Gas Industry Standard

GIS/LC12:2013

Specification for

Sealant systems for joint repair on metallic distribution pipe systems operating at pressures equal to or less than 2 bar, buried in locations subject to low traffic loadings (minor roads and footpaths)


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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

Originally designated PS/LC8: Part 5; re-designated as PS/LC12: Part 1 by MOSC	October 1986
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1 Scope

This Gas Industry Standard (GIS) specifies requirements for joint penetrating repair systems, for internal or external application, to pipes using either lead/yarn or mechanical type joints and operating at a maximum working pressure equal to or less than 2 bar.

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 ISO 48:2010, *Rubber, vulcanized or thermoplastic. 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*.

Individual Gas Distribution Network Standards

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

* = Denotes each gas distribution network reference

Government standards

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) (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 Materials

4.1 Sealant grades

The number of sealant grades shall be kept to a minimum.

4.2Properties for materials applied internally by spraying

4.2.1 *Viscosity*

When tested in accordance with Annex A the kinematic viscosity shall not be less than 2 mm^2/s (2 centistokes) or greater than 5 mm^2/s (5 centistokes) at 25 °C.

NOTE 1 mm^2/s = 0.01 Stokes

4.2.2 *Surface tension*

When tested in accordance with Annex B the surface tension shall not be less than 25 mN/m or greater than 30 mN/m at 25 °C.

4.2.3 *Reactivity*

When tested in accordance with Annex C the sealants shall start to cure in not less than 6 h or more than 48 h in temperatures from 5 °C to 20 °C.

4.2.4 *Stability*

When tested in accordance with Annex D product stability shall be such that the gel time is greater than 30 min. The test shall be carried out at 82 °C in non-anaerobic conditions. The test shall be carried out on the base sealant only, i.e. no accelerator shall be added.

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 in 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 should not have any deleterious effects on the material properties of any elastomeric components encountered in the pipeline:

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 individual 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 E.

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

Methods of handling and injection equipment shall not fail under normal operation.

NOTE 2 Guidance is given in the introduction of */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 a preferred in-service temperature range 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.

6.2.3 The following system performance tests shall be carried out:

a) security of injection points terminations (**7.5.1**);

b) pressure (**7.5.2**);

c) deflection (**7.5.3**);

d) vibration (**7.5.4**);

e) axial pull (**7.5.5**);

f) field application (**7.6.1**);

g) post repair leakage testing (**7.6.2**).

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 Attention is drawn to */PR/EM 74, which 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;

c) the costs involved.

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 both BS 1211 and BS EN 969, except for field evaluation (see **7.6.1**), 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 (16 mm) 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 prepared as follows:

NOTE Test joints found within the gas distribution system are usually Stanlock joints, which are sealed with a lead or nylon tipped rubber gasket.

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 for external joint injection

7.3.1 *Lead/yarn and mechanical joints*

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.

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**).

7.3.2 *Temperature application*

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.

7.4 Repair application for internal anaerobic joint spraying

7.4.1 Set up the joint in accordance with the contractor's fitting instructions (see **6.2.1**) so that the sealant can be applied internally to the joint.

7.4.2 Pressurize the test joint with nitrogen. For low pressure systems the pressure shall be 75 mbar. For medium pressure systems the pressure shall be 2 bar.

7.4.3 Apply the sealant internally to the joint in accordance with the contractor's fitting instructions (see **6.2.1**) and with */PR/EM74.

7.4.4 Seal a test joint of each type (lead yarn and mechanical joint) at -5 °C and 30 °C. Store joints and sealing materials for a minimum of 12 h at the appropriate test temperature before sealing.

7.5 Performance tests

7.5.1 *Test for the security of injection point terminations*

Termination fittings applied in accordance with **7.3** shall be inspected and tested (see **7.2.3**) to ensure that they 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 **7.6**.

7.5.2 *Pressure test*

7.5.2.1 *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.

7.5.2.2 *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.

