Gas Industry Standard

GIS/LC25:2006

Specification for

External sealant injection systems for joint repair on metallic distribution pipe operating at pressures of 2 bar or less

nationalgrid

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WALES&WEST UTILITIES

Contents

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/LC25 Editorial update to reflect merger October 2002 Editorial update to comply with GRM Edited by BSI in accordance with BS 0-3:1997	September 2002 November 2002 August 2006

1 Scope

This Gas Industry Standard (GIS) specifies requirements for flexible joint penetrating sealant repair systems for external application to ferrous distribution pipes with either lead/yarn or mechanical type joints, operating at a maximum working pressure equal to or less than 2 bar, in areas where pipe movement might be experienced. It also details the tests carried out in evaluating a repair system.

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

BS 903-A26:1995, *Physical testing of rubber — Part A26: Method for determination of hardness (hardness between 10 IRHD and 100 IRHD).*

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

BS EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories.*

BS ISO 1817, *Rubber, vulcanized — Determination of the effect of liquids.*

Gas Industry Standards

GIS/PL2-1, *Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas — Part 1: General and polyethylene compounds for use in polyethylene pipes and fitting*.

Government specifications

New Roads and Street Works Act 1991: Specification for the reinstatement of openings in highways [1]

3 Terms and definitions

For the purposes of this GIS the following definitions apply.

3.1
low pressure
operating pressure not greater than 75 mbar

3.2
medium pressure
operating pressure greater than 75 mbar but not greater than 2 bar

3.3
International Rubber Hardness (IRHD) (taken from BS 903-A26:1995)
hardness scale chosen so that “0” represents the hardness of material having a Young’s modulus of zero and “100” represents the hardness of a material of infinite Young’s modulus, with the following conditions being fulfilled over most of the normal range of hardness:

a) one international rubber hardness degree always represents approximately the same proportionate difference in the Young’s modulus

b) for highly elastic rubbers, the scales of IRHD and the Shore A durometer are comparable

4 Sealant grades

4.1 Sealant grades

The minimum possible number of sealant grades shall be used.

5 Design

5.1 General

5.1.1 Both one-part and two-part (i.e. base plus additive) sealant systems may be used. Foams or friable materials may not be used.

5.1.2 The sealant shall be non-biodegradable.

5.1.3 The sealant shall still fully conform to all the requirement of this GIS at the end of the specified shelf life.

5.1.4 There shall be no adverse effect on the sealant when it is in contact with common substances found pipes, including monoethylene glycol, diethylene glycol, water, light lubricating oil and distillate.

NOTE This list is non-exhaustive.

5.1.5 The sealant shall remain stable within the temperature range -20 °C to +50 °C.

5.1.6 ***Effect on rubber: hardness and swell***

The sealant shall not have any deleterious effects on the material properties of any elastomeric components in the pipe:

a) Hardness: the change in hardness value after immersion in the sealant for 7 days shall not be greater than 5 IRHD.

b) Swell: the volume change after immersion in the sealant for 7 days shall not be greater than 20 %, as determined by the method specified in BS ISO 1817.

5.1.7 There shall be no adverse chemical effects (e.g. dissolution or softening) by the reacted sealant or by unreacted components when used on polyethylene pipe.

5.1.8 The test for stress corrosion cracking shall be performed according to the method given in Annex A.

5.2 Safety

All materials used in the repair system shall be subjected to a COSHH assessment, to determine if there any hazards and or special handling requirements.

NOTE Attention is drawn to The Control of Substances Hazardous to Health Regulations 1994 [2].

NOTE Guidance is given in the introduction of T/PR/EM/74.

5.3 Site conditions

Repair systems shall be suitable for application under all normal site conditions.

The cured material shall be designed for preferred in-service temperature ranges of -5 °C to 20 °C for in-ground use, and -20 °C to 50 °C for above-ground use.

5.4 Contractor's recommended maximum working pressure

The sealant system may be designed for use at either 75 mbar or, preferably, 2 bar. The contractor shall inform the gas transporter of the recommended maximum working pressure.

