Gas Industry Standard

GIS/F12:2015

Specification for

Grouted tee connections for metallic mains operating at pressures up to 7 bar

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Classified as Internal

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.

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Brief history

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1 Scope

This Gas Industry Standard specifies requirements for grouted tee connections onto steel, cast or ductile iron gas pipes for the purposes of making hot tap, stopping off or permanent connections, operating at a maximum working pressure of 7 bar.

It applies to full encirclement split tees, attached to the pipeline by bolting together of split shells and then grouting the annular space between the assembled shells and outer surface of the pipeline. The connections are suitable for all gas industry distribution pipes:

- carbon steel distribution pipes of 2 in (50 mm) to 48 in (1 200 mm);
- cast iron pipe of 3 in (75 mm) to 48 in (1 200 mm) in accordance with BS 78:1917, BS 78:1938 and BS 78:1961;
- spun cast iron pipe of 3 in (75 mm) to 27 in (700 mm) in accordance with BS 1211:958;
- ductile iron pipe of 14 in (350 mm) to 24 in (600 m).

This Gas Industry Standard does not specify requirements for the manufacture of grouted tees, these are included in GIS/F11.

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 78-2: 1917, *Specification for cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings — Fittings.*
BS 78-2:1938, *Specification for cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings — Fittings.*

BS 78-2:1961, *Specification for cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings — Fittings.*

BS 1211:1958, *Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage.*

BS 4882, *Specification for bolting for flanges and pressure containing purposes.*

BS 4320, *Specification for metal washers for general engineering purposes — Metric series.*

BS 5400-2:1978, *Steel, concrete and composite bridges — Specification for loads.*

BS 7079-A3, *Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness — Preparation grades of welds, cut edges and other areas with surface imperfections — Preparation grades of welds, cut edges and other areas with surface imperfections.*

BS 7361-1:1991, *Cathodic protection — Part1: Code of practice for land and marine applications.*

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

BS EN 1092-1, *Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1 : Steel flanges.*

BS EN 12068:1999, *Cathodic protection — External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection — Tapes and shrinkable materials.*

BS EN 12954:2001, *Cathodic protection of buried or immersed metallic structures — General principles and application for pipelines.*

BS EN ISO 8501-2, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Preparation grades of previously coated steel substrates after localized removal of previous coatings.*

BS EN ISO 12944 (all parts), *Paints and varnishes — Corrosion protection of steel structures by protective paint systems.*

PD 5500:2015, *Specification for unfired fusion welded pressure vessels.*

Gas Industry Standards

GIS/PL3:2006, *Self anchoring mechanical fittings for polyethylene pipe for natural gas and suitable manufactured gas.*

National Grid standards

T/SP/C4, *Specification for ductile cast iron pipes cast in metal moulds.*

Gas Distribution Network standards

*/SP/CW/5, *Code of practice for the selection and application of field applied external pipework coatings.*

*/SP/CW/6-2, *Specification for the external protection of steel line pipe and fittings using fusion bonded powder and associated coating systems — Part 2: Factory applied coatings.*

*/SP/PA/10 *Specification for new and maintenance painting at works and site for above ground pipeline and plant installations.*

*/PR/WP/1, *Work procedure for weldability testing of pipe fittings for service at pressures above 7 bar.*

Where * denotes each gas distribution network reference.

American Petroleum Institute Standards
API 5L, *Specification for line pipe*

3 Terms and definitions

For the purposes of this standard the following terms and definitions applies.

3.1
grouted tee connection
fitting including the saddle seal, grout containment seal and grout

NOTE See Clause 4.

3.2
body shell
top or bottom half shells, excluding the branch pipe

4 Information to be supplied by the purchaser

The following information to be supplied by the purchaser shall be fully documented. For compliance with the standard both the definitive requirements specified throughout the standard and the following documented items shall be satisfied.

a) gas transporter enquiry/order number;

b) line pipe characteristics:

c) outside diameter of pipe (mm);

If the outside diameter of the pipe is not available, the nominal grouted tee connection size shall be based upon the nominal pipe size, see item e).

d) branch line pipe characteristics:
    1) outside diameter (mm);
    2) wall thickness (mm);
e) grouted tee connection nominal size:
    1) nominal shell diameter;
    2) nominal branch diameter;
f) type of grouted tee connection required:
    1) grouted tee stopple;
    2) grouted tee offtake/bypass connection;
    3) plug requirement;
g) working pressure (maximum) (bar);
h) type of branch flange:
    1) flat face;
    2) raised face;
    3) weld neck;
    4) slip on;
    5) rating;
    6) nominal size;
    7) standard;
i) orientation of installation:
    1) vertical tapping;
    2) horizontal tapping.
j) abnormal traffic loading conditions (yes/no):
    1) expected heaviest vehicle
    2) traffic frequency levels.

