BRITISH STANDARD

BS EN
751-3 : 1997

Incorporating corrigendum March 1997

Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water

Part 3. Unsintered PTFE tapes

The European Standard EN 751-3 : 1996 has the status of a British Standard

ICS 83.140.50; 91.140.40; 91.140.60

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PSE/2, Jointing materials and compounds, upon which the following bodies were represented:

Asbestos Information Centre Ltd.
British Adhesives and Sealants Association
British Compressed Gases Association
British Hydromechanics Research Group
Chartered Institution of Water and Environmental Management
Energy Industries Council
Industrial Water Society
LP Gas Association
Water Services Association of England and Wales

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National foreword

This Part of BS EN 751 has been prepared by Technical Committee PSE/2, and is the English language version of EN 751-3 : 1996 *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes* incorporating corrigendum March 1997, published by the European Committee for Standardization (CEN).

It supersedes BS 6974 : 1991 which is withdrawn.

Cross-references

International Standards	Corresponding British Standard
ISO 7-1	BS 21 *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)*
EN 437	BS EN 437 *Specification for test gases, test pressures and categories of appliance, for gas appliances*
EN 10242	BS EN 10242 *Threaded pipe fittings in malleable cast iron*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 8, an inside back cover and a back cover.

EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 751-3

December 1996
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ICS 21.140; 23.040.80

Descriptors: Pipe fittings, gas pipes, water pipes, hot water, threaded fittings, sealing materials, tapes, classifications, specifications, dimensional tolerances, effectiveness, dimensional measurements, tests, marking

English version

Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3. Unsintered PTFE tapes

Matériaux d'étachéité pour raccords filetés en contact des gaz de la 1ère, 2ème et 3ème famille et de l'eau chaude — Partie 3: Bandes en PTFE non fritté

Dichtmittel für Gewindeverbindungen in Kontakt mit Gasen der 1., 2. und 3. Famile und Heiβwasser — Teil 3: Ungesinterte PTFE-Bänder

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 108 , Sealing materials and lubricants for gas appliances and gas equipment, the secretariat of which is held by NNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

This European Standard consists of the following Parts:

– Part 1: *Anaerobic jointing compounds*
– Part 2: *Non-hardening jointing compounds*
– Part 3: *Unsintered PTFE tapes*

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

Introduction

This European Standard specifies requirements and test methods for tapes produced from virgin unsintered polytetrafluorethylene (PTFE) for use with metallic threaded joints. It defines two classes of PTFE tapes, mainly differing in thickness and mass per area, for fine (F) and coarse (G) threads.

A universally applicable PTFE tape may be used for all gas, potable water, and hot water installations.

In respect of potential adverse effects of the jointing compounds covered by this European Standard on the quality of water intended for human consumption this standard provides no information as to whether the jointing compounds may be used without restriction in any of the Member States of the EU or EFTA. The use and characteristics of the jointing compounds should comply with current regulations, where they exist, depending on the acceptance of verifiable European criteria.

Since the application techniques, sometimes due to different pressure limits and safety requirements, differ from country to country, it was rather difficult to harmonize the existing national standards and approval requirements for PTFE tapes. One particular point relates to the adjustment of parts of an installation which sometimes require the assembled taper/parallel threaded joints to be turned back up to an angle of 45 °. To ensure that PTFE tapes fulfil this requirement in countries where such handling techniques are used, an additional requirement concerning the turn back test was included and such PTFE tapes are additionally designated with 'Rp'.

1 Scope

This European Standard specifies requirements and test methods for unsintered polytetrafluorethylene (PTFE) tapes (hereafter referred to as PTFE tapes) which are suitable for sealing threaded metallic joints as specified in ISO 7-1. The PTFE tapes are typically for use in installations for 1st family gases (town gas), 2nd family gases (natural gas) and 3rd family gases (liquefied petroleum gases (LPG)) up to 5 bar and up to 7 bar for hot water of heating systems (Class A) as well as up to 0,2 bar in gas appliances and their auxiliary equipment (Class B). The maximum working pressure covered in this European Standard is 20 bar which is relevant to LPG storage (Class C). The temperature range is limited to −20 °C to 125 °C.

