BRITISH STANDARD

BS 3142-2: 1990

Specification for

Manufactured solid smokeless fuels for household use —

Part 2: Cokes for domestic openable and closed appliances and open fires with fan-assisted primary air

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Solid Mineral Fuels Standards Policy Committee (SFC/-) to Technical Committee SFC/6, upon which the following bodies were represented:

Association of County Councils
Association of Metropolitan Authorities
British Coal Corporation
Chamber of Coal Traders
Coke Oven Managers' Association
Consumer Policy Committee of BSI
Independent Coke Producers' Association
Institute of Trading Standards Administration
Low Temperature Coal Distillers Association of Great Britain Ltd.
Solid Smokeless Fuels Federation

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Contents

Foreword

This Part of BS 3142 has been prepared under the direction of the Solid Mineral Fuels Standards Policy Committee and replaces BS 3142-2:1965 which is withdrawn.

This edition introduces technical changes to bring the standard up to date but it does not reflect a full review of the standard, which will be undertaken is due course.

The principle changes from the previous edition are as follows:

a) the standard is extended to cover openable appliances and open fires operating with fan-assisted primary air;

b) the larger size of coke is designated in line with current practice;

c) the values and units of parameters have been metricated;

d) reference to gas coke works has been deleted;

e) the testing and requirement for shale have been deleted.

The specification provides for two size ranges of domestic coke, made by the high temperature carbonization of coal. It is not applicable to fuels produced by other processes. Appliances for which these cokes are used include small domestic hot water supply and central heating boilers, solid fuel cookers, open and closed roomheaters and open fires with fan-assisted primary air requiring these size ranges. In all cases it is essential to employ the size of coke appropriate to the appliance in use. To ensure optimum performance in domestic use these cokes should be used in appliances included in the list of "Approved Domestic Solid Fuel Appliances"[1)], many of which comply with current British Standards.

Because the specification covers cokes which may have different densities and other characteristics, the behaviour in use of all cokes complying with it is not the same. For this reason it may be necessary with certain domestic appliances to adjust the controls to new settings to obtain optimum performance if the source of supply of coke is changed. This specification does no more than provide for the quality of cokes at the time that they are dispatched by the producer. It is recognized that quality control cannot be absolute with a product manufactured in quantities of thousands of tonnes a day. The control procedures adopted are designed to ensure that the coke is on average of the specified quality and to limit the frequency with which the coke in any one bag or other small consignment may be found to be of a quality outside the limiting values.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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, pages 1 to 16, 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.

[1)] Published by the Solid Fuel Advisory Service and the Solid Smokeless Fuels Federation.

1 Scope

This Part of BS 3142 specifies the sampling procedure, requirements and test methods for cokes at producers' works, intended for use in coke-burning openable and closed domestic appliances and open fires operating with fan-assisted primary air. These cokes have an overall nominal aperture size range of 10.0 mm to 45.0 mm in accordance with the square aperture plate in Table 3 of BS 410:1986 and are classified as follows:

S (singles): nominal size range 10.0 mm to 25.0 mm square hole

D (doubles): nominal size range 16.0 mm to 45.0 mm square hole

The specification applies to cokes produced under the following manufacturing arrangements:

a) S only;

b) S and D simultaneously from the same coals.

NOTE 1 When a plant is producing S and D coke simultaneously the reactivities of these cokes will be similar. For this reason a combustion test on the S coke is regarded as providing adequate control of the quality of the D coke and no separate combustion test of the D coke is required by this Part of BS 3142.

NOTE 2 The cokes may be dispatched in weighed bags and/or in bulk.

NOTE 3 The titles of the publications referred to in this Part of BS 3142 are listed on the inside back cover.

2 Sampling and preparation of samples

Regular sampling of cokes that are intended to comply with this Part of BS 3142 shall be carried out at producers' works. The samples shall be collected in the manner described in Appendix A and shall be prepared for testing in accordance with Appendix B.

3 Size

When tested in accordance with Appendix C, cokes shall comply with one of the following sets of requirements:

a) **S coke**

1) ***Undersize.*** The mean proportion of coke passing a 10.0 mm square-aperture test sieve complying with BS 410 shall be not greater than 5 % (but see clause **6**).

2) ***Oversize.*** The mean proportion of coke retained on a 25.0 mm square-aperture test sieve complying with BS 410 shall be not greater than 5 % (but see clause **6**).

b) **D coke**

1) ***Undersize.*** The mean proportion of coke passing a 16.0 mm square-aperture test sieve complying with BS 410 shall be not greater than 5 % (but see clause **6**).

2) ***Oversize.*** The mean proportion of coke retained on a 45.0 mm square-aperture test sieve complying with BS 410 shall be not greater than 5 % (but see clause **6**).

NOTE The purchase contract for the coke may indicate a narrower range of sieve sizes if specified by the supplier.

4 Total moisture

When tested in accordance with Appendix D, the mean total moisture content of S or D cokes as dispatched from producers' works shall be not greater than 12 % (but see clause **6**).

5 Combustion test

When tested in accordance with Appendix E, cokes shall comply with the following requirements (but see clause **6**).

Not more than one failure to meet the requirements of a) or b) in this clause shall be permitted in any assessment period.

If D coke is produced from plant which is at the same time producing S coke complying with the requirements of a) and b) as follows, provided that such D coke complies with the appropriate requirements of clauses **3**, **4** and **6**, it shall be deemed to comply with this Part of BS 3142 without being subjected to a combustion test.

a) ***High output test***. The mean water heating output during the 2 h high output test shall be not less than 4.4 kW.

b) ***Banking test***. The coke shall be capable of burning for a minimum period of 10 h with a mean water heating output not greater than 1.4 kW.

6 Quality control

Representative samples shall be taken in accordance with Appendix A. Determinations of total moisture, undersize and oversize shall be carried out on samples taken each day that the coke is dispatched from the works.

In order to control the consistency of quality of the coke the statistical treatment described in Appendix F shall be carried out on the test results for total moisture and size, obtained in accordance with Appendix C and Appendix D.

The results of these tests shall be assessed on running averages, corresponding with 40 consecutive results or an eight-week period, which are recalculated at approximately weekly intervals to ensure that the average values satisfy the specified mean values. As a further control of the consistency of the coke, limiting values are also specified beyond which not more than two results in the assessment period shall fall.

The limiting values for individual determinations (see Appendix F) shall be as follows:

total moisture:	16 % maximum
undersize:	8 % maximum
oversize:	8 % maximum.

