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BRITISH STANDARD

BS 2797:1976

Incorporating Amendment No. 1

CONFIRMED
DECEMBER 1990

Specification for

Leathers for gas meter diaphragms

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British Leather Federation*
British Leather Manufacturers' Research Association*
Hide and Allied Trades Improvement Society
Ministry of Defence
Shoe and Allied Trades Research Association
Society of Leather Technologists and Chemists*
Tropical Products Institute

The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Gas Corporation
Department of Energy, Gas Standards
Institution of Gas Engineers
Society of British Gas Industries

This British Standard, having been prepared under the direction of the Leather Standards Committee was published under the authority of the Executive Board on 30 July 1976

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Foreword

BS 2797 was originally published in two Parts; Part 1:1956, *"E.I. Sheep skin leather"* and Part 2:1962, *"Split hide leather"*. In this first revision the two Parts have been combined as a single document superseding Parts 1 and 2 which are now withdrawn. Minor changes have been made; in particular, the requirement for the boil test has been modified to remove a discrepancy left after an amendment to the first editions. Other changes are mainly editorial, for example, to take into account the revision in 1974 of BS 1309, and to make clear that the use of suitable fillers during manufacture is not excluded by the requirements of the standard.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 Scope

This British Standard specifies requirements for finished leathers for use in diaphragms of gas meters intended for use with natural gas. Two types of leather are specified.

Type 1. E.I. sheepskin leather, manufactured as described in outline in Appendix A.

Type 2. Split hide leather, manufactured as described in outline in Appendix B.

2 References

The titles of the British Standards referred to in this standard are listed on page 6.

3 Definitions

For the purposes of this British Standard, the definitions given in BS 2780 apply.

4 Requirements

4.1 pH value. When determined as described in BS 1309, the pH value of the finished leather shall be not lower than 3.5.

4.2 Iron. When determined by the method described in Appendix C, the iron content of the finished leather [at a volatile matter content of 14 % (*m*/*m*), determined as described in BS 1309] shall not exceed 500 μg (Fe) per gram of leather.

4.3 Shrinkage in boiling water. When the finished leather is tested by the procedure described in Appendix D, the mean percentage decrease in the diameter of the test piece shall not exceed 3.0 %.

4.4 Chromium. When determined by either the perchloric acid method or the alkaline fusion method for chromic oxide content described in BS 1309, the chromic oxide content of the finished leather [at a volatile matter content of 14 % (*m*/*m*), determined as described in BS 1309] shall be not less than 2.5 % Cr_2O_3.

4.5 Thickness

4.5.1 *Type 1.* The thickness of finished type 1 leather, measured by the procedure described in BS 3144, and the permissible variation in thickness, shall be subject to agreement between the purchaser and the vendor.

4.5.2 *Type 2.* When determined as described in BS 3144, the thickness of the finished type 2 leather shall be not less than 1.20 mm at any point within the area which will form a diaphragm. The difference between the maximum thickness and minimum thickness within this area shall not exceed 0.30 mm.

Providing that finished type 2 leather complies with these requirements, the mean thickness and the tolerance on the thickness shall be the subject of agreement between purchaser and vendor.

5 Marking

The finished leather shall be indelibly marked so that the following information will appear on each diaphragm.

a) Manufacturer's name or identification mark.

b) Manufacturer's batch or lot number.

c) "BS 2797 type 1" or "BS 2797 type 2", as appropriate.

NOTE Other information may be added if required. Addition of the date of rettanage is recommended.

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Appendix A Method of manufacture of E.I. sheepskin diaphragm leather (type 1)

A.1 Raw material

Well preserved E.I. tanned Persian sheepskins are used. Skins used are chosen to be of good tannage and free from harmful materials, holes, flaying defects and serious imperfections of fibre structure. Skins are selected for thickness so that during shaving (see **A.2.1**) the thickness is reduced by a minimum.

A.2 Tannage

A.2.1 *Shaving.* The flesh side is slightly shaved and the skin is finished to the required thickness (see **4.5.1**) on the grain side.

A.2.2 *Retanning.* Skins are retanned with basic chromium sulphate so that the finished leather will meet the requirements of **4.4**.

A.2.3 *Inert materials.* At an appropriate stage, the manufacturer may incorporate into the leather inert materials (known as "fillers") which do not prevent the finished leather from complying with the requirements of this standard.

A.3 Fat-liquoring

The leather is treated (fat-liquored) with oil (excluding oil derived from marine animals) and with soap flakes complying with the requirements of BS 1912, to yield a finished leather containing 3 % (*m*/*m*) added oil and 2 % (*m*/*m*) added soap [both calculated on a basis of 14 % (*m*/*m*) volatile matter in the finished leather].