NOTE. For applications outside the scope of this standard (e.g. compressed gases) the purchaser should consult the manufacturer.

Anaerobic jointing compounds are covered by EN 751-1, non-hardening sealing materials in the form of, e.g. jointing compound paste, are covered by EN 751-2.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 7-1	*Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*
ISO 228-1	*Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*
EN 437	*Test gases — Test pressures — Appliance categories*
EN 10242	*Threaded pipe fittings in malleable cast iron*
prEN 10255	*Carbon steel tubes suitable for welding or threading*
prEN 12164	*Copper and copper alloys — Rod for free machining purposes*

3 Definitions

For the purposes of this European Standard the following definitions apply:

3.1 PTFE tape

Thread sealing tape manufactured from virgin unsintered polytetrafluorethylene (PTFE) without fillers or additives.

3.2 gas family

For further information on types of gases see EN 437.

3.3 batch

Any quantity of PTFE-tapes manufactured in a single mix at one time.

4 Classification of PTFE tapes

There are two classes of PTFE tapes, mainly differing in thickness and mass per area, suitable for fine (F) and coarse (G) threads in accordance with table 1.

Table 1. Classification of PTFE tapes

Class	Thread		Nominal size
F, Frp[2)]	ISO 7-1	taper/parallel and taper/taper	DN ≤ 10[1)]
G, Grp[2)]	ISO 7-1	taper/parallel and taper/taper	10 < DN ≤ 50

[1)] Class F tapes may also be used for other dimensions when the number of turns of the thread is ≥ 7,5 cm^{-1}

[2)] PTFE tapes where limited turning back of taper/parallel threaded joints (R/Rp) is permitted, are additionally marked with Rp.

5 Requirements

5.1 Requirements to be met by the PTFE tape as received

5.1.1 *General*

The PTFE tape shall be free from any inclusions or imperfections visible to the naked eye and shall be free from any surface or edge defects, when tested in accordance with **7.1.1**.

5.1.2 *Tolerances on tape dimensions*

5.1.2.1 *Length*

The actual length of the PTFE tape, when tested in accordance with **7.1.2.1**, shall not be less than that marked on the spool.

5.1.2.2 *Width*

The actual width of the PTFE tape, when tested in accordance with **7.1.2.2**, shall not differ from that marked on the spool by more than $\pm$ 0,5 mm.

NOTE. The preferred width is 12 mm.

5.1.2.3 *Thickness*

The thickness of the PTFE tape, when tested in accordance with **7.1.2.3**, shall not differ from the stated value by more than $\pm$ 10 %.

5.1.3 *Tolerances on mass per area*

The mass per area of the PTFE tape, when tested in accordance with **7.1.3**, shall be greater than 90 % of the value declared by the manufacturer.

5.1.4 *Residual lubricant content*

The residual lubricant content of the PTFE tape, when tested in accordance with **7.1.4**, shall not exceed 0,1 % by mass.

5.1.5 *Wrapping properties*

When wrapped around the specified thread in accordance with **7.1.5**, the PTFE tape shall conform to and hold the thread form. The finishing end of the PTFE tape shall remain in position with no tendency to unwind. During wrapping the PTFE tape shall not break, tear, or split.

5.2 Requirements to be met by the PTFE tape after assembly

5.2.1 *Sealing properties*

When tested in accordance with the methods described in **7.2.1** the PTFE tape shall not permit any leakage, when each test assembly is tested in accordance with **7.2.1.2** to **7.2.1.5** in sequence.

5.2.1.1 *Soundness*

When pressurized, within 1 h after preparation all the joints in the test assemblies shall not leak, when tested in accordance with **7.2.1.2**.