Combustion tests shall be carried out on every third sample of coke. The results shall be examined individually and not more than one result in the assessment period shall fall outside the specified high output or banking requirements.

Appendix A Sampling procedure

A.1 Introduction

This appendix outlines the methods to be followed and the precautions to be observed in taking samples.

It is important to ensure that the samples taken reflect the quality and consistency of all the coke dispatched. This requires special attention if the coke is dispatched in bags and/or bulk from more than one point.

NOTE Point of dispatch refers to the point in the works at which either bags are filled and loaded for dispatch or wagons are loaded with coke.

A.2 Frequency of sampling

Carry out sampling on every day that coke is dispatched from the producer's works. Take samples at such times in the course of each week that the whole loading period is covered.

A.3 Methods of sampling

Individual works differ in their procedures of coke handling. Some works dispatch coke in weighed bags, some in bulk and others by both methods. Two methods of sampling are specified, one for sampling where coke is filled into bags, the other for sampling the coke when it is loaded in bulk. The two procedures are described in **A.5** and **A.6** respectively.

If both the bag and the bulk loading points are fitted with similar debreezing or guard screens it is probable that the coke from each point will have the same size distribution. If this is found to be so by a series of tests, all samples shall be taken from the bag loading points by the method described in **A.5**, provided that all such points are covered in the sampling scheme.

For plants where a difference is found between samples of the coke loaded from different dispatch points, all such points shall be included in the sampling scheme, samples being taken from each by the methods described in **A.5** and **A.6**, with a frequency in proportion to the quantity of coke loaded from that point.

A.4 Stock and bought-in coke

Any coke taken from stock, or bought-in from other works, which forms a part of the coke bagged or loaded in bulk for subsequent dispatch, shall be taken into account in the scheme of sampling.

NOTE 1 If such coke is returned to the screening plant and mixed with current product for dispatch, no special arrangements are required.

If coke is loaded direct from stock heaps, take an appropriate number of the samples from this coke.

NOTE 2 As a guide the frequency of sampling from stock heaps should depend on the proportions loaded from stock and loaded direct from current production.

If there is a significant difference between the quality of the coke from stock and that of the coke from the current production, they shall be regarded as separate products for the purposes of sampling and testing.

A.5 Bag sampling

When sampling 50 kg bags of S coke take two bags together each day from those filled for dispatch. Use one of these bags as the sample for a total moisture determination and the other for size analysis. If smaller bags are being filled, take sufficient bags to provide the two 50 kg samples. Use these samples as necessary for the combustion test as indicated in Appendix B.

When sampling bags of D coke the same principles apply. In this instance take bags for size analysis each day the coke is dispatched and for a total moisture determination either each day or every third day that it is dispatched.

NOTE 1 The relaxation of sampling D coke every third day for total moisture is permitted only so long as the S coke complies with the total moisture requirements specified in clause 4 and provided that both cokes are being dispatched without being mixed with coke taken from stock.

After the samples have been taken ensure that the coke is removed from the bags otherwise changes may occur in size or total moisture content, or both. Unless the samples are to be prepared immediately for testing by the methods described in Appendix B, transfer the coke samples at once to closeable containers of metal or other rigid material and close the containers immediately.

NOTE 2 Sanitary dustbins with tight-fitting lids complying with BS 792 are suitable for this purpose.

A.6 Sampling during bulk loading

Take two samples of S coke each day that coke is dispatched, one for total moisture determination and the other for size analysis. The mass of each sample shall be approximately 50 kg and in no circumstances greater than 100 kg. These samples shall also be used as necessary for the combustion test as indicated in Appendix B.

When sampling D coke the same principles shall apply. Take samples for size analysis each day the coke is dispatched and for a total moisture determination either each day or every third day that it is dispatched.

Sample either at the loading point or at some position between the last screen (final debreezing screen if fitted) and the loading point. Take each sample as one increment with the loading boom or conveyor temporarily stopped, the whole cross section of the coke being sampled, or collect it at a point where the coke is falling freely and taken so that the whole cross-section of the stream is sampled at once.

NOTE If neither of these procedures is practicable, collect each sample by taking increments, at intervals as short as possible, representative of the whole cross section of the stream of coke. The mass of each increment should be as large as possible and in no case less than 5 kg.

Unless the samples are to be prepared immediately for testing, transfer them at once to closeable containers of metal or other rigid material and close the containers immediately.

Appendix B Preparation of samples for testing

B.1 Introduction

The two samples of S coke, taken as described in Appendix A each day that the coke is dispatched from the works, shall be used for the following determinations as required:

sample A:	total moisture
sample B:	size analysis
	combustion test.

The two samples of D coke, taken as described in Appendix A, shall be used for the following determinations as required and sample A will have been taken either each day or every third day that the coke is dispatched from the works. Sample B will have been taken each day that coke is dispatched from the works.

sample A:	total moisture
sample B:	size analysis.

B.2 Size analysis

Spread the whole of sample B in a layer, no deeper than 50 mm for D coke and 35 mm for S coke, on a hard, clean surface. Remove a sub-sample of about 25 kg by taking increments each of about 0.7 kg and evenly distributed over the whole sample. Use the remainder of the sample for the determination of oversize and undersize as described in Appendix C.

B.3 Total moisture

Crush sample A for the determination of total moisture. Two alternative procedures involving different sample preparation are permitted and these are as follows.

a) Crush and sub-sample the sample in accordance with BS 1017-2. Determine the total moisture in accordance with **D.2**.

b) Spread the whole of the uncrushed sample in a single layer on a hard, clean surface and take 35 increments each of about 0.7 kg and evenly distributed over the whole sample. Determine the total moisture in accordance with **D.3**.

B.4 Combustion test

Spread the sub-sample (see **B.2**) into a layer no deeper than 35 mm on a hard, clean surface. Collect a volume of 11.5 L in the calibrated container (**E.2.6**) by taking increments each of about 0.7 kg and evenly distributed over the sub-sample. Use this coke for the initial charging of the boiler for the combustion test.

Collect the further quantity of coke required for the banking charge by similar increments and store and retain the remainder in a closed container in case it is needed for a repeat combustion test (see **E.7**).

NOTE The samples may be dried, if desired, before carrying out the combustion and banking test.

Appendix C Determination of undersize and oversize

Analyse the relevant sample, obtained and prepared in accordance with Appendix A and Appendix B, in accordance with BS 1016-18. Determine the amounts of coke passing the undersize sieve and retained on the oversize sieve and record the results as percentage by mass of undersize and oversize respectively.