NOTE 1 The use of neatsfoot oil is recommended.

NOTE 2 Bar soap, complying with the requirements of BS 1911, is an alternative to soap flakes, provided that the quantity used is adjusted to compensate for any difference in fat content.

Appendix B Method of manufacture of split hide diaphragm leather (type 2)

B.1 Raw material

The raw material used is good quality vegetable-tanned split hide made from either:

a) UK market hides, or

b) good quality wet-salted hides of European origin.

The split hides are selected so that during shaving (see **B.2.1**) no more than 0.5 mm of the leather need be removed.

Hides used are selected so that they are free from harmful material and so that the areas from which the diaphragms will ultimately be cut are free from ticks, holes, healed or partially healed warble holes, brands, score marks and other serious imperfections of the grain or fibre structure.

B.2 Rettanage

B.2.1 *Shaving.* The hides are shaved so that the finished leather complies with the requirements of **4.5.2**.

As a final operation, the leather may be lightly shaved or buffed on the grain side.

B.2.2 *Retanning.* The split hides are retanned with basic chromium sulphate so that the finished leather will meet the requirements of **4.4**.

B.2.3 *Inert materials.* At an appropriate stage the manufacturer may incorporate into the leather inert materials (known as "fillers") which do not prevent the finished leather from complying with the requirements of this standard.

B.3 Fat-liquoring

The leather is treated (fat-liquored) with oil (excluding oils derived from marine animals) and with soap flakes complying with the requirements of BS 1912, to yield a finished leather containing 3 % (*m*/*m*) added oil and 2 % (*m*/*m*) added soap [both calculated on a basis of 14 % (*m*/*m*) volatile matter in the finished leather].

NOTE 1 The use of neatsfoot oil is recommended.

NOTE 2 Bar soap, complying with the requirements of BS 1911, is an alternative to soap flakes, provided that the quantity used is adjusted to compensate for any difference in fat content.

Appendix C Procedure for the determination of iron content

C.1 Reagents

Use reagents of recognized analytical reagent quality and water complying with the requirements of BS 3978. The following reagents are required.

C.1.1 *Ammonia solution, dilute.* Mix ammonia solution (d = 0.880) with an equal volume of water.

C.1.2 *Hydrochloric acid, dilute* (approximately 6N). Mix concentrated hydrochloric acid (d = 1.18) with an equal volume of water.

C.1.3 *Potassium thiocyanate solution.* 400 g per litre.

C.1.4 *Standard iron solution* (10 µg Fe per millilitre). Dissolve 0.7022 g of ammonium ferrous sulphate, $(NH_4)_2SO_4.FeSO_4.6H_2O$, in water. Add 1 ml to 2 ml of concentrated nitric acid and evaporate the solution to dryness on a water bath. Dissolve the residue in 10 ml of the dilute hydrochloric acid and dilute to 1 000 ml with water. From this solution prepare a 1 + 9 dilution [10 µg of iron (Fe) per millilitre] immediately before use.

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C.2 Apparatus

Usual laboratory apparatus is required and, in particular, the following.

C.2.1 *Platinum dish,* iron-free.

C.2.2 *Nessler cylinders,* 50 ml, complying with the requirements of BS 612.

C.2.3 *Microburette*

C.2.4 *One-mark volumetric flask,* 100 ml, class B, complying with the requirements of BS 1792.

C.3 Procedure

Weigh 5 ± 0.1 g of the leather into the platinum dish and heat it carefully, at the minimum temperature necessary, below 500 °C, to form an ash free from carbonaceous particles. Take care that at no time does any part of the dish reach a bright red heat.

NOTE The low ignition temperature prevents fusion of alkali salts present.

If necessary, to eliminate carbonaceous particles, cool the dish, moisten the ash with a few drops of water, dry carefully and then heat again to a temperature below 500 °C.

Cool the dish, add 1 ml to 2 ml of the dilute hydrochloric acid to the ash and evaporate to dryness on a water bath. Dissolve the residue in 1 ml to 2 ml of the dilute hydrochloric acid, dilute with water, boil and filter. Dilute the cooled filtrate to 100 ml in the volumetric flask.

Transfer a 10.0 ml aliquot portion into a Nessler cylinder, dilute with water, add 5 ml of the dilute hydrochloric acid then add 5 ml of the potassium thiocyanate solution. Dilute to 50 ml with water and mix.

Into a second Nessler cylinder containing 5 ml of the dilute hydrochloric acid, 5 ml of the potassium thiocyanate solution and approximately 37 ml of water, gradually add standard iron solution from the microburette until the colour of the solutions in the two Nessler cylinders matches when the solutions are viewed vertically from above with the cylinders held over a white surface. Note the volume of standard iron solution added.