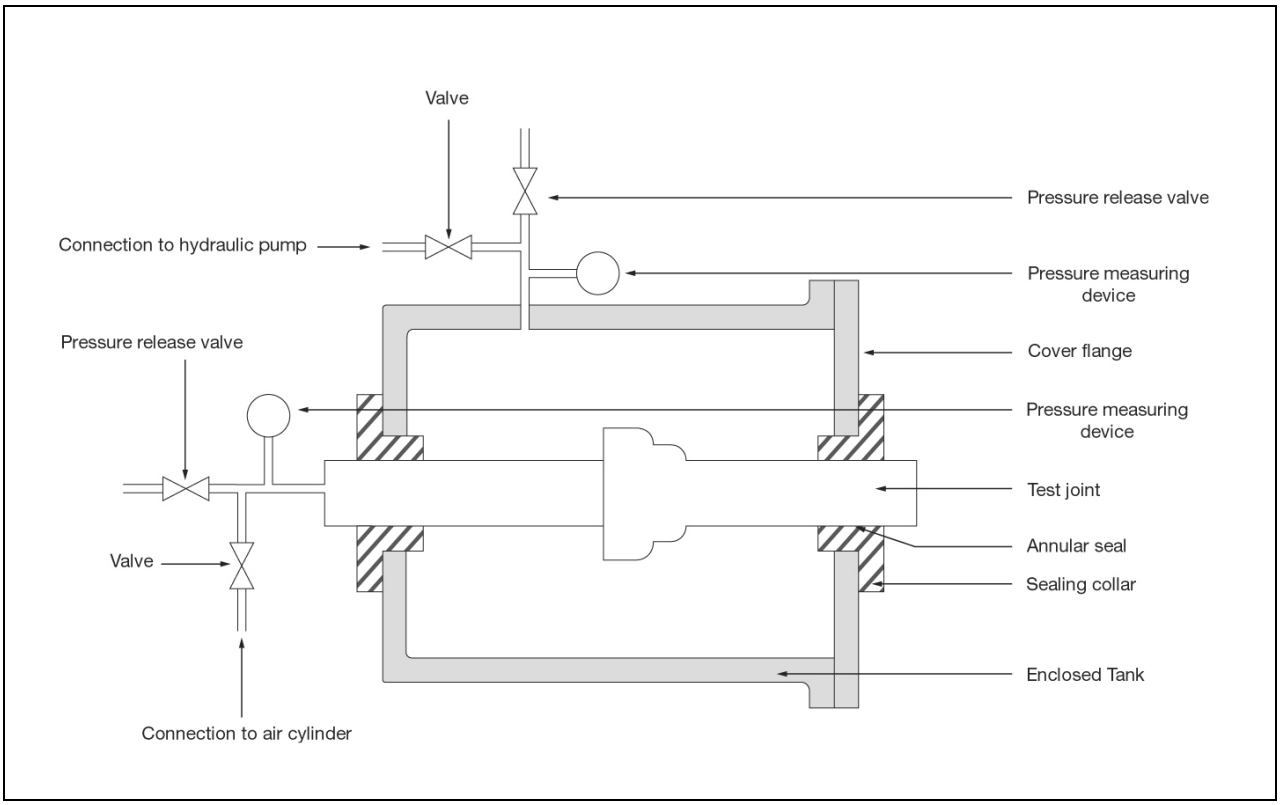


Figure 1 — Short-term external pressure test apparatus

7.5.3 *Deflection test*

Three test joints of each type shall be deflected from 0° to 0.5° in 0.1° increments at 2 h intervals and the leakage rate shall be monitored at each deflection. The test shall be terminated after 2 h at the maximum deflection of 0.5°.

There shall be no leakage from these joints between 0° and 0.1°, and between 0.1°and 0.5° the leakage rate shall not exceed 2.8 l/h.

7.5.4 *Vibration test*

Three test joints of each type shall be vibrated through 0.1° for up to 0.5×10^6 cycles at a frequency of (1 ± 0.1) Hz and the leakage rate monitored.

There shall be no leakage from these joints between 0×10^6 cycles and $0.3^{o} \times 10^6$ cycles, and between 0.3×10^6 cycles and 0.5×10^6 cycles the leakage rate shall not exceed 2.8 l/h.

7.5.5 *Axial pull test*

Three test joints of each type shall be extended axially by 0.3 mm at a rate of 0.3 mm/h, and the leakage rate monitored throughout the test.

There shall be no leakage from these joints between 0 and 0.2 mm displacement, and between 0.2 mm and 0.3 mm displacement the leakage rate shall not exceed 2.8 l/h.

7.6 Site tests for externally applied sealant

7.6.1 *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 F 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:

a) product name;

b) batch or serial number;

c) date.

7.6.2 *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 are to 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.

7.7 Site tests for internally applied sealant

7.7.1 *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. The sealant shall be applied in accordance with the contractor's instructions (see **6.2.1**).

NOTE Attention is drawn to */PR/EM/74, under the heading Anaerobic Mains Spraying.

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.