Appendix D Determination of total moisture

D.1 Introduction

Two alternative methods are described for the determination of total moisture. One method involves crushing the sample, the other does not. These are of equal accuracy for the purposes of this specification and either may be used.

D.2 Total moisture determination on the crushed sample

Determine the total moisture of the relevant sample, obtained and prepared in accordance with Appendix A and **B.3** a), in accordance with BS 1016-2.

D.3 Total moisture determination on the uncrushed sample

D.3.1 *Sampling*

Obtain and prepare the sample in accordance with Appendix A and **B.3** b).

D.3.2 *Principle*

The sample of coke is heated to constant mass in an air oven at 105 °C to 200 °C and its moisture content is calculated from the loss in mass.

D.3.3 ***Apparatus***

D.3.3.1 *Drying trays,* preferably of non-corrodible metal, not more than 15 cm deep and of an area sufficient to contain the sample.

D.3.3.2 *Oven,* capable of accommodating the required number of drying trays and of maintaining a temperature within the range 105 °C to 200 °C over a period of 16 h.

D.3.4 ***Procedure***

Transfer the uncrushed sample of coke of mass approximately 25 kg to a tray(s) (**D.3.3.1**) weighed to the nearest 0.01 kg. Weigh the tray(s) of coke to the nearest 0.01 kg and heat in the oven (**D.3.3.2**) at 105 °C to 200 °C for 5 h to 16 h. Remove carefully the tray from the oven and weigh to the nearest 0.01 kg while hot. Return the tray(s) to the oven for a further 1 h and then remove and reweigh, to the nearest 0.01 kg. Return the tray(s) to the oven for successive periods of 1 h followed by removal and reweighing until the difference in mass between successive weighings is no greater than 0.02 kg.

D.3.5 ***Calculation of result***

Calculate the percentage by mass of total moisture in the coke, M, from the equation:

$$M = \frac{(M_2 - M_3)}{(M_2 - M_1)} 100$$

where

M_1 is the mass of empty tray(s) (in kg);

M_2 is the mass of tray(s) plus coke before drying (in kg);

M_3 is the mass of tray(s) plus coke after drying (in kg).

Appendix E Combustion test

E.1 Principle

Samples of S coke taken every third day that coke is dispatched from the works are tested for high output and banking performance in a small independent hot water boiler.

A standard volume of 11.5 L of the prepared sample of coke is charged into a specified thermostatically controlled small independent hot water boiler. Using a special igniter, the coke is ignited with 5.3 MJ of gas supplied at a uniform rate of 15.8 MJ/h. The thermostat is so adjusted that a mean water heating output of at least 4.4 kW is obtained from the boiler over the 2 h period following the attainment of a water heating output of 4.4 kW.

The boiler is then operated for 30 min at the thermostat setting one above that required for banking.

The thermostat is then set to give a mean water heating output not greater than 1.4 kW, the boiler is filled to capacity and allowed to operate undisturbed. Satisfactory banking is assessed either by revival of the fire after 10 h or alternatively by examination of the hot water output/time chart after 12 h.

E.2 Equipment

E.2.1 ***Boiler***

The boiler used shall be the Crane 20A, installed as shown in Figure 1. The boiler shall be connected to a straight cylindrical cast iron flue pipe 305 cm long by 102 mm internal diameter, complying with BS 41. The pipe shall be insulated with 25 mm thickness of non-asbestos mineral wool with an outside wrapper of millboard. The thermostat bypass of the boiler shall be closed and the four secondary air openings shall be sealed. The flue damper shall be fully opened at all times.

E.2.2 ***Thermostat***

The type QW/JS thermostat shall be used (see Figure 2). This differs from the type QW/A thermostat normally fitted to the boiler only in so far as its bearing surfaces are machined and chromium plated to inhibit wear.

The thermostat shall be calibrated in accordance with Appendix G and shall be positioned with its sensing element in the water outlet pipe from the boiler, as shown in Figure 1 and Figure 3(b).

E.2.3 ***Extraction system***

Products of combustion shall be carried away by an extraction system which shall have no effect on the draught in the boiler flue.

E.2.4 ***Ignition burner and gas supply***

The ignition burner shall be as shown in either Figure 4 or Figure 5 depending upon which gas is used.

The gas used for ignition shall be either simulated town gas or coke oven gas (1st family gas) or natural gas (2nd family gas) having a calorific value in the range of 16.8 MJ/m^3 to 20.9 MJ/m^3 and 38.2 MJ/m^3 to 40.2 MJ/m^3 respectively. The gas supply to the ignition burner shall include a pressure governor, a calibrated test gas meter reading to 1 L, a control valve and a stopcock. A flowmeter may also be included for checking the gas rate to the ignition burner.

The gas shall be supplied at a rate corresponding to 15.8 ± 0.6 MJ.

E.2.5 ***Temperature measurement***

Use one of the two types of instrument below (positioned as shown in Figure 3) and the fittings shown in Figure 3.

a) *Two resistance thermometers,* 0 °C to 100 °C scale, accurate to ± 0.5 °C.

b) *Two thermocouples.* The temperature difference between the inlet and outlet water is recorded by means of nickel-chromium/nickel-aluminium thermocouples (positioned as shown in Figure 3), connected to a recording instrument accurate to 0.1 mV.

Convert readings from millivolts to degrees Celsius in accordance with BS 4937-4.

NOTE 1 A suitable scale for the recorder is 0 mV to 10 mV. In order to record adequately the water temperature rise it is desirable to connect three thermocouples in series (calibrated as a unit) in both the inlet and outlet pipes.

NOTE 2 If desired, the thermocouples may be sheathed.

E.2.6 ***Container***

Use a container calibrated at 11.5 L water capacity.

NOTE A suitable container may be made of calibrating a domestic solid fuel hod made of non-corrodible material. Add 11.5 kg water to the hod and mark the water level on the inside. A permanent indication may conveniently be made by drilling two or three holes through the hod at that level.

E.3 Water supply

The initial temperature of the water supply to the boiler shall be within the range 23.5 °C to 26.5 °C. For any one test the temperature shall not vary by more than 16 ± 1.5 K from the initial temperature set.

The flow rate shall be controlled at between 87.5 kg/h and 92.5 kg/h for the 2 h high output test period and between 43.5 kg/h and 46.5 kg/h for the banking test. Once set, the flow rate for any one test shall not vary by more than 0.68 kg/h. A constant water rate may be obtained by means of either carburetter jets or a valve. In either case the rate of flow shall be established and checked by weighing the water over a known period.

