum Pipe Diameter</b>
80mm (3in)	88.9mm	98.0mm		500mm (20in)	508.0mm	560.3mm
100mm (4in)	114.3mm	122.0mm		525mm (21in)	571.5mm	587.2mm
125mm (5in)	139.7mm	149.9mm		550mm (22in)	559.0mm	613.7mm
150mm (6in)	168.3mm	177.3mm		600mm (24in)	610.0mm	667.0mm
175mm (7in)	193.7mm	204.7mm		700mm (27in)	711.0mm	746.8mm
200mm (8in)	219.1mm	232.2mm		800mm (30in)	813.0mm	826.0mm
225mm (9in)	244.5mm	259.1mm		900mm (36in)	914.0mm	984.5mm
250mm (10in)	273.0mm	286.0mm		1000mm (40in)	1016.0mm	1090.2mm
300mm (12in)	323.9mm	345.4mm		1200mm (48in)	1219.0mm	1300.5mm
350mm (14in)	355.6mm	399.3mm				
375mm (15in)	413.0mm	426.2mm				
400mm (16in)	406.4mm	453.1mm				
450mm (18in)	457.0mm	507.0mm				

## **Annex G (normative)**

**End loading test – For fittings (up to 300mm diameter only) where the manufacturer claims end restraint is NOT required for pressures up to a maximum of 75mbar**

### **G.1 Principle**

Cap end ability to maintain its integrity at test pressures without external restraint.

### **G.2 Apparatus**

**G.2.1** Test pipes shall be manufactured from steel pipe of adequate wall thickness to withstand all forces and pressures applied during testing.

The test pipes shall be without any surface defects.

Test pipes shall be dry and free of contamination.

The test pipes shall be 3"/80mm and 12"/300mm diameter as specified in Clause 4.5, Annex F, capable of withstanding all forces and pressures applied during testing.

**G.2.2** Three cap ends shall be assembled on maximum and minimum diameter test pipes. Test pipes shall be unrestrained, in free air and set vertically with the cap at the lower end. The cap must not be restrained or placed on the ground.

### **G.3 Procedure**

**G.3.1** The temperature for system conditioning and performance testing shall be as follows:

- 30 °C ± 2 °C
- -10 °C ± 2 °C.

**G.3.2** Assemble each cap end on the pipe test section and tighten the fasteners to the manufacturers minimum recommended torque for the diameter of the fitting.

**G.3.3** The position of the cap end shall be marked around the full circumference on the pipe to identify its initial location.

**G.3.4** Pressurise test pipe with air or nitrogen. Apply a test pressure of 375 mbar ± 10 mbar for a period of 24 hour. The pressure and temperature at the commencement of the test shall be recorded and continuously monitored and maintained throughout the duration of the test.

**G.3.5** Increase the test pressure in the test pipe to 1 bar ± 10 mbar for a period of 1 hour. The pressure at the commencement of the test shall be recorded and continuously monitored and maintained throughout the duration of the test.

**G.3.6** Leakage shall be determined by checking with an approved leak detection fluid or by immersion of the assembly in clear water and by detection of pressure loss during the test. No pressure loss shall be permitted.

**G.3.7** Following the leakage and observation test confirm relaxation of the bolt torques

***Note:** This test shall be repeated at the same torque setting for a second set of caps and a final test carried out with the caps fitted and tightened to half the manufacturers minimum recommended torque for the diameter of the fitting*

### **G.4 Test results**

**G.4.1** No component of the fitting shall break, show evidence of any damage, movement or have severe distortion.

**G.4.2** Each fitting shall pass the test with no detectable leakage, no movement and no visible detrimental effect on the cap end assembly being tested or release of test gas from the test pipe.

**G.4.3** Record the test pressure.

**G.4.4** Record the values of bolt torque settings at the beginning and end of each test.

Care shall be taken to accurately identify any change in torque by progressively retightening the bolts from at least 10Nm below the original setting at the end of the test.

**Safety**

Special precautions shall be taken in the test area to take account of the potential for release of the cap end, stored energy in the pipe, and all connections, etc. used in the pressure test.

## Annex H (Normative) Temperature (thermal) cycling test

### H.1 Principle

This test method assesses performance and stability of the cap end when subjected to temperature cycling.

### H.2 Apparatus

**H2.1** Test pipes, manufactured from steel pipe of adequate wall thickness to incorporate the surface defects as shown in Figure 1 and withstand all forces and pressures applied during testing and in test pipe sizes for diameters specified in Clause 4.5 and Annex F.