All repaired joints shall be logged using the pro-forma in Annex G and copies of the pro-forma shall be sent to the contractor.

7.7.2 *Post repair leakage testing*

Following internal joint spraying, monitoring shall be carried out to establish that the treatment has been effective. Barholes shall be monitored daily for a minimum of 48 h to establish that

there are no leaks from the treated joints. If there are still apparent leaks the barholes shall be monitored for a maximum of 7 days to establish whether there are still any leaks.

8 Marking

Products conforming to GIS/LC12 shall be permanently marked with the following information:

a) the number and date of this standard, i.e. GIS/LC12:2013 [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/LC12:2013 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)
Viscosity measurement

A.1 Principle

This test is to discover whether the viscosity of each finished product is acceptable.

A.2 Apparatus

A.2.1 *Test sample of repair material,* from 1 ml to 1.5 ml.

A.2.2 *Equipment for measuring viscosit*y, [e.g. a Bohlin CS10 rheometer [2)]].

A.2.3 *Acetone.*

A.2.4 *Torque roll.*

A.3 Method

A.3.1 Start the rheometer in accordance with the manufacturer's instructions.

A.3.2 Fit the cone:

NOTE There are two cones supplied with the rheometer: 4/40 and 1/55. The 1/55 is used for monomers and the 4/40 for all other products.

a) slide the air bearing lock to the left to lock the chuck. If the lock does not move freely, gently turn the chuck until it slides freely across;

b) insert the relevant cone into the chuck. If the cone cannot be inserted freely, loosen the chuck by turning it clockwise;

c) push the cone up as far as it will go and tighten the chuck;

d) move the air bearing lock to the right to free the chuck;

e) rotate the cone gently by hand to ensure that it moves freely.

A.3.3 Set the zero:

NOTE For accurate measurement, it is very important that the gap setting is correct for each cone, so the instrument should be calibrated and set to zero each time the cone is changed.

a) using a hex key, undo the two scale ring screws so the scale ring is free to rotate on the stop;

b) slowly lower the cone by turning the handle, until the cone is almost touching the lower plate;

NOTE It might be necessary to turn the stop for the cone to reach the lower plate.

c) gently rotate the cone and turn the handle downwards as far as possible (if the cone continues to rotate raise it by turning the handle upwards and decrease the gap by turning the stop anticlockwise);

[2)] Bohlin CS10 rheometer is a trade mark owned by Malvern Instruments Ltd., Enigma Business Park, Grovewood Road, Malvern, Worcestershire WR14 1XZ and is the trade name of a product supplied by Malvern Instruments Ltd. This information is given for the convenience of users of this standard and does not constitute an endorsement of the product named. Equivalent products may be used if they can be shown to lead to the same results.

d) turn the stop a division at a time until the cone rotates only a small amount before stopping;

NOTE It might be necessary to move the stop by only half a division.

e) turn the scale ring until it is set to zero, ensuring that the stop does not move;

f) tighten both lock screws on the scale ring with the hex key, ensuring the stop does not move and the scale ring is still set at zero;

g) set the scale ring to 150 for the 4/40 cone or 30 for the 1/55 cone.

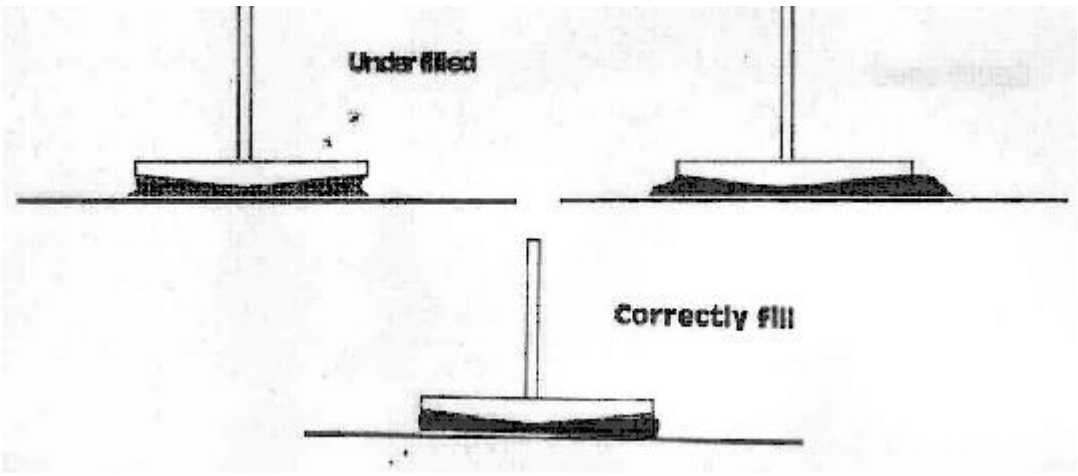


Figure A.1 — Underfilled, overfilled and correctly filled samples

A.3.4 Load the sample according to Figure A.1:

NOTE It is important when applying a sample that the correct amount is used, as over or under filling will result in errors in the data.

a) place the sample on the lower plate (approximately 1 ml to 1.5 ml);

NOTE It is normally easier to slightly over fill and then trim off any excess sample after bringing the cone and plate together.

b) slowly lower the cone to the plate by turning the handle downwards as far as possible;

c) rotate the cone gently to distribute the sample evenly;

d) on the computer, select “file” then “open”;

e) select the drop down menu for files of types then select “parameters”;

f) from the list of preset parameters, choose the one relevant for the sample being tested, e.g. “Monomer 55 cone” for testing monomers, then select “open”;

g) click on the green “start” button;

NOTE If a test needs to be stopped before completion, the abort button can be used. When the test is completed, “test complete” will appear on the computer monitor screen.

h) after the test is completed, clean the rheometer by raising the cone, wiping off the sample with torque roll and cleaning both cone and plate with acidified acetone in situ.

A.4 Calculations and result

A.4.1 Multiply the viscosity reading on screen by 1 000 to convert to mPa·s.

A.4.2 Record the viscosity of the sample in mPa·s.

Annex B (normative)
Surface tension measurement

B.1 Principle

This test is to measure the surface tension of the product, which is a guide to its ability to rise by capillary action.

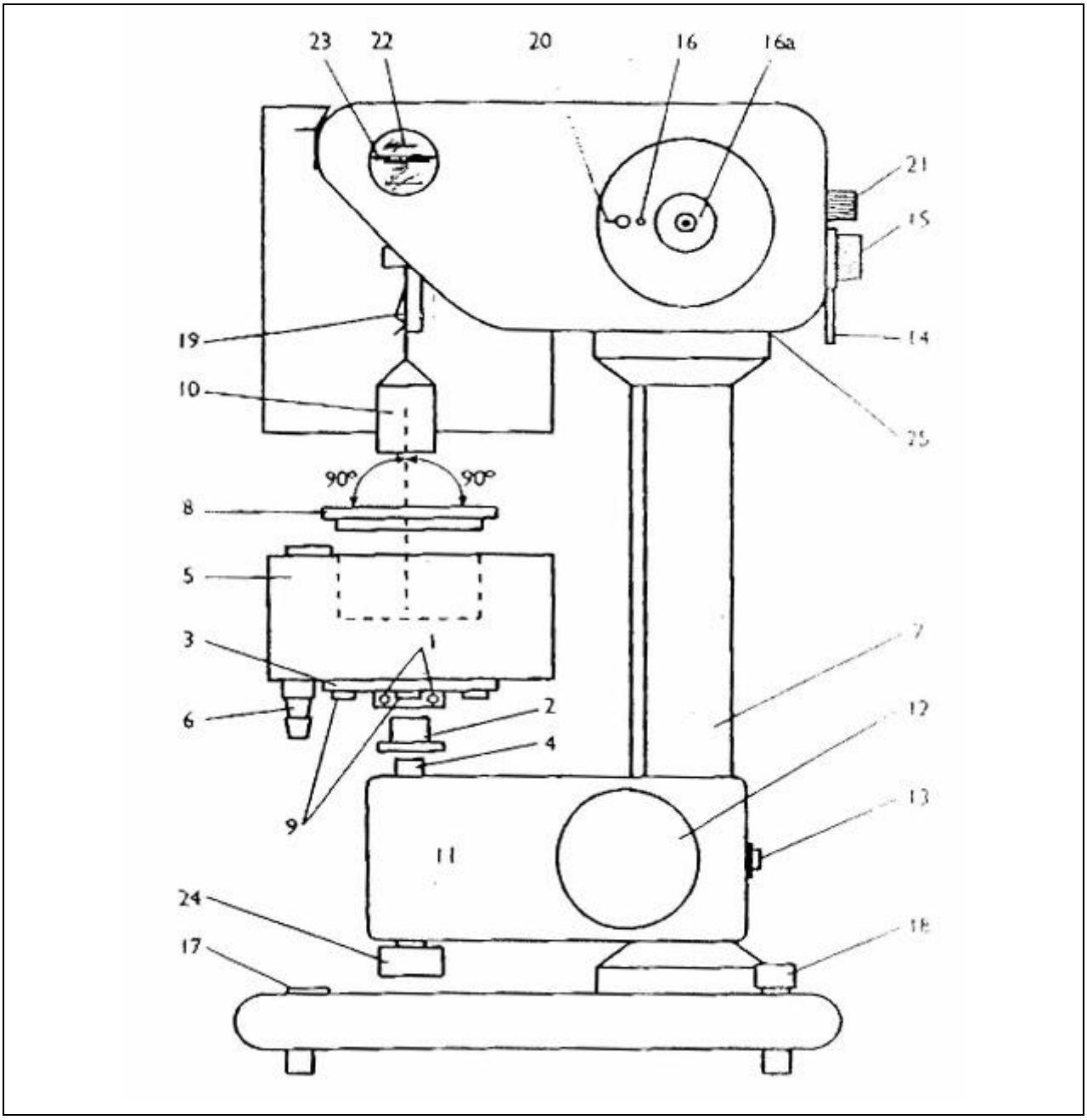


Figure B.1 — Kruss K8 Interfacial tensiometer

B.2 Apparatus

B.2.1 *Tensiometer,* giving direct reading sin mN/metre, [e.g. a Kruss K8 Interfacial tensiometer [3)], shown in Figure B.1].

B.2.2 *Water bath,* with ±1 °C accuracy.

B.2.3 *Chromo-sulphuric acid.*

B.2.4 *Bunsen burner.*

B.3 Test sample

The sample size shall be enough to ensure that the tensionmeter is 50 % to 75 % full, i.e. approximately 20 g.

B.4 Procedure

B.4.1 *General*

a) Wash the ring/plate thoroughly in distilled water and then heat in a bunsen flame to dull red heat.

NOTE White heat is to be avoided as this could damage the ring.

b) Lock the torsion balance with the screw (15) and insert the pin of the ring/plate into the balance's ring guidance (19).

NOTE The balance should be locked whenever the ring or plate is changed to protect the system.

c) Ensure that the surface plane of the ring/plate is completely flat by turning the ring/plate around its axle and by looking the surface plane from a vertical orientation.