NOTE If a valve is used, a flowmeter may be included in the circuit for the instantaneous checking of the flow rate.

E.4 Sample

Prepare a sub-sample of the coke in accordance with Appendix B.

E.5 Procedure

Set the water flow rate within the range of 87.5 kg/h to 92.5 kg/h and, once set, maintain it within a tolerance of 0.68 kg/h. Start the recorder and note the inlet water temperature. Set the thermostat so that the water temperature difference obtained is equivalent to an output of at least 4.4 kW (see **E.8**).

Charge the boiler with a volume of coke equivalent to 11.5 L, any coke falling through the grate being replaced in the boiler. Set the gas rate through the ignition burner at a rate equivalent to 15.8 ± 0.6 MJ/h and remove the deashing lever guide casting.

Ignite the gas and fit the burner to the deashing lever. Supply a volume of gas equivalent to 5.3 ± 0.1 MJ. Extinguish the gas supply, remove the ignition burner and replace the deashing lever guide casting. Replace the ashpan, leaving it partially withdrawn. Leave the ashpit door open until the water heating output reaches 3.5 kW, then push in the ashpan and close the ashpit door.

Record the time at which the water heating output reaches 4.4 kW. The thermostat dial setting may need adjustment at this point but do not adjust it during the ensuing 2 h. At the end of this 2 h period note whether the mean value of the water heating output has exceeded 4.4 kW. If this output has not been attained discontinue the test (see **E.7**).

Immediately at the end of the 2 h high output period set the thermostat to the number one above that chosen for banking and maintain this setting for 0.5 h. Reduce the water rate to within the range 43.5 kg/h to 46.5 kg/h and, once set, maintain it to within a tolerance of 0.68 kg/h. After a further 0.5 h set the thermostat to the number chosen for banking. Fill the boiler to capacity, taking care to ensure that it is full at the rear and sides, and close the refuelling lid properly.

NOTE It is important that when any change of thermostat setting is made the dial be turned to "12" before being turned to the new setting.

Ensure that the water flow and thermostat setting are left unaltered for 10 h or 12 h (see **E.6**) and do not add further fuel.

E.6 Assessment of banking

Banking shall be deemed to have taken place satisfactorily if, during the banking period, the mean value for the water heating output has not exceeded 1.4 kW and either of the following requirements is complied with

a) after a banking period of 10 h the fire revives when the thermostat setting is increased to 12;

b) at the end of a banking period of 12 h the hot water output/time trace is remaining substantially level.

E.7 Repeat tests

If the coke fails to comply with the requirements of the banking test because of an incorrect setting of the thermostat, carry out a repeat test on the reserve sample of coke (see **B.4**), provided that one of the following requirements was complied with during the original test:

a) the mean hot water heating output for the period of banking was not greater than 1.35 kW and the test did not last for the required 10 h to 12 h period (see **E.6**) (the output of the last 4 h of the banking period shall not be taken into account when measuring the mean output);

b) the mean water heating output was greater than 1.4 kW during the banking period.

E.8 Calculation of water heating output

Calculate the total water heating output, H_w (in kW), as either an instantaneous or a mean water heating output over a given period, from the following equation:

$$H_w = \frac{C_p WN}{3600}$$

where

C_p is the mean specific heat capacity of water 4.187 kJ/(kg·K);

W is the mean water flow rate through the boiler (in kg/h);

N is the water temperature difference or the mean water temperature difference over the given period (in K).

E.9 Recording of results

Record the following information:

a) whether the mean water heating output during the 2 h high output period was greater than 4.4 kW;

b) whether the coke was capable of banking at a mean water heating output not greater than 1.4 kW for 10 h as specified in **E.6**.

Appendix F Quality control

F.1 Introduction

This appendix describes the method of examining the results of tests which have been carried out at the producer's works to establish whether the coke complies with this Part of BS 3142. The results to be examined fall into the following two groups.

a) Total moisture content determination, undersize and oversize tests. These are carried out on samples taken each day that coke is dispatched from the producer's works.

b) Combustion tests for S coke are carried out on samples taken every third day that coke is dispatched from the producer's works.

The requirements of this Part of BS 3142 have been stated in terms of mean values calculated over an assessment period for eight complete weeks or, alternatively, the period covered by 40 consecutive samples, and also of limiting values beyond which not more than a specified number of individual results shall fall in the same period. Alternative methods of assessment of an equivalent standard are described to meet the requirements of works dispatching coke on varying number of days each week and because certain works may prefer to assess results weekly, while others may prefer to assess results on a fixed number of consecutive samples irrespective of the period over which they are taken.

F.2 Tests on all samples

F.2.1 *General*

The requirements of this Part of BS 3142 for S and D coke in respect of undersize and oversize and total moisture are given in clauses **3**, **4** and **6**.

F.2.2 *Assessment on forty consecutive samples*

Record the mean of the results for each of the above variables when 40 determinations have been made. When a further five determinations have been made recalculate and record the mean using the 40 most recent results. The mean values so calculated shall at all times comply with clauses **3** and **4** and at no time shall more than two out of 40 determinations fall beyond the appropriate limiting values specified in clause **6**.

F.2.3 *Assessment on eight-weekly basis*

Record the mean of the results for each of the variables at the end of eight weeks. At the end of each ensuing week recalculate and record the mean using the test results obtained during the eight most recent weeks. The mean values so calculated shall at all times comply with clauses **3** and **4** and at no time shall the appropriate limiting values stated in clause **6** be exceeded more often than stipulated in Table 1.

F.3 Tests on every third sample

The requirements of this Part of BS 3142 for S coke in respect of high output and banking in the combustion test are specified in clause **6**.

Record the mean of the results for total moisture over the assessment period (see Table 1). When a further two determinations have been made recalculate the mean which shall always correspond to the most recent assessment period. The mean value so calculated shall at all times comply with clauses **4** and **6** and at no time shall more than one determination in the assessment period fall beyond the appropriate limiting values specified in clause **6**.

Examine individually the results of the combustion test to check that they comply with clause **5**. At no time shall more than one combustion test in an assessment period fail to comply with clause **5**.

Appendix G Calibration of the thermostat

G.1 Principle

Calibration of the thermostat (**E.2.2**) is undertaken in two stages as follows:

a) checking of the mechanical response; and

b) calibration of the dial setting.