5.5 Excavation

The repair system shall be designed to minimize the size and amount of excavation.

5.6 Surface preparation and cleaning

It shall be possible to apply the repair system without special surface preparation.

5.7 Quality control specification

5.7.1 For each complete repair system an individual materials specification or quality control specification shall be drawn up by the contractor.

5.7.2 These supplementary specifications shall be produced as separate documents and shall only be available to the contractor for the specific system to which they apply and the gas transporter.

6 Operation and test requirements

6.1 General

The contractor shall submit a general written description of the proposed repair system to the gas transporter, which shall include information on the range of pipe diameters, types of joint and fittings, pipe pressures and ambient conditions for which the repair system is considered suitable.

The introduction of a repair system into use shall follow the procedures specified in **6.2** and **6.3**.

6.2 Operation and tests

6.2.1 The contractor shall prepare full fitting instructions.

6.2.2 Tests to demonstrate the practicability of the repair system and show that the application meets the requirements of **7.3.1, 7.3.2** and **7.3.3** shall be carried out by the contractor and witnessed by the gas transporter or their representative(s), or alternatively carried out by an independent laboratory accredited to BS EN ISO/IEC 17025**.**

6.2.3 The following system performance tests shall be carried out:

a) Security of injection points terminations (**7.4.1**).

b) Pressure (**7.4.2**).

c) Deflection (**7.4.3**).

d) Vibration (**7.4.4**).

e) Axial pull (**7.4.5**).

f) Field application (**7.5.1**).

g) Post repair leakage testing (**7.5.2**).

6.2.4 A minimum of three field demonstrations shall be carried out by the contractor, spanning the range of pipe sizes and joint types.

NOTE The gas transporter will make the field sites available during the testing programme.

The testing programme is intended to verify, under field conditions:

a) the general practicability of the repair system and to confirm a safe method of application as specified in the contractor's fitting instructions (see **6.2.1**);

NOTE T/PR/EM/74 gives details of joint configurations that will be encountered in practice.

b) the effectiveness of leak sealing in the short term under different ambient conditions.

6.2.5 The quality control specification given in **5.7** shall apply.

6.2.6 A report confidential to the gas transporter or its representatives and the contractor shall be prepared by the contractor at the conclusion of the testing and shall include the technical performance of the repair system, in both laboratory and field applications, and other information including operating instructions, drawings, safety data sheets, etc., as required by the gas transporter.

7 System performance testing

7.1 General

7.1.1 All test work in Clause **7** shall be carried out using cast iron pipe joints with a minimum nominal diameter of 6 in (150 mm), of a design conforming to BS 1211 and BS EN 969, except for field evaluation (see **7.5.1**), which shall cover the range of pipe sizes recommended for the system.

7.1.2 Joints shall be repaired in accordance with the contractor's fitting instructions (see **6.2.1**). Care shall be taken to inject the sealant in such a manner that ensures the whole of the joint is treated (to prevent drain down).

7.2 Preparation of test joints

7.2.1 *Standard lead/yarn joint*

The test joint shall be prepared as follows:

a) Cleaning of the surfaces to be in contact with sealant by grit blasting to produce a uniform surface with no oxides or other coatings.

b) Insertion of the spigot into the socket: contact between the end of the spigot and the socket shall be prevented by insertion of three cardboard spacers with a thickness of 0.25 in at approximately 120° intervals.

c) Three turns of standard 11-strand or 13-strand 5/8 in (16mm) yarn packed into the joint annulus and tamped down to 38 mm from the end of the socket face.

d) Lead poured into the joint to fill the annulus completely and caulked into the joint until the joint is leak tight at the appropriate test pressure.

e) At normal (standard) temperature and pressure (STP), a leakage rate of between 20 l/h and 40 l/h (for 75 mbar) or between 100 l/h and 160 l/h (for 2 bar) established by shock impact with a wooden block and hammer.