d) Clean the sample vessel using chromo-sulphuric acid, then boiling in distilled water, and briefly heating in a bunsen flame.

NOTE The measuring vessel consists of refractory glass and could also be heated lightly with the bunsen burner after washing, but a thorough cleaning with acetone and consecutive drying is sufficient.

e) Ensure that the distance from the ring/plate to the vessel walls is equal on all sides.

f) Set the circuit division (20) to zero using the screw (21) before each measurement.

g) Switch on the scale illuminations (25).

h) After releasing the arrest screw (15) the light pointer (23) should settle on the middle line of the dark screen; if this does not occur reset the zero position by turning the zero adjustment-screw at the rear of the main body.

NOTE In this state the balance will swing freely around its zero position.

[3)] Kruss K8 Interfacial tensiometer is a trade mark owned by Kruess GmbH, Borsteler Chausee 85-99a, 22453 Hamburg, Germany and is the trade name of a product supplied by Kruess GmbH. This information is given for the convenience of users of this standard and does not constitute an endorsement of the product named. Equivalent products may be used if they can be shown to lead to the same results.

B.4.2 *Measurement*

a) Lift the thermostat table (5) with the handwheel (12) until the ring/plate is entirely covered with liquid.

b) Using the handwheel (12), lower the table carefully until the light pointer (23) is driven out of the zero position by the interface tension acting at the ring/plate.

c) Increase the torsion and apply a pull to the ring/plate by turning the screw (21) anticlockwise.

d) Observe the upward displacement of the light pointer (23) on the dark screen scale.

e) Use the micrometer screw (24) to lower the measuring vessel and bring the light pointer (23) back to zero position.

f) Repeat a) to e) until the upward pull on the ring/plate completely overcomes the interface tension forces and it breaks upward out of the surface.

g) Estimate values of 0.05 mN/m from the interface tension in mN/m, indicated at the nonius of scale (20).

h) Pushing up the screw (21) to turn the circuit division (2).

B.5 Result

Surface tension shall not exceed 25 mN·m to 30 mN·m at 25 %.

B.6 Test report

The test report shall include the following:

a) reference to this standard, i.e. GIS/LC12;

b) The results of the determination;

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

Annex C (normative)
Reactivity measurement

C.1 Principle

This test is to determine the reactivity of the sealant using two tests, one at 5 °C and one at 20 °C, carried out in cast iron test pots.