5.2.1.2 *Soundness after adjustment (additional requirement for Classes FRp and GRp only)*

After adjusting the test assemblies in accordance with **7.2.1.3** the joint of these test assemblies shall not leak when tested in accordance with **7.2.1.2**.

NOTE. This additional requirement is only valid for countries in which a limited turning back of prefabricated taper/parallel (R/Rp) threaded joints is permitted. PTFE tapes fulfilling this requirement should additionally be marked with Rp.

5.2.1.3 *Resistance to temperature cycling*

The sealing properties of the PTFE tapes shall not be impaired by the temperature cycling test in accordance with **7.2.1.4**.

5.2.1.4 *Resistance to vibration*

The sealing properties of the PTFE tapes shall not be impaired by vibration when tested in accordance with **7.2.1.5**.

5.2.2 *Dismantling*

When dismantling the screwed joints with commercial tools, after all tests in accordance with **7.2.1** have been completed, there shall be no damage or corrosion of the threads.

5.3 Re-test

If more than one joint in all test assemblies should fail throughout the tests specified in **7.2.1.2** to **7.2.1.5** no re-test shall be permitted. Should only one joint fail to comply with the requirements of any test, two further test assemblies shall be prepared using PTFE tape from the same production batch and each of them shall comply with the requirements of all tests. If any of the joints in the re-tested assemblies fails then it shall be deemed that the whole batch of PTFE tape has failed.

6 Test material and documentation

6.1 Test material

The manufacturer shall submit 20 spools of the PTFE tape in original packing to the test laboratory.

6.2 Test documentation

The following documents shall be submitted to the test laboratory:

a) description of the PTFE tape including classification according to table 1, mass per area, and dimensions of the PTFE tape (nominal length, width and thickness);

b) application and wrapping instructions including a note relating to permissible adjustment in accordance with **5.2.1.2**;

c) declaration from the manufacturer that the PTFE tape is manufactured from virgin consistent PTFE and does not contain any filler.

7 Test methods

All samples of PTFE tape used for the tests in **7.1.1, 7.1.2.2, 7.1.2.3, 7.1.3** to **7.1.6** and **7.2** shall be taken from spools omitting the external layer or wrapping.

7.1 Test methods for PTFE tapes as received

7.1.1 *Test of general requirements*

PTFE tapes from three different spools are inspected for inclusions and defects when measuring the dimensions.

7.1.2 *Measurement of tape dimensions*

7.1.2.1 *Length*

PTFE Tapes from three different spools are measured free of tension along their length to an accuracy of $\pm$ 1 cm.

7.1.2.2 *Width*

Measure the width of the three PTFE tapes with a micrometer or an optical comparator to an accuracy of $\pm$ 0,1 mm at two points approximately 50 mm from each end and at a minimum of three other points equally spaced between the first two readings.

7.1.2.3 *Thickness*

Measure the thickness of the three PTFE tapes with a micrometer gauge, capable of reading to an accuracy of not less than 0,0025 mm and having a bell of not less than 6,3 mm in diameter. The micrometer shall apply a pressure at the bell of between 10 kPa and 20 kPa. The thickness is measured at two points approximately 50 mm from each end of the tape and at a minimum of three other points equally spaced between the first two readings.

7.1.3 *Measurement of mass per area*

After measuring the dimensions cut from each of the three spools three pieces of tape of approximately 100 mm, one from each end and one from the middle of the PTFE tape. Measure the length to an accuracy of 1 mm and the width to an accuracy of $\pm$ 0,1 mm and the mass to an accuracy of 0,1 mg. Use the length and the width of the single pieces to calculate their mass per area.

7.1.4 *Determination of residual lubricant content*

Clean and dry an extraction thimble fitted with a sintered glass plate with a maximum pore diameter within the range 100 μm to 160 μm and weigh to the nearest 0,1 mg.

Cut three samples of tape to give a weight of approximately 15 g (see clause **7**). Place a single sample into the extraction thimble fitted with the sintered glass plate and weigh to the nearest 0,1 mg.