5 Design

5.1 Maximum working pressure

All grouted tee connections shall be suitable for operating at pressures up to 7 bar.

5.2 Temperature range

Grouted tee connections shall be designed to operate in the temperature range −5 °C to 30 °C.

5.3 Grouted tee connection configuration

Grouted tee connections shall comprise two semi-circular shells which are bolted in the horizontal flanges. The gap between the shell and main carrier pipe shall be between 6.5 mm to 27.5 mm.

The branch shall be perpendicular to the body shell.

5.4 Grouted tee connection life

Grouted tee connections shall provide an effective pressure containment seal for at least 50 years, in the internal and external environment present in and around gas pipes.

5.5 Grouted tee connection loads

5.5.1 *General*

Grouted tee connections shall be capable of accommodating internal pressure, subsequent pipe movements and resisting external applied loads without failure throughout the design life of the pipes or 50 years whichever smaller.

NOTE Grouted tee connections can experience stresses from installation loadings such as drilling and flow stopping combining with internal pressure.

The design factor for the combined loadings between pipe movements and internal pressure shall be 25 % of the minimum ultimate tensile strength of the linepipe.

There shall be no reinforcement from the existing pipe in the design of the grouted tee connections.

5.5.2 *Internal pressure loadings*

Grouted tee connections shall provide full pressure containment at 7 bar and also at hydrostatic proof test pressure of 10.5 bar.

NOTE Grouted tee connections can experience stresses from in service internal pressure (static and cyclic conditions).

Pressure cycles shall be within the stress range equivalent from atmospheric pressure to 7 bar and grouted tee connections shall be subjected to maximum pressure cycles of 195 000 from atmospheric pressure to 7 bar.

After maximum pressure cycles have been applied grouted tee connections shall be capable of withstanding an internal proof test level of 10.5 bar and after holding for 24 h there shall be no pressure drop. Effect of temperature changes of the surrounding environment shall be accommodated.

5.5.3 *Loadings due to ground and pipe movements*

NOTE In service, grouted tee connections can experience stresses from external loadings such as ground and pipe movements combining with internal service pressure equivalent to 7 bar.

Analysis of any external loadings shall be subjected to a unit load in accordance with Table 1 of the main carrier pipe, the orientation of the branch and internal pressure providing an equivalent combined stress level up to 25 % of the ultimate tensile strength of the main carrier pipe. This condition shall be held for a minimum of 24 h without any signs of internal pressure depletion.

The loading conditions for grouted tee connections shall be in accordance with Table 1.

Table 1 — External loading parameters

Load case no.	Load conditions		Fixed conditions	Bending moment, M_B			
				For pipe diameter range from 2 in (50 mm) up to 3 in (75 mm)	For pipe diameter range above 4 in (100 mm) up to 12 in (300 mm)	For pipe diameter range above 12 in (300 mm) up to 24 in (600 mm)	For pipe diameter range above 24 in (300 mm) up to 48 in (1 200 mm)
1	Loading on main header pipe	In plane bending	Tee branch in horizontal position (freely supported)	2.7 kN·m	22 kN·m	125 kN·m	667 kN·m
2		In plane torsion moment		1.3 kN·m	19 kN·m	115 kN·m	287 kN·m
3		Out-of-plane bending moment	Tee branch in vertical position (freely supported)	2.7 kN·m	22 kN·m	125 kN·m	667 kN·m
4		Out-of-plane torsion moment		1.3 kN·m	19 kN·m	115 kN·m	287 kN·m
5	Loading on tee branch	Branch bending moment	Main header pipe fixed	2.7 kN·m	4 kN·m	43 kN·m	130 kN·m
6		Branch torsion moment		N/A	7 kN·m	78 kN·m	269 kN·m
7		Branch axial loading by applying internal pressure after coupon removed		30.3 MPa	1.51 MPa	1.05 MPa	1.05 MPa

5.5.4 *Traffic loadings*

Testing of grouted tee connection, within each pipe diameter range specified in Table 2, shall be carried out with loading equivalent to a buried pipeline with a 1 m depth of soil cover using an embankment type condition where soil specific gravity shall be equivalent to 2 000 kg/m^3 and angle of internal friction shall be 30°.