C.2 Apparatus

C.2.1 *2 cast iron test pots.*

C.2.2 *Stopwatch.*

C.2.3 *Water bath or environmental chamber,* with ±1 °C accuracy.

C.3 Test sample

The sample shall consist of 20 ml mainspray plus 0.3 ml catalyst.

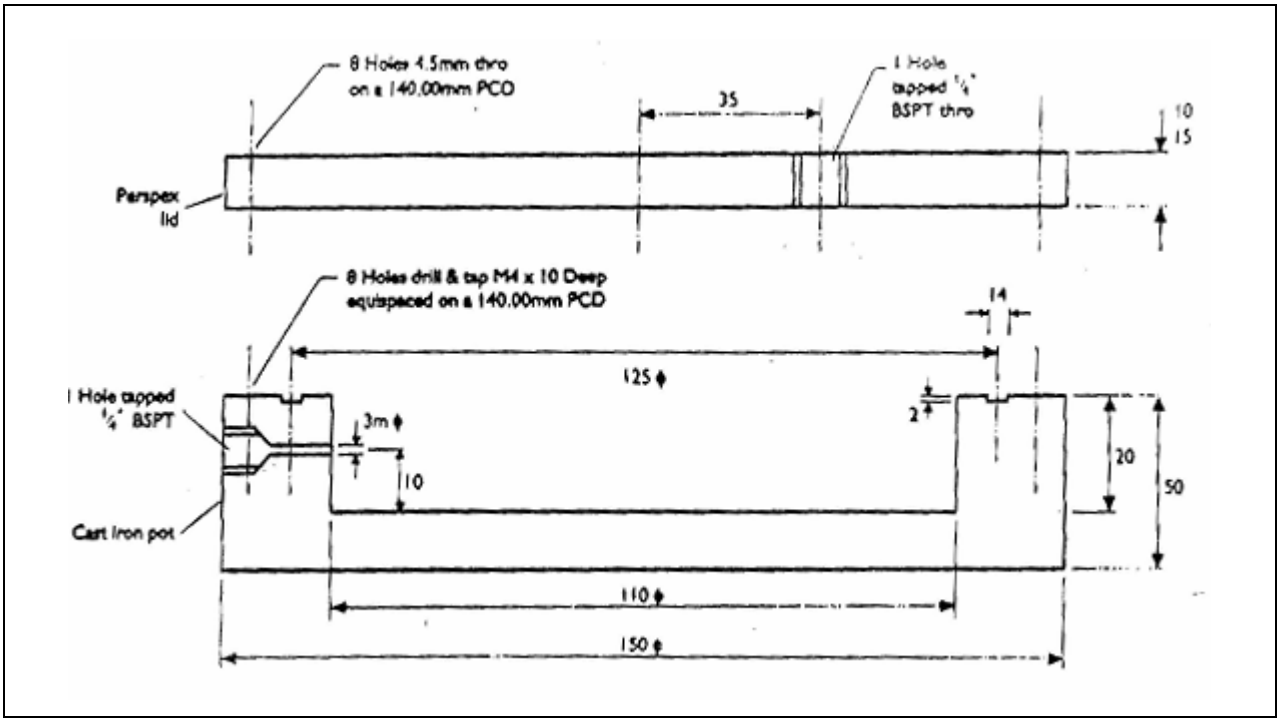


Figure C.1 — Reactivity measurement apparatus

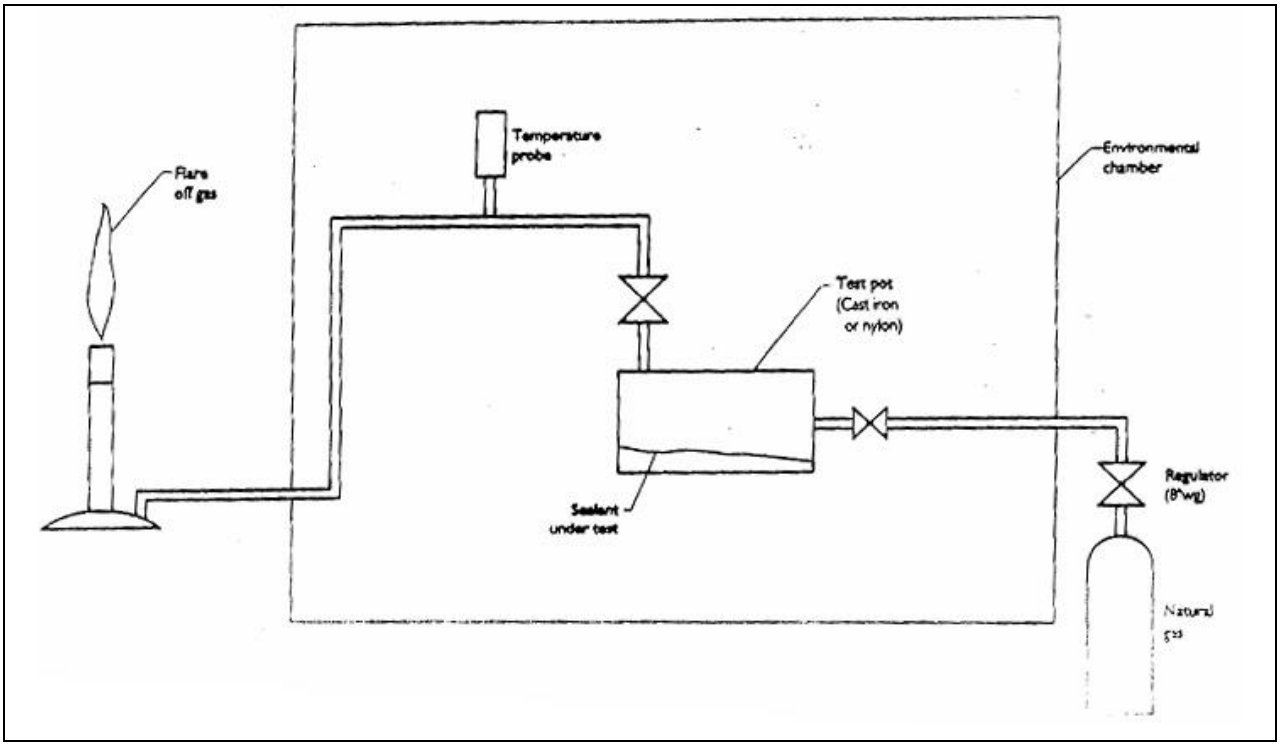


Figure C.2 — Connection for reactivity measurement apparatus

C.4 Procedure

C.4.1 Allow all the test components to soak at the test temperature for 1 h before testing.

C.4.2 Connect the pots to a supply of natural or inert gas as shown in Figures C.1 and C.2.

C.4.3 Put 20 ml of sealant into the pots and replace the “0-ring” seal and lid. Secure the lid with screws.

C.4.4 Turn on the gas supply and allow gas to pass over the sealant under test. Start the stopwatch.

C.4.5 Establish whether the sealant has cured by tilting the test posts in a direction perpendicular to the axis of the gas inlet/outlet holes.

NOTE The sealant is deemed to have cured once an obvious change in its viscosity has occurred.

C.4.6 Turn off the gas supply and vent any entrained gas.

C.4.7 Stop the stopwatch.

C.5 Expression of results

The sealant shall take no less than 6 h and no more than 48 h to cure.

C.6 Test report

The test report shall include the following:

a) reference to this standard, i.e. GIS/LC12;

b) the results of the determination;

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

Annex D (normative)
Stability measurement

D.1 Principle

This test is to determine the stability of the sealant.

D.2 Apparatus

D.2.1 *Environmental chamber,* capable of being maintained at 82 °C.

D.2.2 *Stopwatch.*

D.3 Test sample

The test sample shall consist of 1 l of sealant without accelerator present.

D.4 Procedure

D.4.1 Place test sample in the environmental chamber and start the stopwatch.

D.4.2 Check whether the sealant is still liquid after 30 min.

D.5 Result

The sealant shall still be liquid at the end of the test.

D.6 Test report

The test report shall include the following:

a) reference to this standard, i.e. GIS/LC12;

b) the results of the determination;

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

Annex E (normative)
Environmental stress cracking of polyethylene pipe

E.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.

E.2 Apparatus

E.2.1 *250 ml airtight glass container.*

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

E.2.3 *Nylon cable ties.*

E.2.4 *Razor blade.*

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

E.3 Procedure

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

E.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.

E.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).

E.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.

E.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.

E.4 Results

No cracking shall be observed.