The checking of the mechanical response is carried out on the instrument detached from the boiler to ensure its smooth operation throughout its temperature range. Calibration of the dial setting is carried out after fitting the thermostat to the boiler set up as described in Appendix E.

NOTE The purpose of this calibration is to check that the thermostat will control the test boiler over the desired range of outputs while burning the coke normally under examination.

G.2 Frequency of calibration

Ensure that the mechanical response is checked (see **G.3**) before the thermostat is accepted as being suitable for test purposes and thereafter at intervals not exceeding 12 months. Ensure that the dial setting is calibrated (see **G.4**) before commencing any testing and subsequently whenever the thermostat is refitted to the boiler after being removed for any purpose. If it becomes apparent that the characteristics of the thermostat have changed during use, recalibrate the thermostat in accordance with **G.3** and **G.4**.

G.3 Checking the mechanical response

G.3.1 *Procedure*

Examine the thermostat for visible defects prior to calibration then set it up for testing. After removing the valve plate, clamp vertically the thermostat with the sensing element immersed in water at approximately room temperature in a container equipped with a thermometer and stirrer. Arrange a horizontal millimetre scale to measure the movement of the free end of the valve arm (see Figure 2). Turn fully anticlockwise the dial of the thermostat and fix a pointer in line with "1" on the dial. Set the dial so that "2" is in line with the pointer. Record the temperature of the water and the position of the valve relative to the millimetre scale. Heat the water so that the temperature rises at a rate not exceeding 3 K/min until a temperature of 55 °C is reached. During this period stir the water continuously and record the position of the valve arm relative to the scale at intervals of 5 K.

Plot a graph of the positions of the valve arm against the respective water temperatures as shown in Figure 2. Repeat the procedure with the water temperature falling at approximately the same rate but not exceeding 3K/min and plot the results on the same graph. Repeat the procedure with "12" on the dial in line with the pointer but in this case allow the temperature to rise to 75 °C.

G.3.2 *Requirements*

The pairs of curves plotted (see **G.3.1**) shall be substantially smooth and regular. The vertical distance at any point between the individual curves forming the pairs obtained at dial settings "2" and "12" shall be not greater than the equivalent on the scale of 3 mm in both cases. If a substantially smooth curve is not obtained or the above distances between the individual curves are greater than the requirements, the thermostat shall be rejected.

G.4 Calibrating the dial setting

G.4.1 *Procedure*

Fit the thermostat to the boiler with the sensing element located as shown in Figure 1 and Figure 3(b). Set an index marker or pointer on the casing of the boiler immediately above the thermostat dial so that it is located midway between the positions of "1" with the dial turned fully anticlockwise and "12" with it turned clockwise. Adjust the position of the valve plate by rotating the screw so that the distance between the plate and its seating with the boiler at room temperature and with the dial set at "12" is approximately 22 mm.

NOTE To obtain this adjustment it may be necessary to loosen the locking nut of the valve plate and alter its position on the screw; in some cases it may be necessary to bend the valve arm slightly.

Charge the boiler with approximately 11.5 L of coke similar in type to the coke to be tested and ignite the charge as described in **E.5**, with the water rate set between 43.5 kg/h and 46.5 kg/h. With the dial set at "12" allow the trace recording of the water temperature to remain steady for 1.5 h and record the mean control temperature. In cases where the water temperature differential is recorded, note the mean inlet water temperature indicated by the thermometer and add this to the mean differential temperature in order to obtain the mean control temperature. Obtain the mean control temperatures corresponding to dial settings "10", "8", "6", "4" and "2" by the same procedure. De-ash and refuel the boiler each time the dial setting is changed. Before adjusting the thermostat to any setting turn the dial in every case first to "12" before setting to the desired number.

Obtain a calibration graph by plotting the mean control temperatures against the corresponding dial settings.

G.4.2 ***Requirements***

If the curve of the graph plotted (see **G.4.1**) is not smooth and regular the thermostat shall be rejected. It is essential to check that the thermostat is capable of control at an output of 1.4 kW (the maximum banking rate) with the dial set at a number not less than "2". To achieve this it may be necessary to adjust the position of the valve plate slightly (see **G.4.3**).

G.4.3 ***Adjustment of thermostat valve plate***

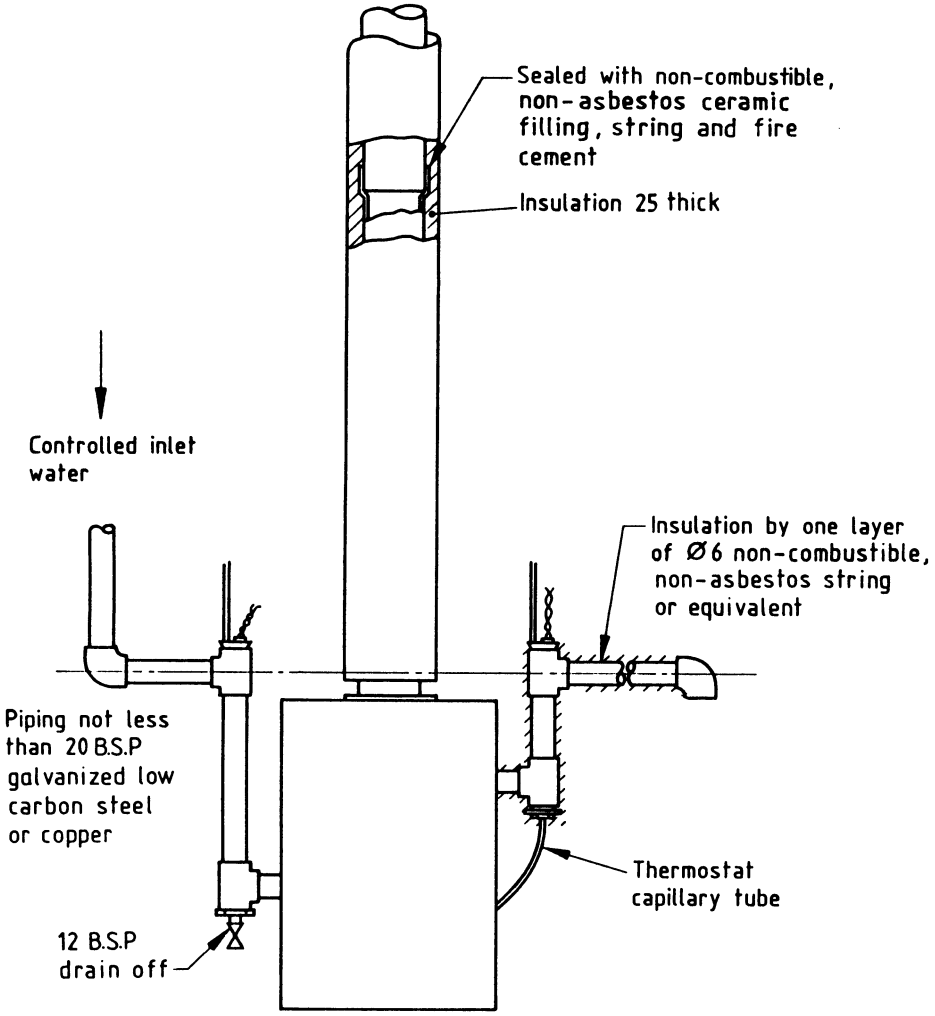
To facilitate the adjustment of the valve plate when in position on the boiler it is convenient to dismantle the valve plate and mounting, consisting of a 2 BA screw, lock-nut and washer, and to provide a second lock-nut. Reassemble the parts as shown in Figure 7. Then adjust the distance, D, between the valve plate and seat by means of the screw, S, securing it with the lock-nut, L.