Insert the extraction thimble fitted with the sintered glass plate and PTFE tape into a Soxhlet extractor with a nominal capacity of 100 ml. Pour 300 ml to 400 ml of petroleum spirit (boiling range 40 °C to 60 °C) into a 500 ml boiling flask. Assemble the boiling flask, Soxhlet extractor, and condenser and subject the PTFE tape to at least 60 extractions during a continuous period of not less than 4 h.

After the extraction is completed, remove the thimble from the apparatus and dry for about 1 h at (20 $\pm$ 5) °C in a fume cupboard.

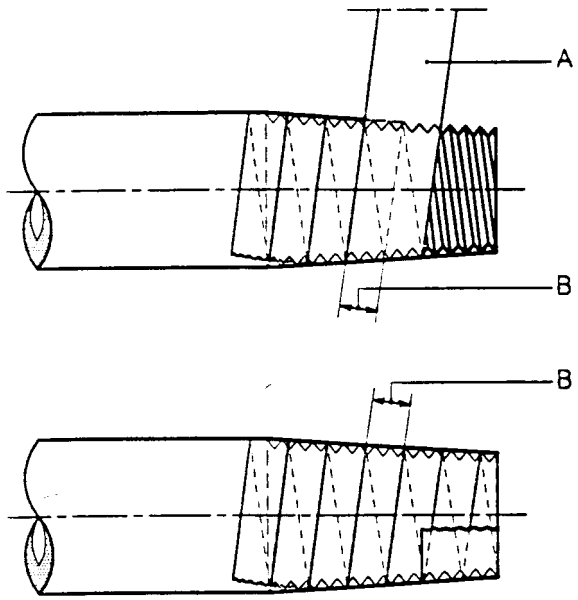
Clean, dry and weigh a metal crucible to the nearest 0,1 mg. Transfer the extracted PTFE tape from the thimble to the metal crucible and place them in an air circulation oven at (300 $\pm$ 5) °C for $(6^{\ 0}_{-0,5})$ h. At the end of this period remove the metal crucible from the oven, cool in a desiccator, and weigh the crucible with the PTFE tape to the nearest 0,1 mg.

The residual lubricant content shall be calculated as a percentage difference between the original mass of the PTFE tape and the mass of the PTFE tape after the heating treatment. Calculate the mean value of three measurements to the nearest 0,01 %.

7.1.5 *Test of wrapping properties*

Wrap a length of PTFE tape clockwise round the male threads starting from the only partially cut thread on the pipe of the test assemblies described in **7.2.1.1** to give a double layer covering, using minimal sufficient tension for the PTFE tape to take up the form of the thread. The end is torn off. For coarse threads 50 % overlap is recommended (see figure 1).

Report whether or not the PTFE tape has taken the form of the thread, the finishing end of the tape remains in position, and if the PTFE tape has broken, torn, or split during wrapping.



A Tape
B 50 % Overlap to give double layer covering

Figure 1. Clock wise wrapping procedure for Class G tapes (coarse threads)

7.2 Test of PTFE tapes after assembly

7.2.1 *Test of sealing properties*

7.2.1.1 *Preparation of test assemblies*

The test shall be performed on test assemblies prepared from new unused threaded joint.

The parts specified in table 2 are required for preparing the test assemblies for PTFE tapes of Class F.

Table 2. Parts list for test assemblies for Class F

Quantity	Part	Thread	Characteristics
4	Thread pipe	R ¼	brass[1)] tube – DN 6 Length: 250 mm
8	Socket	Rp ¼	prepared from brass[1)] hexagon bar
4	Plug	R ¼	prepared from brass[1)] hexagon bar

[1)] Free machining brass $CuZn_{40}Pb_2$ in accordance with EN 12164.