**F.0.1** Cap ends, two of each diameter assembled on same diameter test pipes.

**H.2.3** Temperature-regulated chamber(s), with an accuracy of  $\pm 2$  °C.

### H.3 Procedure

**H.3.1** The temperature range for temperature cycling test shall be  $-10$  °C to  $30$  °C.

**H.3.2** Each end cap shall be tightened on to the test pipe to the manufacturers minimum recommended bolt torque with no end restraint fitted.

**H.3.3** Leakage test pressure shall be 1.5 times maximum operating pressure (MOP) for LP systems (i.e. 112.5 mbar).

**H.3.4** The temperature cycling test shall be carried out on 2 samples of diameter (” / 150mm).

**H.3.5** The cycling shall be undertaken as follows:

- 1 hour at  $10$  °C.
- Increase temperature at  $1$  °C every 5 minutes until  $30$  °C is reached.
  - Sustain at  $30$  °C for 8 hours.
- Decrease temperature at  $1$  °C every 5 minutes until  $-10$  °C is reached.
  - Sustain at  $-10$  °C for 8 hours.
- Increase temperature at  $1$  °C every 5 minutes until  $10$  °C is reached.
  - Sustain at  $10$  °C for 20 minutes.

### H.4 Cycles

Each cap end sample shall be subjected to 2 full cycles as specified in H3.5

### H.5 Test Results

**H.5.1** No component of the fitting shall break, show evidence of any damage, movement or have severe distortion.

**H.5.2** Each fitting shall pass the test with no detectable leakage, no movement and no visible detrimental effect on the cap end assembly being tested or release of test gas from the test pipe.

**H.5.3** Record the test pressure.

**H.5.4** Record the values of bolt torque settings at the beginning and end of each test. Care shall be taken to accurately identify any change in torque by progressively retightening the bolts from at least 10Nm below the original setting at the end of the test. There shall be no leakage or movement of the cap end recorded.

### H.6 Safety

Special precautions shall be taken in the test area to take account of the potential for release of the cap end, stored energy in the pipe, and all connections, etc. used in the pressure test.

NOTE: The purpose of adding *temperature cycling testing to this specification is to address the periods where cap ends that are designed for below ground use are temporarily exposed to the elements following installation – this can often be for significant periods of time.*

## Annex I Summary of Rationale for changes to document – November 2024

GIS/F13 Clause	Comment & Rationale	Proposer	Action Required (if applicable)
Scope	<p>Addition to text to clearly state that the scope applies to cap ends for use below ground.</p> <p>Discussion on inclusion of temperature cycling testing identified that cap ends are exposed to elements, however this occurs temporarily, and the fittings are not designed for above ground use. It was determined to be necessary to reinforce the scope to state that cap ends are designed for use below ground.</p>		
Clause 4.1 & Annex G	<p>Following development of larger diameter self-anchoring cap ends (up to 300mm) for LP use, extensive testing has been undertaken on their suitability.</p> <p>Independent testing identified no issues with the increased sizes, however strict adherence to the required bolt torques was recommended. Some GT's have field tested and approved cap ends up to 300mm.</p> <p>References to diameter range for self-anchored cap ends for use at low pressure have been changed from 200mm to 300mm.</p>		
Scope; Clause 4.4; & Annex G	<p>A review meeting with BSi and The British Plastics Federation was held to discuss the suitability of current temperature ranges for testing considering recent extreme weather events. The review was inconclusive; however it was noted that GIS/LC1 has an elevated design temperature range in comparison and it was logical that F13 should align to that.</p> <p>Change design temperature range to –20 °C to 50 °C where applicable.</p> <p>Retain test specific temperature requirements.</p>		
Annex H	<p>In addition to temperature ranges the suitability and relevance of a temperature cycling test was discussed with BSi and The British Plastics Federation and later with a manufacturer. It was concluded that, despite the design for cap ends being used below ground, there is a need for temperature cycling due to the possibility that these fittings could be exposed for a significant time in some usage circumstances. The manufacturer also confirmed that this test is already undertaken as part of their regime. Reference to standards for similar products also included temperature cycling testing.</p> <p>Create new annex to detail temperature cycling test applicable to cap ends.</p>		



## **Bibliography**

BS 1759:1969, *Specification for knurling wheels.*