Table 1 — Alternative methods of assessing results

Number of samples normally taken each week (i.e. number of days that coke is normally dispatched from works each week)		Less than 5	5		6		7	
Assessment period		40 consecutive samples	40 consecutive samples	8 weeks[a]	40 consecutive samples	8 weeks[a]	40 consecutive samples	8 weeks[a]
Total moisture Undersize Oversize	Number of consecutive samples tested	All	All	All	All	All	All	All
	Number of results beyond limiting value which may occur within the assessment period	2	2	2	2	2	2	3[b]
	Period after which mean is recalculated	5 consecutive tests	5 consecutive tests	1 week	5 consecutive tests	1 week	5 consecutive tests	1 week
Moisture: D coke	Number of consecutive samples tested	Every third	Every third	Every third	Every third	Every third	Every third	Every third
	Number of results beyond limiting value which may occur within the assessment period	1	1	1	1	1	1	1

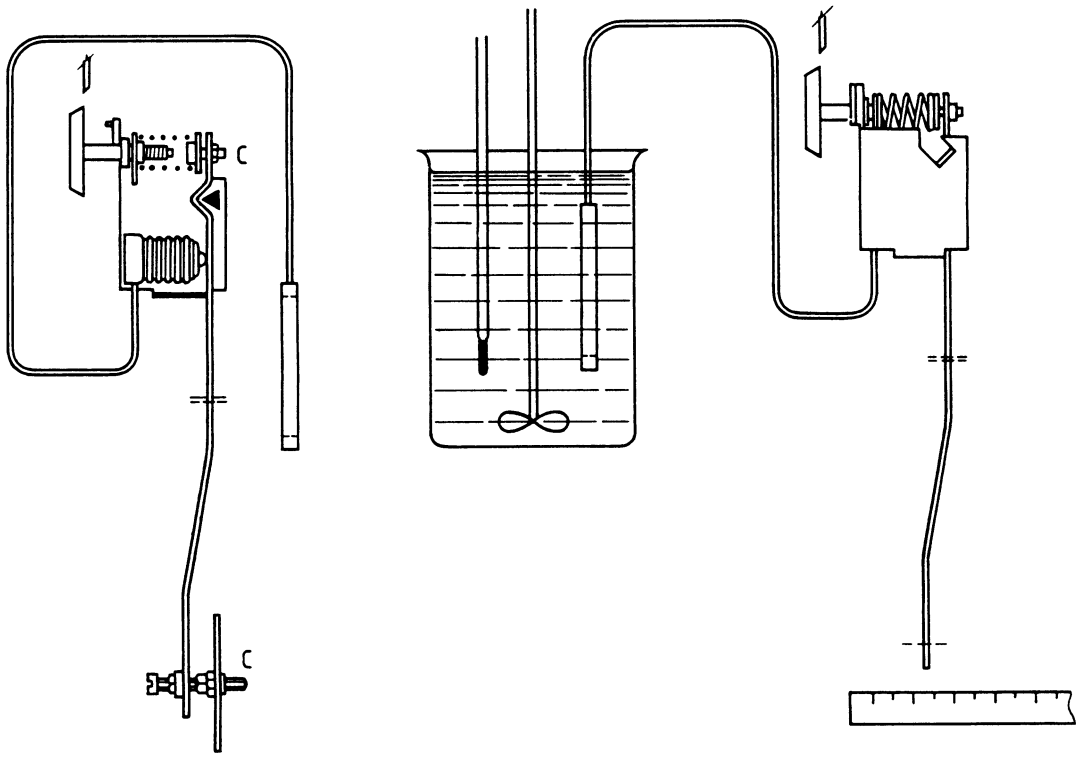
[a] Using these methods of reporting there will be fewer than 5, 6 or 7 samples, as the case may be, taken in weeks containing public holidays, unavoidable breakdowns, etc. Thus when operating the eight-weekly system for coke dispatched on 5 days a week the assessment will, for example, be made on 38 results for a period containing Christmas Day and Boxing Day.

[b] If there are fewer than 50 results in an eight-week period



Dimensions are in millimetres.