The simulated installation is subjected to Highway bridge (HB) loading and shall be in accordance with BS 5400-2.

NOTE The loading in this analysis is equivalent to a heavy vehicle which has a total load of 11.2 tons travelling over a pipe main of 1 m depth, 82 times per day continuously for 50 years.

The grouted tee connection, within each pipe diameter range, shall be tested by subjecting it to stress levels in accordance with Table 2.

For grouted tee connections up to 12 in, a 12 in grouted tee connection shall be tested. For grouted tee connections up to 24 in, a 24 in grouted tee connection shall be tested. For grouted tee connections up to 48 in, a 36 in or 48 in grouted tee connection shall be tested.

Configuration shall be 3 point bend for fatigue loading. Equivalent combined stress shall act at the centre of the grouted tee connection. A frequency to alternate load between zero and maximum in a sinusoidal waveform for 1 500 000 cycles shall be applied.

NOTE The test specimen can be in the vertical or horizontal position.

Table 2 — Stress levels for traffic loadings

Pipe diameter in	**Maximum tensile stress** [a] MPa	
	Circumferential stress	**Longitudinal stress**
2 to ≤3	28	112
4 to ≤12	19.6	7.3
>12 to ≤24	29.4	10.2
>24 up to ≤48	62.6	12.6
[a] Stress values extracted from SURFLOAD™ computing analysis for cast iron pipes with diameter to wall thickness ratio up to 49.71 and Young's modulus of 98.8 GPa.		

5.6 Primary seal design specifications and material selection

5.6.1 *General*

The main function of the primary seal shall be to contain the line pressure during installation and in service loads. The seal shall sit on a grit blasted steel surface. The seal shall accommodate a large variation in outside diameter due to different grades of cast iron and ductile iron pipes.

If percentage of compression is required in the design then the same level of compression shall be specified in the installation procedures.

5.6.2 *Pressure containment specifications of the primary seal*

The primary seal shall conform to the following specifications:

- product operating internal pressure: 7 bar (without any grout in the annulus);
- fully installed grouted tee connection test operating pressure: 10.5 bar;
- cyclic duty: 150 000 cycles;
- seal operating temperature: Room (−25 °C to 50 °C);
- surface finish of pipe and shell: R_a = 12.5 µm to 75 µm;
- as-rolled grit blast: in accordance with BS EN ISO 8501-2, Grade Sa 3.

When tested in accordance with Annex B, the seal shall undergo the full 195 000 cycles between 7 bar and zero without leaking. After successful completion of this test the following details shall be noted and used in the design of the grouted tee connection:

a) nominal thickness of the seal;

b) percentage compression of the seal;

c) plan area and geometry of the seal (i.e. the surface area of seal laid over the pipe after the branch connection hole has been drilled through the seal).

5.6.3 *Seal's life specifications*

The design life of the primary seal shall be 50 years.

The seal shall be temperature resistant in the range from −25 ºC to +50 ºC.

The material shall also be moisture tolerant to cope with the formation of condensation on the pipeline surface, which can result from the combination of low pipeline temperatures and high atmospheric humidity.

5.6.4 *Preliminary seal design*

5.7 Horizontal bolted flanges

At the maximum loadings specified in **5.5**, any unit stresses in the horizontal bolted flanges shall not exceed 50 % of their yield strength.

5.8 Bolt head and nut clearances

All grouted tee connections with integral bolts and nuts shall be designed to provide clearance for ring spanners, socket spanners and torque wrenches used for assembly.

5.9 Stopping off plug

When the grouted tee connections are used in flow stopping operations or for the installation of a pig guide bar then a suitable stopping off plug, in the branch flange, shall be provided. Grout injection points, telltale holes and grout feed riser.

The grouted tee connection shall be designed to have grout injection near the bottom dead centre (BDC) of the pipe and risers near the top dead centre (TDC) of the pipe.

5.10 Primary saddle seal assembly

The primary branch seal assembly shall be designed to resist internal pressure loadings specified in **5.5.2** without any support from the grout.

Seals delivered to site shall be one piece and on site jointing shall not be undertaken.