C.4 Expression of result

Calculate the result as follows.

$$\text{Iron content (μg Fe per gram)} = 1\,720\,V/(100 - x)$$

where

V is the volume, in millilitres, of standard iron solution used;

x is the percentage volatile matter content of the leather, determined as described in BS 1309.

Appendix D Procedure for the determination of shrinkage in boiling water

D.1 Apparatus and material

Use the following apparatus and material.

D.1.1 *Glass dish,* flat bottom, circular, diameter between 75 mm and 105 mm, capacity at least 350 ml.

D.1.2 *Glass rods,* each approximately 2.5 mm in diameter, 100 mm in length, and bent in the middle to an angle of 60°.

D.1.3 *Beaker,* 250 ml.

D.1.4 *Desiccator or similar glass vessel,* which can be evacuated and which will contain the glass dish.

D.1.5 *Vacuum pump,* capable of reducing the absolute pressure in the desiccator to less than 25 mbar[1)] within 120 s of being switched on.

D.1.6 *Scale,* calibrated in millimetres.

D.1.7 *Stopclock*

D.1.8 *Pressure vessel,* constructed of aluminium or aluminium alloy, in which water can be boiled at a pressure greater than atmospheric pressure. The vessel shall incorporate the following features.

D.1.8.1 *Lid* that can be rapidly removed and replaced.

D.1.8.2 *Thermometer* covering the range 100 °C to 105 °C.

NOTE Thermometer F 125C/100, complying with the requirements of BS 593, is suitable.

The thermometer shall be fitted in the lid near one side, so that with the lid in position the thermometer bulb extends to within 20 mm of the bottom of the vessel.

D.1.8.3 *Gas ring* capable of heating the vessel so that the temperature of 1 000 ml of water in the vessel is raised from 98 °C to 100 °C in less than 60 s.

D.1.8.4 *Adjustable release valve,* spring-loaded, capable of adjustment (in conjunction with the gas flow to the gas ring) so that the temperature of water boiling in the vessel is maintained at 102.0 ± 0.3 °C.

NOTE A domestic pressure cooker may be modified to form a suitable pressure vessel for the test. The volume of water in the pressure vessel is unlikely to be of critical importance; losses as steam are restricted by following the method described.

[1)] 1 bar = 10^5 N/m^2 = 100 kPa

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D.1.9 *Test piece holder,* to prevent the test piece from curling during heating in boiling water.

The holder (see Figure 1) shall have a brass plate A of diameter about 100 mm and thickness about 3 mm standing on legs formed by brass screws which raise it about 10 mm. The test piece B, when in position, (shaded) shall rest on plate A, and a bent copper wire of diameter about 1 mm shall rest on the test piece (for clarity, the wire is drawn thicker than 1 mm in the plan of Figure 1). On the wire shall rest another similar brass plate A′, which shall carry a bridge formed by two brass screws and a brass rod. When the holder has been assembled with the test piece in position, a brass nut shall be screwed on to each of the three vertical screws attached to the lower plate, so that the holder can be lifted from boiling water by a bent wire hooked under the bridge, but the holes in the upper plate shall have sufficient clearance on the three screws to permit the upper plate to slide freely on them. The nuts on these screws shall screw on sufficiently to prevent the upper plate from being lifted off, but shall leave it free to rise at least 5 mm, so that the force constraining the specimen to remain flat during its heating is merely the weight of the upper plate and bridge. To allow boiling water free access to the specimen, holes of 10 mm diameter shall be bored as shown in both the upper and lower plates. The mass of the upper plate and bridge shall be 250 ± 20 g.

D.1.10 *Two circular brass plates,* diameter approximately 100 mm, thickness approximately 3 mm.

D.1.11 *Water,* complying with the requirements of BS 3978.

D.2 Test piece

Cut one test piece with a steel press knife, the inner wall of which is a right circular cylinder of diameter 70 mm. Mark on the grain side two diameters at right angles. Mark on the flesh side two diameters which are at right angles and which lie approximately mid-way between the pair marked on the grain side.

D.3 Procedure

Place one of the bent glass rods on the bottom of the glass dish, place the test piece on the rod, the second rod on the test piece, and a brass plate on the rod. Add 200 ± 5 ml of the water to the dish, transfer it to the desiccator, and evacuate the desiccator for 180 ± 10 s. Allow air to enter the desiccator to restore atmospheric pressure and force water into the specimen (see notes 1 and 2).

Put into the pressure vessel 1 000 ± 20 ml of the water and with the lid on, but not screwed down, heat the water to the boiling point. Then reduce the rate of heating, so that the water continues to boil gently without much escape of steam.