Cut threads R ¼ in accordance with ISO 7-1 on both ends of the pipe sections. Use only pipes and fittings with threads without any defects visible to the naked eye. When screwing pipes and plugs by hand into the sockets used for preparing the test assemblies ($2 \pm ½$) fully cut threads shall be visible. Clean male and female threads before assembling by wiping with absorbent tissue paper to remove any cutting oil.

PTFE tapes are wrapped around the total length of the male threads in accordance with **7.1.5** to give a double layer covering. The end is torn off.

Use a pipe vice (three- or four-point clamp) for assembling the parts. Screw the sockets onto the ends of the pipe sections and close one socket with a plug. Ensure that the full length of the outer threads is covered by the sockets, but that at least a part of one fully cut thread is visible and take care during assembly not to transmit the force to the joints already made. Remove excess PTFE tape with a knife.

Test assemblies for PTFE tapes of Class G are prepared in a similar manner using the parts listed in table 3. In this case when screwing pipes and plugs by hand into the sockets for preparing the test assemblies ($2½ \pm ½$) fully cut threads shall be visible. Screw one socket and one reducing socket to each pipe section. Close the socket with a plug.

Table 3. Parts list for test assemblies for Class G

Quantity	Part	Thread	Characteristics
4	Thread pipe	R 1½	EN 10255 – DN 40 – welded; medium series, Length: 250 mm
4	Socket	Rp 1½	EN 10242
4	Socket, reducing	Rp 1½ × ½	EN 10242
4	Plug	R 1½	EN 10242

All test assemblies are successively tested in accordance with **7.2.1.2** up to **7.2.1.5**.

7.2.1.2 *Soundness test*

Pressurize the test assemblies 0,5 h to 1 h after preparation of the test assemblies with air or nitrogen to the pressure given in table 4 while immersing in a water bath at (20 ± 5) °C.

Table 4. Test pressure

Class	Test pressure bar
A	$7{,}5 \pm 0{,}3$
B	$0{,}3 \pm 0{,}015$
C	$30 \pm 1{,}5$

Inspect all R ¼ and R 1½ threaded joints for leakage over a 5 min period. Gas leakage shall be determined by the appearance of bubbles during the immersion period, ignoring those noted during the first 15 s of immersion.

7.2.1.3 *Soundness test after adjustment (additional test for Class FRp and GRp only)*

The threaded joints between the sockets closed with plugs and pipe on every test assembly are turned back for $(45 \pm 2)°$ immediately after the soundness test according to **7.2.1.2**. After storage for $(72^{\ 0}_{-2})$ h at (20 ± 5) °C repeat the soundness test in accordance with **7.2.1.2**.

NOTE. It is advisable to perform this test on every PTFE tape, because otherwise the application of such tapes would be limited to countries where adjustment is not permissible.

7.2.1.4 *Temperature cycling test*

Place the test assemblies in an oven and expose them to 5 temperature cycles. During each 24 h test cycle put the test assemblies at first for $(22^{\ 0}_{-0,5})$ h in an oven heated to (150 ± 2) °C and then cool down to (20 ± 5) for $(2^{\ 0}_{-0,2})$ h. After the last temperature cycle the test assemblies are put into a freezer (cold cabinet) cooled to $-(20 \pm 2)$ °C for $(4^{\ 0}_{-0,4})$ h and subjected to the soundness test in accordance with **7.2.1.2** after warming up to (20 ± 5) °C.

NOTE. The individual cycles in this test need not take place consecutively.

7.2.1.5 *Vibration test*

Clamp the plugged sockets of the test assemblies successively in a rotating chuck (see figure 2). Screw a stud bolt threaded G ¼ B to ISO 228-1 (Class F) or G ½ B (Class G) into the other socket and secure a bearing (ball race) to it. Suspend a mass of 1 kg (Class F) or 5 kg (Class G) from a spring (spring constant approximately 5000 Nm^{-1} for Class F and G) attached to the bearing. Rotate each test assembly at a rotation frequency of (700 ± 20) min^{-1} for a period of (30 ± 1) min. Repeat the soundness test in accordance with **7.2.1.2**.