Total compressive load of the seal shall not exceed 50 % of the specified minimum buckling or yield stress of the main carrier pipe whichever is smaller.

5.11 Design qualification tests

Small-scale tests for any particular design of the grouted tee shall be subjected to small-scale testing to validate larger size of grouted tee connections. Testing shall satisfy all loading conditions specified in Clause **5**.

6 Construction and materials

6.1 General

All materials shall conform to the relevant British Standard.

All materials shall be selected to ensure a minimum service life of 50 years of the grouted tee connections.

Selected materials of the main body of grouted tee connections shall conform to PD 5500. Sheet shall be cut so that the principal direction of rolling lies in the circumferential direction of the finish shells.

Sheets shall have an arrow showing the principal direction of rolling.

6.2 Branch flanges

Branch flanges shall be in accordance with BS EN 1092-1.

6.3 Fasteners and jointing materials

Bolts for fastening the body shells together shall be in accordance with Grade B7 of BS 4882.

Nuts for fastening the body shells together shall be in accordance with Grade 2H of BS 4882.

The washers for bolts shall be of BRT finish in accordance with BS 4320.

6.4 Elastomeric material

Elastomeric materials shall be in accordance with BS EN 682 for the appropriate hardness class.

6.5 Grout containment end seals

The grout containment seal shall be used only to prevent leakage during grout injection.

NOTE This can be elastomeric or certite putty.

6.6 Grout specification

Grout shall be designed primarily to resist combined structural loadings in **5.5**.

Grout shall not be designed primarily for containment of the fluid in the pipelines. Fluid containment shall be performed by the primary saddle seal.

Selected grout shall have the following properties:

- *potting time*: 30 min minimum
- *exothermic characteristics*: 15 °C maximum above ambient;
- *volume shrinkage*: 0.58 %;
- *working temperature range*: 5 °C to 45 °C;
- *tensile adhesion*: 12 MN/m^2 minimum at 22 °C;
- *compressive strength*: 62 MN/m^2 minimum at 22 °C;
- *viscosity*: 1 000 cP to 1 500 cP at 15 °C;
- *ultimate tensile strength*: 18 MN/m^2 at 10 °C;
- *tensile modulus*: 7 $GN/m^{2;}$
- *curing time*: 90 % of tensile strength after 12 h.

6.7 Weldability

The weldability of materials used for grouted tee connections shall be tested in accordance with */PR/WP/1.

7 Performance testing

7.1 General

All test instrumentation shall be traceable to national or international standards of measurement which, in the UK are the responsibility of the National Physical Laboratory.

7.2 Surface finish

Prior to any performance testing the inner surface area of the grouted tee shells, and the outside surface of the pipe to which it is attached, shall be grit blasted in accordance with BS 7079-A3, to achieve a surface finish of sa 2.5 quality.

7.3 Hydrostatic shell test

7.3.1 Each unique design and size of branch saddle, seal and flange shall be subjected to hydrostatic pressure testing. The pressure test shall be held for a period of not less than 30 min. The test pressure shall be 1.5 times the maximum working pressure. During this test there shall not be any leakage.

7.3.2 All test instrumentation used shall be covered by approved calibration certificates issued within the previous six months.

7.4 Static loading

7.4.1 Each unique design and size of branch saddle shall be fully installed and subjected to static loading in accordance with Table 1.

7.4.2 During the test, a pressure load of 7 bar shall be applied.

7.4.3 After static load testing the arrangement shall then be subjected to a pressure test of 1.5 times the maximum working pressure for a period of 30 min, during which there shall be no leakage.

7.5 Pressure cycling

7.5.1 Each design and size of grouted tee connection shall undergo a cyclic pressure test. The grouted tee shall be attached to the pipe in accordance with the installation procedure.

7.5.2 The cyclic loading shall alternate between 7 bar and atmospheric pressure for 195 000 cycles.

7.5.3 After cyclic loading the grouted tee connections shall be subjected to a pressure test of 10.5 bar and held for 24 h without experiencing any loss of pressure.

NOTE It may be necessary to compensate for the effects of changing external temperatures.

7.6 Dynamic traffic loading

7.6.1 As a minimum, one grouted tee connection within each size range specified in Table 2 shall be tested to qualify the other grouted tee connections in that particular range.

NOTE It is recommended that each unique design and size of branch saddle is subjected to dynamic loading as shown in Table 2.

The grouted tee shall be attached to the pipe in accordance with the installation procedure.