Figure 1 — Test setting for boiler performance tests

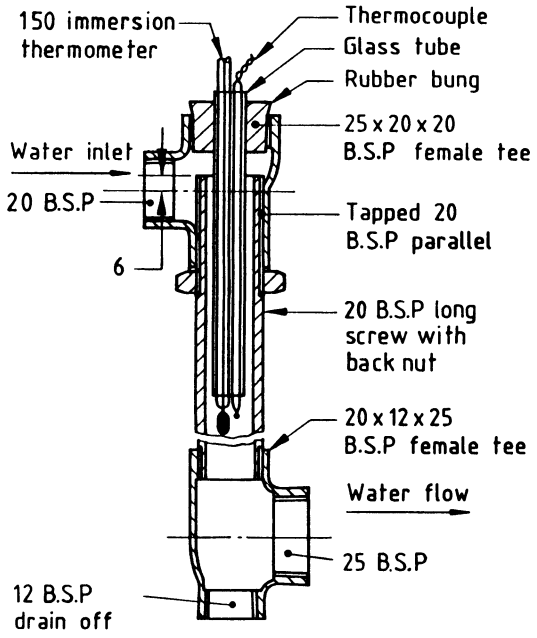


C = adjustments

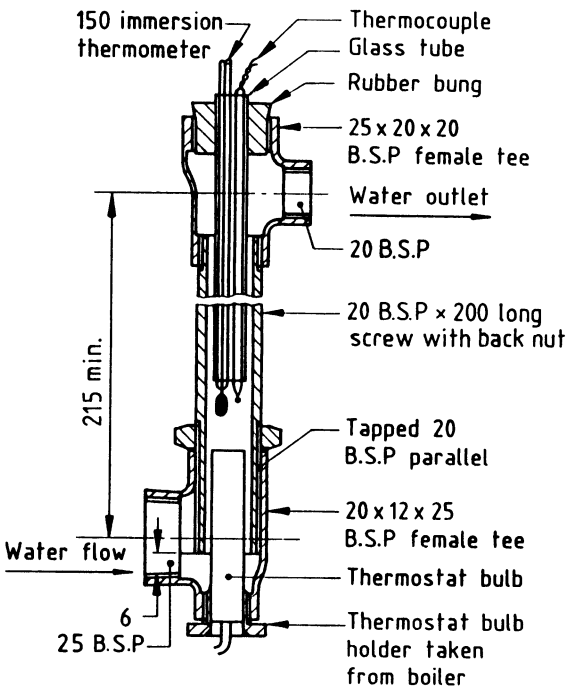
(a) Diagrammatic view

(b) Set up for calibration

Figure 2 — QW/JS thermostat



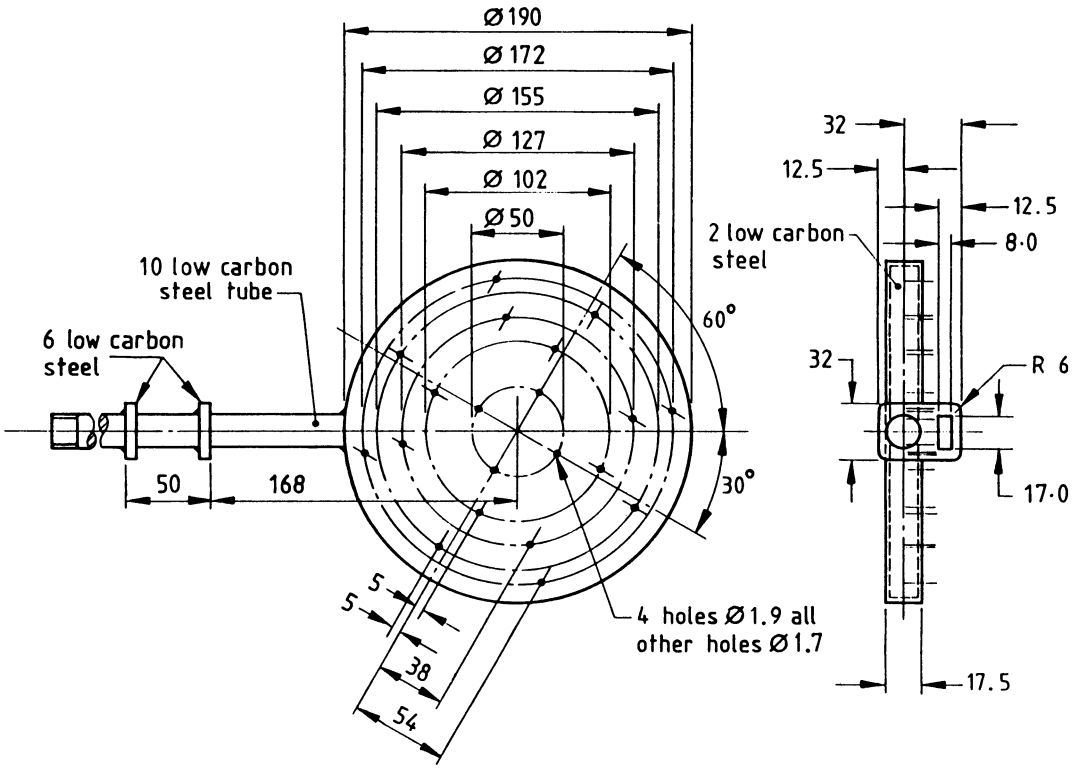
(a) Inlet fitting



(b) Outlet fitting

All dimensions are in millimetres.

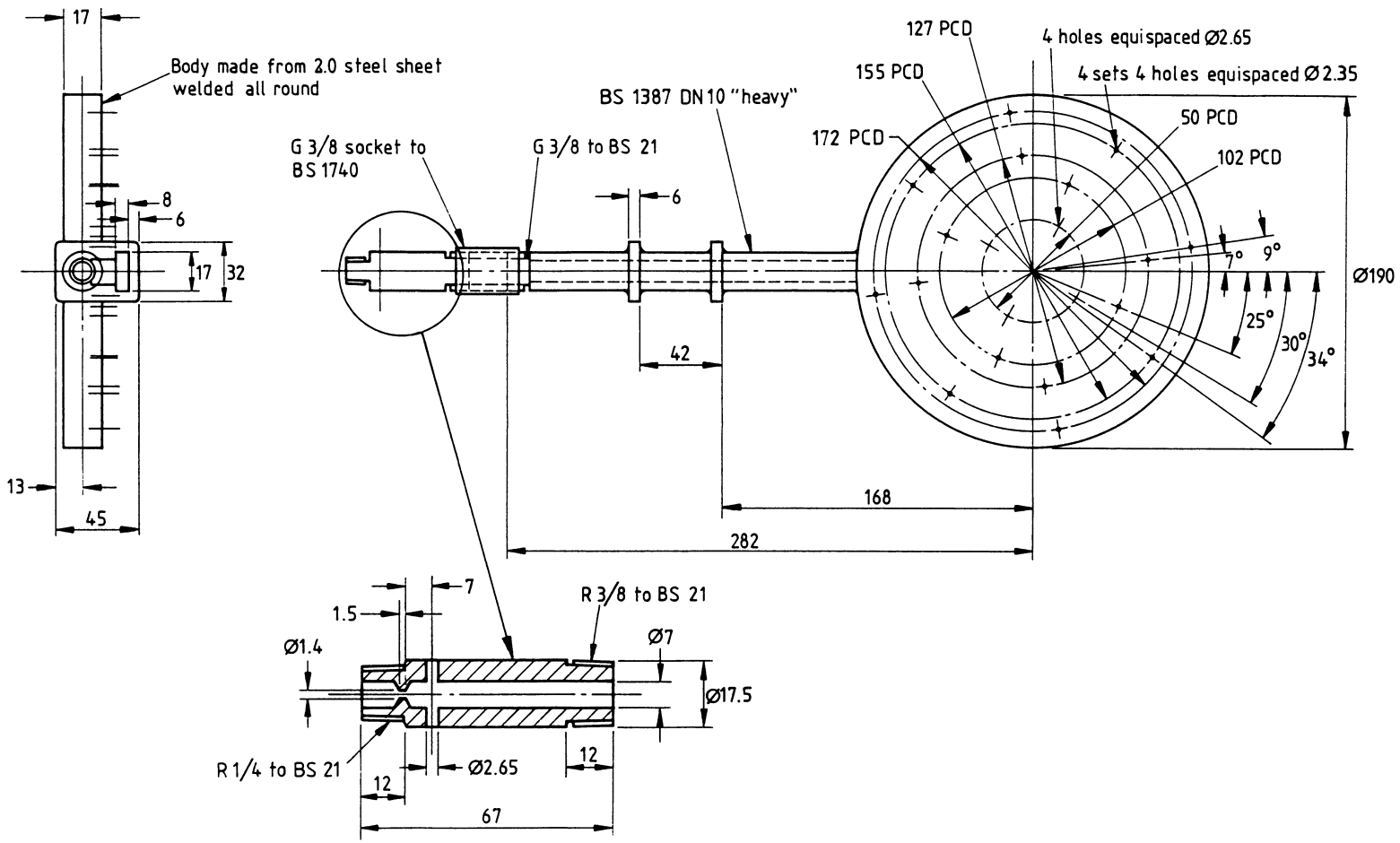
Figure 3 — Fittings for water temperature measurement (see Figure 1)