7.2.2 *Standard mechanical joints*

The standard test joint shall be a Stanlock joint, sealed with a lead or nylon tipped rubber gasket. It shall be prepared as follows:

a) Made up and tightened to a torque of 68 Nm, held for a period of 24 h.

b) The bolts completely slackened and the test joint allowed to relax for 24 h.

c) After this time, the test joint re-tightened evenly until a leakage rate of between 20 l/h and 40 l/h (for 75 mbar) or between 100 l/h and 160 l/h (for 2 bar) is established.

7.2.3 Where injection point terminations are engineered to create a durable seal, it shall be subject to an additional test. An additional injection point termination shall be fitted to the wall of the pipe so that when the joint (whether a lead yarn joint or a standard mechanical joint) is tested in accordance with **7.5.2**, the injection point termination will also be subject to the test pressure.

7.2.4 *Conditioning*

All joints shall be conditioned at ambient temperature for seven days following sealing (no leakage shall be permitted after sealing).

7.3 Repair application

A joint of each type shall be tested.

Not more than two 0.4 in (9 mm) maximum diameter holes shall be drilled and tapped to 1/8 in (3 mm) BSP at the back of the joint socket.

A test joint of each type shall be sealed at -5 °C and 30 °C. Joints and sealing materials shall be stored for a minimum of 12 h at the appropriate test temperature before sealing.

The means, volume and rate of injection and sealing of injection points shall be that recommended in the contractor's fitting instructions (see **6.2.1**).

All joints shall be conditioned at ambient temperature for seven days following sealing.

7.4 Performance tests

7.4.1 *Test for the security of injection point terminations*

The termination fitting shall be inspected and tested (see **7.2.3**) to ensure that it will provide a durable and permanent seal.

Where the integrity of the repair clearly depends upon the presence of cured resin blocking the bore of the injection point termination, the termination fitting shall not have any additional closure elements fitted during any of the subsequent tests outlined in **7.4**.

7.4.2 *Pressure test*

7.4.2.1 *Short term internal pressure test*

Three test joints of each type shall be maintained at an internal pressure of twice the maximum working pressure for 2 weeks.

There shall be no measurable leak from the joint or the termination fitting.

7.4.2.2 *Short term external pressure test*

Three test joints of each type shall be subjected to an external hydrostatic pressure of 5 × maximum working pressure for 1 week.

No failure shall occur. This shall be ascertained by removing the external hydrostatic pressure and applying air at an internal pressure of twice the maximum working pressure. There shall be no pressure drop. An example of suitable test apparatus is shown in Figure 1.

