

Specification for

Manufactured solid smokeless fuels for household use —

**Part 3: Specially reactive fuels for all
types of domestic open fire**

Co-operating organizations

The Solid Fuel Industry and the Gas Industry Standards Committees, under whose supervision this British Standard was prepared, consist of representatives from the following Government departments and scientific and industrial organizations:

- Association of Consulting Engineers
- BCURA Industrial Laboratories
- British Cast Iron Research Association
- British Coke Research Association*
- British Electrical and Allied Manufacturers' Association
- British Ironfounders' Association*
- British Mechanical Engineering Confederation
- British Steel Industry
- Chamber of Coal Traders
- Chemical Industries Association
- Coal Utilisation Council*
- Coke Oven Managers' Association*
- Council of Ironfoundry Associations
- Domestic Solid Fuel Appliances Approval Council
- Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
- Gas Council*
- Heating and Ventilating Contractors' Association
- Imperial Chemical Industries Ltd.
- Institute of British Foundrymen
- Institute of Fuel
- Institution of Gas Engineers
- Institution of Heating and Ventilating Engineers
- Institution of Mechanical Engineers
- Liquefied Petroleum Gas Industry Technical Committee
- Low Temperature Coal Distillers' Association of Great Britain Ltd.*
- Ministry of Housing and Local Government
- Ministry of Public Building and Works
- Ministry of Technology
- National Coal Board*
- Society of British Gas Industries
- Water-tube Boilermakers' Association
- Women's Advisory Council on Solid Fuel*

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:

- Association of Municipal Corporations
- Consumer Council
- Consumers' Association
- County Councils Association
- Independent Coke Producers Association
- Institute of Weights and Measures Administration
- National Federation of Coke Distributors' Associations
- Solid Smokeless Fuels Federation
- Women's Advisory Committee of BSI

This British Standard, having been approved by the Solid Fuel Industry and the Gas Industry Standards Committees, was published under the authority of the Executive Board on 18 November 1970

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Foreword

This standard makes reference to the following British Standards and Code of Practice:

- BS 410, *Specification for test sieves.*
- BS 792, *Specification for mild steel dustbins.*
- BS 1016, *Methods for the analysis and testing of coal and coke.*
- BS 1016-1, *Total moisture of coal.*
- BS 1016-2, *Total moisture of coke.*
- BS 1016-3, *Proximate analysis of coal.*
- BS 1016-4, *Moisture, volatile matter and ash in the analysis sample of coke.*
- BS 1016-5, *Gross calorific value of coal and coke.*
- BS 1016-13, *Tests special to coke.*
- BS 1016-18, *Size analysis of coal.*
- BS 1017, *Methods for sampling coal and coke.*
- BS 1017-1, *Sampling of coal.*
- BS 1017-2, *Sampling of coke.*
- BS 1251, *Specification for open-fireplace components.*

This Part of BS 3142 has been prepared under the direction of the Solid Mineral Fuels Standards Policy Committee. A minor amendment, published in 1990, deleted references to asbestos-containing material for reasons of safety.

The specification provides for one size range of specially reactive fuels, made by the partial carbonization of coal, and intended for use with all types of domestic open fire. An alternative fire performance test is included.

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 18 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.

| *Introduction deleted*

1 Scope

This British Standard specifies the requirements of quality control at producers' works for specially reactive open fire fuels for use on all types of domestic open fires.

2 Sampling and preparation of samples

Regular sampling of fuels produced to this standard 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 the manner described in Appendix B.

3 Calorific value

When tested in the manner described in Appendix C the mean calorific value, as despatched from producers' works, shall be not less than 25 600 kJ/kg (11 000 Btu/lb).

4 Undersize

When tested in the manner described in Appendix D the mean proportion of fuel passing a 19 mm ($\frac{3}{4}$ in) mesh BS test sieve¹⁾ shall not exceed 7 %.

5 Fire performance tests

When tested in the stool bottomgrate in the manner described in Appendix E, fuels shall conform to the following requirements.

Ignition time. The mean time for the radiation output to reach 630 W/m^2 ($200 \text{ Btu/ft}^2 \text{ h}$) using 4 220 kJ (4 000 Btu) of gas for ignition shall not exceed 35 min.

Three peak radiation test. The mean peak value for the third peak shall not be less than 945 W/m^2 ($300 \text{ Btu/ft}^2 \text{ h}$).

In Appendix F, provision is made for the use of an inset grate for fire performance testing, where it can be demonstrated that the fuel would meet the fire performance requirements of the specification if tested by the method of Appendix E. The alternative fire performance requirements are also given in Appendix F.

6 Assessment of results

The method of assessing the results is given in Appendix G.