Dimensions are in millimetres.

NOTE All-welded construction.

Figure 4 — Ignition burner for simulated town or coke oven gas (1st family gas)



Dimensions are in millimetres unless otherwise stated.

Figure 5 — Ignition burner for natural gas (2nd family gas)

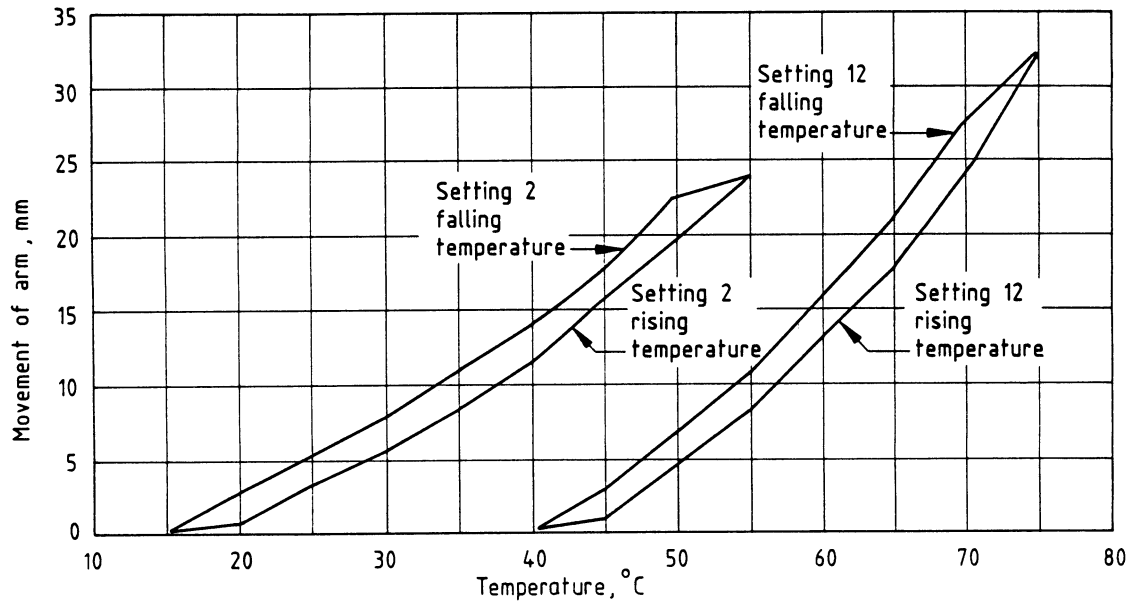


Figure 6 — Thermostat calibration curves

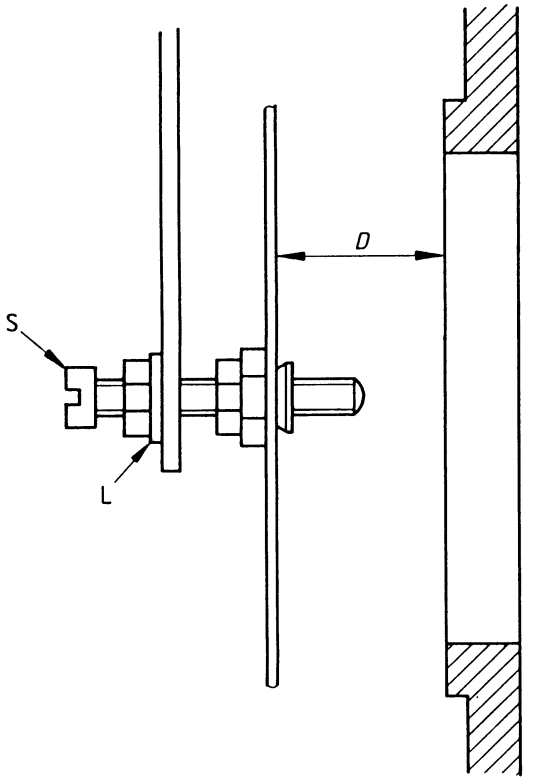


Figure 7 — Modified valve plate mounting
(see **G.4.3**)

Publications referred to

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions).*

BS 41, *Specification for cast iron spigot and socket flue or smoke pipes and fittings.*

BS 410, *Specification for test sieves.*

BS 792, *Specification for mild steel dustbins.*

BS 1016, *Methods for analysis and testing of coal and coke.*

BS 1016-2, *Total moisture of coke.*

BS 1016-13, *Tests special to coke.*

BS 1016-18, *Size analysis of coke.*

BS 1017, *Methods for sampling of coal and coke.*

BS 1017-2, *Sampling of coke.*

BS 1387, *Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads.*

BS 1740, *Specification for wrought steel pipe fittings (screwed BS 21 R-series thread).*

BS 4937, *International thermocouple reference tables.*

BS 4937-4, *Nickel-chromium/nickel-aluminum thermocouples. Type K.*

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