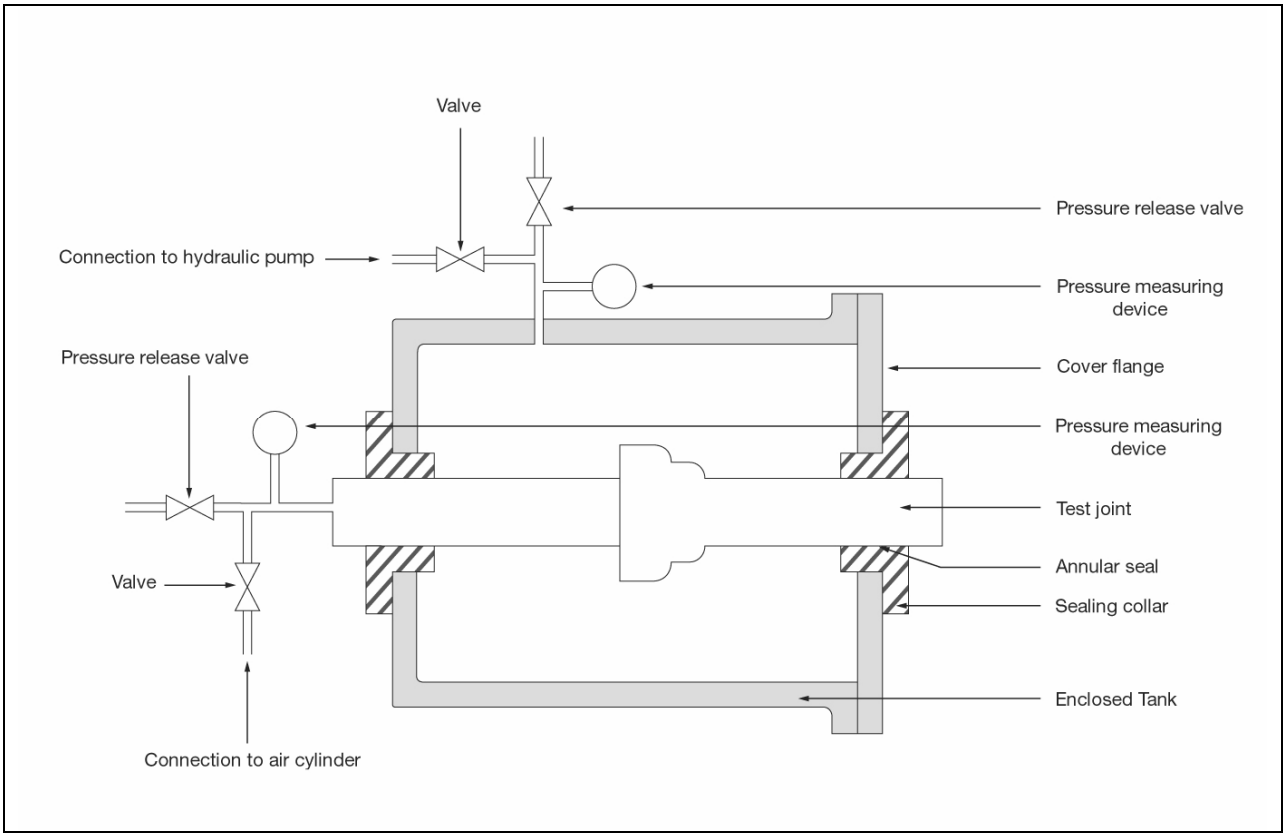


Figure 1 — Short-term external pressure test apparatus

7.4.3 *Deflection test*

Three test joints of each type shall be deflected from 0° to 5° at a rate of 1° per min. Maintain at 1.5 × the maximum working pressure for 1 week.

During and at the completion of each test the leakage rate shall not exceed 2.8 l/h.

7.4.4 *Vibration test*

Three test joints of each type shall be vibrated at both of the angular deflection figures given as follows:

a) 0° to 0.25° at 1 Hz for 10^6 cycles;

b) 0.25° to 0.75° at 1 Hz for 40,000 cycles.

After each vibration test maintain at 1.5 × the maximum working pressure for 1 week.

During and at the completion of each test the leakage rate shall not exceed 2.8 l/h.

7.4.5 *Axial pull test*

Three test joints of each type shall be extended axially by 6.0 mm at a rate of 1 mm/min. Maintain at 1.5 × the maximum working pressure for 1 week.

During and at the completion of each test the leakage rate shall not exceed 2.8 l/h.

7.5 Site tests

7.5.1 *Field application test*

A minimum total of 150 joints, spanning the range of pipe sizes and joint types specified by the contractor, shall be sealed. These repairs shall be normally actioned, including a minimum of 10 joints greater than 12 in (300 mm) but less than 24 in (600 mm) nominal diameter, and two joints equal to or greater than 24 in (600 mm) nominal diameter. The application success rate shall be greater than 95 % i.e. only two repair failures shall be permitted.

Wherever possible, joints shall be excavated to expose the socket face without disturbing the original bed of the pipe.

All repaired joints shall be logged using the pro-forma in Annex B and copies of the pro-forma shall be sent to the contractor. All repaired joints shall be tagged, using a non-degradable material, containing the following information:

- product name;
- batch or serial number;
- date.

7.5.2 *Post repair leakage testing*

The repair shall be carried out on a minimum of 6 in (150 mm) nominal diameter cast iron pipe joints. The pipes shall be sealed on site by the contractor, using the recommendations and instructions for the application of the joint sealant. After repair, the joint shall be tested for leakage using approved leak detecting fluid or with approved gas detection equipment. There shall be no gas leakage.