Sixty minutes after beginning evacuation (and 57 min after restoring the pressure to atmospheric), remove the test piece from its dish of water, and blot its surfaces gently with blotting paper to remove surplus water. Lay the test piece on a flat surface, taking care not to extend it, and measure the four marked diameters to the nearest 0.5 mm.

Adjust the heating to its maximum, quickly fit the test piece in the test piece holder and immediately transfer the holder and test piece to the pressure vessel, noting the time when it enters the water. Fasten down the lid and allow the temperature to rise to 102.0 °C. By adjusting the heating and the release valve of the pressure vessel, maintain the temperature at 102 ± 0.3 °C with a slow escape of steam through the release valve (see note 3).

After the test piece has been in the pressure vessel for 15 ± 0.1 min, transfer the vessel to a sink and play a rapid stream of cold tap water on the lid to cool it, and after 1 s or 2 s allow two or three litres of tap water to enter the vessel. Remove the test piece and holder from the vessel, and the test piece from the holder. Lay the test piece horizontally on one of the brass plates. Place the other plate on the test piece and on the upper plate place the beaker containing sufficient water so that a total mass of 250 ± 20 g is applying gravitational force on to the test piece.

After the specimen has cooled for 5 ± 0.5 min, remove it, blot its surfaces gently and again measure its four marked diameters to the nearest 0.5 mm.

NOTE 1 The object of reducing the pressure and restoring it again is to remove most of the air from the leather and to force water into it, so that all its fibres become wetted. Mere immersion without pressure changes is insufficient to wet some leathers.

NOTE 2 The percentage shrinkages of some leathers in the boil test depend to a marked extent on pH value; to obtain consistent results, fixed volumes of water must be used in which to wet and boil them.

NOTE 3 The temperature of boiling water depends upon atmospheric pressure. To maintain the temperature of the boiling water at 100.0 °C requires relatively elaborate apparatus, and 102.0 °C is used in the method because this is a temperature (near 100 °C) which is easily maintained.

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D.4 Expression of result

Calculate the mean percentage decrease, P, in diameter of the test piece by means of the following formula.

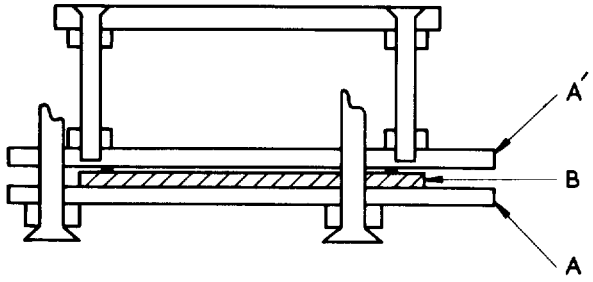
$$P = 100\ (S_0 - S_1)/S_0$$

where

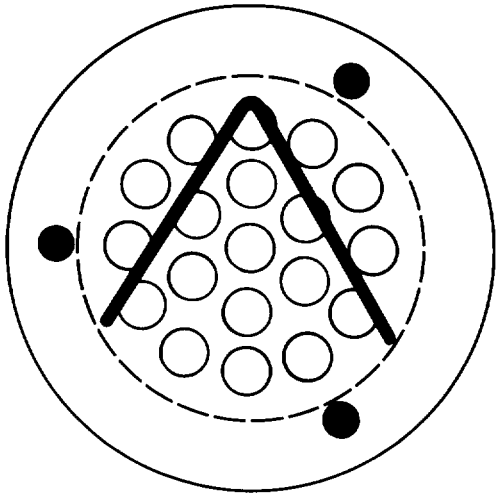
S_0 is the sum of the four marked diameters measured before heating;

S_1 is the sum of the four marked diameters measured after heating.

NOTE Test pieces which are initially circular and which shrink considerably in the boil test are sometimes far from circular after shrinkage. For such test pieces, the formula for P gives only a rough approximation of the mean percentage linear shrinkage. In such cases, however, the exact amount of shrinkage is seldom (if ever) of interest. The simple formula given is reasonably accurate for test pieces whose shrinkage is less than 10 %.



Part elevation (see **D.1** for description of lettered parts)



Plan of plate 'A' showing position of sample and wire

Figure 1 — Test piece holder for determination of shrinkage in boiling water

Publications referred to

This standard makes reference to the following British Standards:
BS 593, *Laboratory thermometers.*
BS 612, *Nessler cylinders.*
BS 1309, *Methods for sampling and chemical testing of leather.*
BS 1792, *Specification for one-mark volumetric flasks.*
BS 1911, *Genuine hard soap.*
BS 1912, *Soap flakes.*
BS 2780, *Glossary of leather terms.*
BS 3144, *Methods of sampling and physical testing of leather.*
BS 3978, *Water for laboratory use.*

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