7.6.2 Each grouted tee connection to be tested shall be subjected to a 3-point bend configuration for fatigue loading corresponding to stress levels shown in Table 2. Equivalent combined stress shall act at the centre of the grouted tee connection. The applied loading shall alternate load between zero and maximum in a sinusoidal waveform for 1 500 000 cycles. Test specimens can be in the vertical or horizontal position so this shall be accounted for in the testing.

7.6.3 After dynamic load testing the grouted tee connection shall then be subjected to a pressure test of 1.5 times the maximum working pressure for a period of 30 min, during which there shall be no leakage.

7.7 Primary seal testing

7.7.1 A cyclic pressure test shall be carried out for each primary seal having a particular design, plan area, choice of material and degree of compression.

7.7.2 The seal shall be compressed between a representative pipe section and grouted tee in accordance with the installation procedure except that the test shall be carried out without any additional support from the presence of grout.

7.7.3 The following information shall be recorded:

- nominal thickness of the seal;
- percentage compression of the seal when fitted between grouted tee and pipe;
- the plan area and geometry of the seal (i.e. the surface area of seal laid over the pipe after the branch connection hole has been drilled through the seal).

7.7.4 The test arrangement shall be subjected a cyclic pressure test between 0 bar and 7 bar for 195 000 cycles with out leaking.

7.7.5 After the cyclic pressure load test the grouted tee connection shall then be subjected to a pressure test of 1.5 times the maximum working pressure for a period of 30 min, during which there shall be no leakage.

7.7.6 The results of the cyclic pressure test may be used to qualify a seal having a larger plan area as long as the design, material and degree of compression remain the same. If there is any variation in design, material or degree of compression then testing shall be carried out starting at **7.7.1**.

7.7.7 If the grouted tee connection is to be used in an above ground installation, then it shall be tested in accordance with GIS/PL3:2006, **6.9**.

8 Marking

8.1 Die stamped markings

Die stamped markings shall not be used.

8.2 Identification details

Products conforming to GIS/F12 shall be permanently marked with the following information:

a) the number and date of this Gas Industry Standard, i.e. GIS/F12:2007[1)];

b) the name or trademark of the manufacturer or their appointed agent;

c) the manufacturer's contact details;

d) grouted tee connection size: shell NB x branch NB;

e) design pressure in bar: 7 bar;

f) test pressure in bar: 10.5 bar

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.

[1)] Marking GIS/F12:2007 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.

Marking of details on grouted tee connections shall be by suitable means, and shall be clearly visible after coating. The method used shall be compatible with the grouted tee connection material and shall not have a deleterious effect on it.

9 Corrosion protection

9.1 Grouted tee connection for buried installations

9.1.1 Factory-coated grouted tee connections for buried installations shall be in accordance with */SP/CW/6-2.

NOTE It is only necessary to protect external surfaces.

9.1.2 If grouted tee connections are not factory coated, then all external surfaces of the installed grouted tee connection shall be in accordance with */SP/CW/5. Coatings shall also conform to BS EN 12068:1999. Furthermore where the grouted tee connection is not factory coated it shall be supplied bare and free from oil and metal turnings.

9.1.3 The installation shall be protected in accordance with BS EN 12954, and BS 7361-1, generally by the use of a sacrificial anode system.

NOTE If a sacrificial anode is used this allows a reduction in the frequency functional checks in comparison to an impressed current system.

9.2 Grouted tee connection for above ground installations

Grouted tee connections for above ground installations shall be in accordance with */SP/PA/10 and BS EN ISO 12944 (all parts).

NOTE It is only necessary to protect external surfaces.

Annex A (normative)
Type approval testing of grouted tee connections

A.1 Test pipes

The test pipes shall be manufactured in accordance with the following specifications:

- carbon steel distribution pipes in the nominal diameters ranging from 2 in (50 mm) to 48 in (1 200 mm) API-5L;
- cast iron pipes in the nominal diameters ranging from 3 in (75 mm) to 48 in (1 200 mm) in accordance with BS 78-2:1917, BS 78-2:1938 and BS 78-2:1961;
- ductile iron pipe in the nominal diameters ranging from 12 in (300 mm) to 24 in (600 mm) in accordance with */SP/C4.

A.2 Test batch

For pipes ranging from 2 in (50 mm) to 3 in (75 mm) tests shall be carried out on one grouted tee connection of any pipe diameter in this range.