¹⁾ BS 410, "Test sieves"

Appendix A Sampling procedure

A.1 Introduction

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

A.2 Frequency of sampling

Sampling shall normally be carried out on every day on which fuel is despatched from the producer's works. Samples shall be taken 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 procedure of fuel handling. Some works despatch fuel in weighed bags, some in bulk and others by both methods. Two methods of sampling are specified, one for sampling where fuel is filled into bags, the other where the fuel is loaded in bulk. The two procedures are described in **A.5** and **A.6** respectively.

It is important to ensure that the samples taken reflect the quality and consistency of the fuel despatched. This requires special attention where the fuel is despatched either from more than one point²⁾ or both in bags and in bulk.

For some plants this can be achieved by using only one method to sample the fuel despatched. Two such examples are as follows.

Example 1. If both the bag and the bulk loading points are fitted with similar de-breezing or guard screens it is probable that the fuel from each point will have the same size distribution. If this is found to be so, all samples can 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.

Example 2. If the fuel for despatch alternates between two bulk loading points and it is not practicable to obtain samples from one of these points, all the samples may be taken from the other loading point, provided that there are no differences in operating procedure which could introduce a significant bias.

For plants where a significant difference is found between samples of the fuel loaded from different despatch points it will be necessary to include all such points in the sampling scheme, samples being taken from each by the methods described in **A.5** and **A.6** with a frequency roughly proportional to the quantity of fuel loaded from that point.

A.4 Stock and "imported" fuel

Any fuel taken from stock or imported from other works, which forms a part of the fuel bagged or loaded in bulk for despatch, shall be taken into account in the scheme of sampling. Where such fuel is returned to the screening plant and mixed with current production for despatch, no special arrangements are required.

Where fuel is loaded direct from stock heaps, an appropriate number of the samples shall be taken from this fuel. As a rough guide the frequency of sampling from stock heaps should depend on the proportions loaded from stock and direct from current production.

A.5 Bag sampling

When sampling 50 kg (1 cwt) bags of fuel, two bags shall be taken together each day that fuel is despatched from those filled for despatch. One of those bags shall be used as the sample for the determination of calorific value, the other for the fire performance and undersize tests. If smaller bags are being filled, sufficient bags shall be taken to provide the two 50 kg (1 cwt) samples.

After the samples have been taken, the fuel shall not be left in the bags, as this may lead to changes in size or moisture content or both. Unless, therefore, the samples are to be prepared immediately for testing by the methods described in Appendix B, they shall be transferred at once to closeable containers³⁾ of metal or other suitable material, which shall immediately be closed.

A.6 Sampling during bulk loading

Two samples shall be taken each day that fuel is despatched. One of these samples shall be used for the determination of calorific value, the other for the fire performance and undersize tests. The weight of each sample shall be approximately 50 kg (1 cwt) and in no circumstances greater than 100 kg (2 cwt).

²⁾ "Point of despatch" refers to the point in the works at which either bags, wagons or lorries are loaded immediately prior to despatch.

³⁾ Sanitary dustbins with tight-fitting lids in accordance with BS 792, "Mild steel dustbins", are suitable for this purpose.

Sampling shall be carried out either at the loading point or at some position between the last screen (final de-breezing screen, if fitted) and the loading point. Each sample should be taken either as one or as a series of increments [each of which shall not be less than 4.5 kg (10 lb)] with the loading boom or conveyor temporarily stopped, the whole cross section of the fuel being taken. Alternatively, the increments may be collected at a point where the fuel is falling freely and taken so that the whole cross section of the stream is sampled at once. When the fuel is bulk loaded into wagons and it is not practicable to obtain a sample prior to loading, a wagon may be unloaded and a representative sample taken in increments from the fuel discharged from that wagon.

Unless the samples are to be prepared immediately for testing, they shall be transferred at once to closeable containers⁴⁾ of metal or other suitable material which shall immediately be closed.

Appendix B Preparation of samples for testing

B.1 Introduction

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

- Sample A: calorific value;
- Sample B: size,
fire performance.

B.2 Calorific value

The whole of Sample A shall be used for the preparation of a sub-sample for the determination of the calorific value as despatched from the producer's works.

According to whether the fuel is considered for analytical purposes to be of a "coke type" or a "coal type", one of the following procedures shall be used. (For the purposes of this specification a "coke type" fuel is defined as "the solid product of carbonization, generally at a temperature in excess of 900 °C, of a charge consisting predominantly of bituminous coal", see BS 1016-5⁵⁾, 2.1 5); a "coal type" fuel covers all specially reactive solid fuels produced by other manufacturing processes.)

1) "Coke type". A 1 kg (2 lb)⁶⁾ total moisture sample shall be taken and prepared as described in BS 1017-2⁷⁾, Section 7. After drying, a 60 g sub-sample of "through 212 μm " fuel shall be prepared as described in BS 1017-2⁷⁾, Section 8, for the determination of calorific value as described in Appendix C.