The repaired joints shall be backfilled and reinstated in accordance with the *New Roads and Street Works Act 1991: Specification for the reinstatement of openings in highways* [1]. Care shall be taken to avoid hitting or damaging the sealant injection fittings in the joint.

Within 48 h of the completed reinstated repair the area shall be surveyed using Flame Ionisation Machine equipment. If leakage is detected, further investigation of the leakage shall be undertaken.

The tests shall be carried out on three lead/yarn and three mechanical joints.

8 Marking

Products conforming to GIS/LC25 shall be permanently marked with the following information:

a) the number and date of this standard, i.e. GIS/LC25:2006 [1)];

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

c) the manufacturer's contact details;

d) 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/LC25:2006 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.

Annex A (normative)
Environmental stress cracking of polyethylene pipe

A.1 Principle

This test is used to determine the ability of joint penetrating sealants to promote environmental stress cracking in polyethylene pipe.

For two-part sealants, each part is tested separately.

A.2 Apparatus

A.2.1 *250 ml airtight glass container.*

A.2.2 *Polyethylene pipe,* 25 mm in diameter (SDR 11 polyethylene conforming to GIS/PL2-1).

A.2.3 *Nylon cable ties.*

A.2.4 *Razor blade.*

A.2.5 *Magnifying glass,* low magnification level (×10) with an illumination lamp.

A.3 Procedure

A.3.1 Cut four test pieces, each 12.7 mm wide from the pipe (see Figure A.1).

A.3.2 Cut a notch 19 mm long and 0.64 mm deep in each ring using the razor blade, as indicated in Figure A.1. Place the notch in the centre of the ring and parallel to the edge.

A.3.3 Compress the rings until the inner section of the middle areas touch. Secure this compression using a nylon cable tie. During compression, place the notched area parallel to the direction of compression, i.e. on the short radius (see Figure A.1).

A.3.4 Immediately immerse three of the rings (the fourth ring being the control sample) into 125 ml of the unreacted liquid component in a 250 ml capacity sealed glass container, maintained at a temperature of (23 ± 2) °C.

A.3.5 Examine samples for crack initiation in the notched area after one week, one month and four months, using the magnifying glass. Compare with control sample.