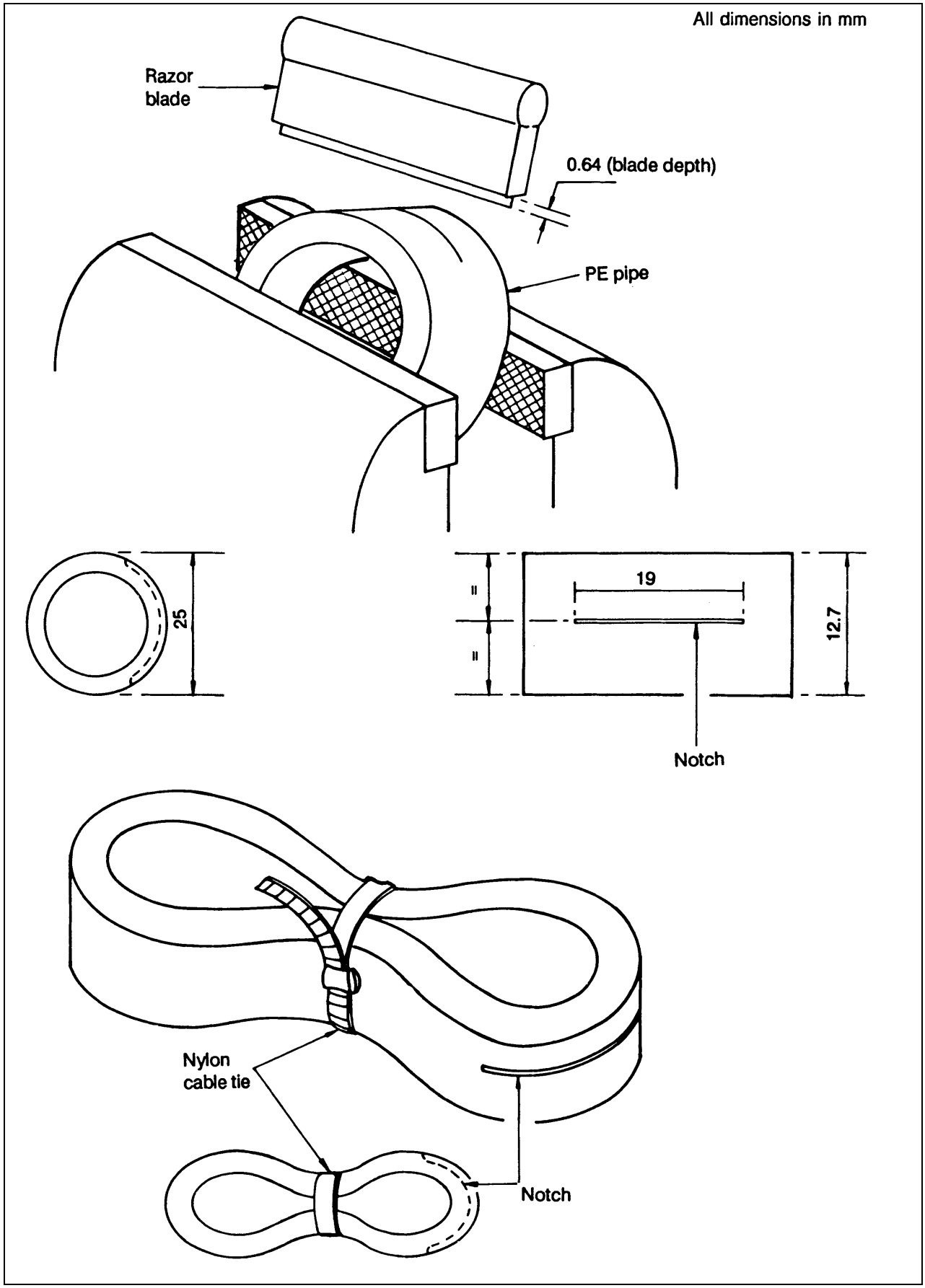


Figure E.1 —Test pieces for environmental stress cracking test

Annex F (normative)
Application log sheet proforma 1

FIELD APPLICATION TEST REPORT FOR EXTERNALLY APPLIED SEALANT

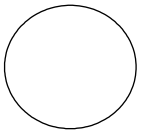
For completion on application of repair

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

Annex G (normative)
Application log sheet proforma 2

FIELD APPLICATION TEST REPORT FOR INTERNALLY APPLIED SEALANT

For completion on application of repair	**Result :**
General information Location of main..... 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)..... Length of main to be treated (m)…… Estimate of number of joints…….. **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).....	Gas in air reading after 48 hours…….. Gas in air reading after 7 days if applicable…… **General Comments** .... **A COPY OF THIS TEST REPORT SHALL BE RETAINED BY THE CONTRACTOR**

Bibliography

[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.