7.2.2 ***Test of dismantling***

After all tests have been completed in accordance with **7.2.1** the joints are dismantled at (20 ± 5) °C with commercial tools (pipe wrench), cleaned and the threads of pipes and fittings inspected for damage or corrosion.

8 Marking and instructions

8.1 Marking on packages

Each spool carrying PTFE tape shall be clearly and indelibly marked in the language of the country of destination with the following information:

a) the manufacturer's or supplier's name and/or registered trade mark;

b) the Class according to table 1 covering size of thread, and whether adjustment of taper/parallel (R/Rp) threads after assembly is permitted:

Class F, FRp: fine threads
Class G, GRp: coarse threads;

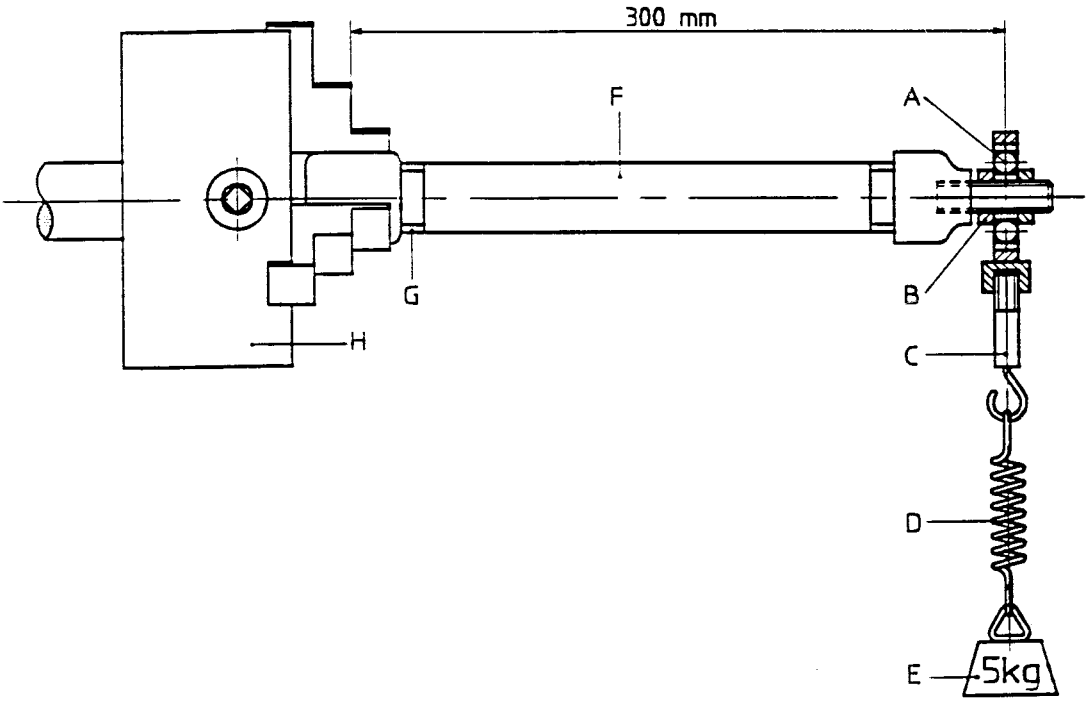
c) the nominal length, width, thickness and mass per area of the tape in metric units;

d) essential instructions for use and wrapping technique.

8.2 Instructions

The data mentioned under a), b) and d) of **8.1** together with any possible limitation of use shall be included in the manufacturer's instructions and in the language of the country of destination.

At least one set of instructions shall be provided with each consignment.



A Ball race
B Nut
C Attachment
D Spring
E Mass
F Test piece, pipe length 250 mm
G Jointing compound to be tested
H Rotatable chuck

Figure 2. Vibration rig

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List of references

See national foreword.

BSI — British Standards Institution

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