For pipes ranging from 4 in (100 mm) to 12 in (300 mm) tests shall be carried out on one grouted tee connection on an 8 in (200 mm) pipe.

For pipes ranging from above 12 in (300 mm) to 24 in (600 mm) tests shall be carried out on one grouted tee connection on an 18 in (450 mm) pipe.

For pipes ranging from above 24 in (600 mm) to 48 in (1 200 mm) tests shall be carried out on one grouted tee connection on either 36 in (900 mm) pipe or 48 in (1 200 mm) pipe.

A.3 Types of test

Each batch of grouted tee connections specified in **A.1.2** shall be subjected to loading specifications in accordance with **5.5**.

Each batch of grouted tee connections shall be assembled on the test pipes and subjected to drilling when the test pipe is under pressure.

A.4 Number of grouted tee connections

Three specimens from each batch of grouted tee connections specified in **A.1.2** shall be tested. Assembly of grouted tee connections

Grouted tee connections shall be assembled in accordance with the contractor’s installation instructions.

A.5 Standard test temperature

The standard test temperature for system conditioning and performance shall be 20 °C ± 5 °C.

A.6 Standard test pressure

The standard test pressure shall be in accordance with **5.5.2**.

Each static pressure shall be held for a minimum of 1 h.

A.7 Failure criteria

A grouted tee connection shall be considered to fail when leakage occurs or when any individual component fail to meet its normal specified operating conditions.

A.8 Leakage testing

For leakage testing, the grouted tee connection assembly shall be pressurized with air or nitrogen. Depending on the design of grouted tee connection, the pressure shall be applied either through the test pipe or through a tapping in the wall of the grouted tee connection.

A.9 Leakage check

Leakage shall be determined by checking with a recommended leak detection fluid or by immersion of the grouted tee connection assembly in clear water.

NOTE This Gas Industry Standard calls for the use of substances 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

Annex B (normative)
Cyclic pressure test

B.1 Principle

The capability of the seal to withstand cyclic pressure loadings during its operational lifetime.

B.2 Apparatus

B.2.1 *Pneumatic pressure equipment,* capable of cyclically pressurizing the seal arrangement within the grouted tee branch between 0 bar and 7 bar for 195 000 cycles.

B.2.2 *Pressure monitor,* capable of recording pressures up to 10 bar.

B.2.3 *Flange,* to connect grouted tee outlet branch to pressure source.

B.3 Test sample

One grouted tee fully assembled in accordance with the manufacturer's fitting instructions but without being grouted. The size of the grouted tee shall be in accordance with Table B.1.

Table B.1 — Size of grouted tee to be tested

Range of grouted tee in	**Size of grouted tee to be tested** in
≥2 to ≤12	8
>12 to ≤24	18
>24 to ≤48	36

It shall not be necessary to drill a hole from the tee branch into the test pipe.

B.4 Procedure

Measure the thickness of the seal before assembling the grouted tee.

Connect the branch of the tee to the pressure source via the flange attached to the branch of the grouted tee.

Cyclically raise the pressure in the branch from 0 bar to 7 bar and then from 7 bar back to 0 bar. Repeat this pressure cycle for a period of 195 000 times.

At the end of the cyclic test period raise the pressure to 10.5 bar and hold this pressure for a period of 30 min and record any pressure drop.

Disconnect the grouted tee from the pressure source and disable the grouted tee.

Remove the seal and measure the thickness of the seal.

B.5 Expression of results

Record the nominal thickness of the seal before assembling within the grouted tee (mm).

Record the nominal thickness of the seal after the cyclic test and removal from the grouted tee (mm).

Record the number of pressure cycles that the seal was subjected to (cycles).

Record the cyclic test pressures (bar).

Record the frequency (Hz).

Record the test pressure held for 30 min after the cyclic pressure test and record any pressure lost (bar).

B.6 Test report

The test report shall include the following information:

a) reference to this Gas Industry Standard, i.e. GIS/F12;

b) the results of the determination;

c) any additional factors which may have affected the results of the test.

Bibliography

Gas Industry Standards

GIS/F11:2115, S*pecification for the manufacture of grouted tee connections for metallic mains operating at pressures up to 7 bar.*

Institution of Gas Engineers and Managers standards

IGEM/TD/1, *High Pressure Pipelines*.

IGE/TD/12**,** *Pipework stress analysis for gas industry plant*.