A.4 Results

No cracking shall be observed

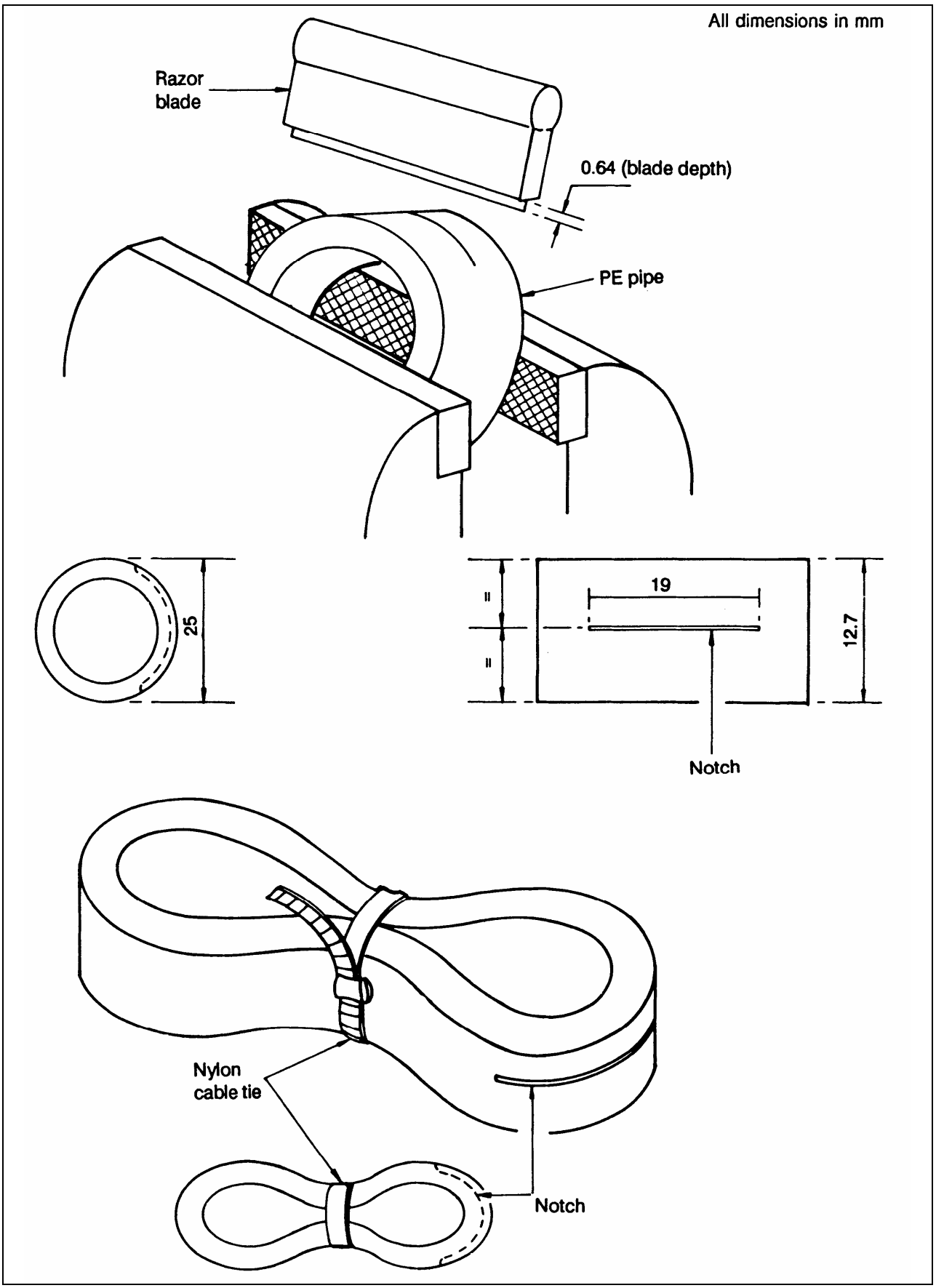


Figure A.1 — Test pieces for environmental stress cracking test

Annex B (normative)
Application log sheet proforma

FIELD APPLICATION TEST REPORT

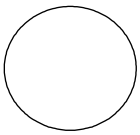
For completion on application of repair

General information

JV/Serial no.....
Cross reference.....
Date of repair.....
Name of Team Leader.....
Direct Labour/Contractor (Please circle)
Name of Contractor……..
Job Address.....
.....
.....
Source of report PRE / Survey / Other
(if Other please specify).....

Information concerning leakage

Position of Leakage



Whole joint face YES/NO
Leakage rate (please circle) :
Small foam / large bubbles /
Sound of escaping gas

Sealant information

Grade.....
Volume .....
Installation temperature (please circle)
Very cold / cold / warm / very warm / hot

Joint information

Type of joint.....
Nominal diameter.....
System pressure.....
Location (please circle) :
Footpath / Carriageway / Verge / Other
(if Other please specify).....

Repair information

Repair method (Please circle)
Through lead/back of socket/Both

Approx. time to inject.....

Result (please circle) **:**

Completely sealed / Slowed but did not stop /
No effect.

General Comments .....
.....
.....
.....

For completion on re-repair

Original repair method.....
.....

A COPY OF THIS TEST REPORT SHALL BE RETAINED BY THE CONTRACTOR

Bibliography

National Grid standards

T/PR/EM/74, *Work procedures for locating and repairing gas escapes on the network operating at pressures not exceeding 7 bar.*

Other publications

[1] GREAT BRITAIN. *New Roads and Street Works Act 1991: Specification for the reinstatement of openings in highways.* Second edition. London: TSO.

[2] GREAT BRITAIN.The Control of Substances Hazardous to Health Regulations 1994. London: TSO.