2) "Coal type". A 1 kg (2 lb)⁶⁾ total moisture sample shall be taken and prepared as described in BS 1017-1⁸⁾, Section 6. A 250 g sub-sample of "through 212 μm " fuel shall also be taken and prepared as described in BS 1017-1⁸⁾, Section 5, for the determination of calorific value as described in Appendix C.

B.3 Undersize

The whole of Sample B shall be spread in a single layer on a hard clean surface and a sub-sample removed by filling a 0.056 m³ (2 ft³) bulk density box, taking increments each of about 0.7 kg (1½ lb) evenly distributed over the sample. The remainder of the sample shall be used for the determination of undersize as described in Appendix D.

B.4 Fire performance

The sub-sample obtained from the 0.056 m³ (2 ft³) box (see B.3) shall be used for the determination of the bulk density of the fuel, using the procedure described in BS 1016-13⁹⁾ (the determination shall be carried out with the fuel at approximately the same moisture content as for the fire performance test). The sub-sample shall then be spread into a single layer on a hard, clean surface and a weight equivalent to 0.0095 m³ (0.335 ft³) shall be collected by taking increments each of about 0.7 kg (1½ lb) and evenly distributed over the sub-sample. This fuel shall be used for the ignition test as described in Appendix E. The further quantity of fuel required, when necessary, for the three peak radiation test shall be collected at the same time by similar increments.

If the procedure of Appendix F is to be used, the weight collected shall be increased to the equivalent of 0.115 m³ (0.40 ft³).

These samples may be dried, if desired, before carrying out the ignition and radiation tests.

⁴⁾ Sanitary dustbins with tight-fitting lids in accordance with BS 792, "Mild steel dustbins", are suitable for this purpose.

⁵⁾ BS 1016, "Methods for the analysis and testing of coal and coke", Part 5, "Gross calorific value of coal and coke".

⁶⁾ For fuels of low bulk density, it is permissible to reduce the mass of sample to not less than 750 g.

⁷⁾ BS 1017, "The sampling of coal and coke", Part 2, "Sampling of coke".

⁸⁾ BS 1017, "The sampling of coal and coke", Part 1, "Sampling of coal".

⁹⁾ BS 1016, "Methods for the analysis and testing of coal and coke", Part 13, "Tests special to coke".

Appendix C Determination of calorific value as despatched

The sample for the determination of calorific value, obtained and prepared as described in Appendix A and **B.2**, shall be tested in the manner specified in BS 1016-5¹⁰⁾. The moisture content of the sample shall be determined, at the same time, by the method described in BS 1016-3 or BS 1016-4,¹¹⁾ as appropriate.

The calorific value shall be calculated to the “as despatched” basis using the total moisture content of the sample, determined by the method described in BS 1016-1 or BS 1016-2¹²⁾, as appropriate, on the sample prepared for this purpose as described in **B.2**.

Alternatively, for works control purposes, provided a consistent relationship can be established, the “as despatched” calorific value may be calculated from the previously established dry, ash free calorific value, using the “as despatched” total moisture content (determined as described in BS 1016-1 or BS 1016-2¹²⁾, as appropriate) and ash content (determined as described in BS 1016-3 or BS 1016-4¹¹⁾, as appropriate) of the sample. The validity of the relationship shall be checked at appropriate intervals.

Appendix D Determination of undersize

The sample for the determination of undersize, obtained and prepared as described in Appendix A and **B.3**, shall be tested in the manner specified in BS 1016-18¹³⁾. The amount of fuel passing a 19 mm ($\frac{3}{4}$ in) mesh BS sieve shall be determined and the result recorded as percentage of undersize.

Appendix E Fire performance tests

E.1 Introduction

The sample taken each day that fuel is despatched shall be subjected to an ignition test.

Samples taken every third day that the fuel is despatched shall also be subjected to a three peak radiation test, of which the ignition test forms the initial part.

E.2 Principle

E.2.1 Ignition test. A standard volume of 0.0095 m³ (0.335 ft³) of the prepared sample of fuel shall be charged into a standard design of open fire and setting. Using the ignition burner, the fuel shall be ignited with 4 220 kJ (4 000 Btu) of gas, supplied at a uniform rate of 7.3 ± 0.3 kW (0.25 ± 0.01 therm/h). The time taken for the intensity of radiation from the fire to reach 630 W/m² (200 Btu/ft² h), measured by a Moll thermopile in a standard position, shall be recorded.

E.2.2 Three peak radiation test. The fire, ignited by the method described in **E.2.1**, shall be allowed to continue burning and to pass the peak value of radiant intensity. Refuelling to the standard volume shall be performed when the radiant intensity drops to a level of 630 W/m² (200 Btu/ft² h). After a further peak value of radiant intensity has been passed, refuelling shall be performed again according to the standard procedure and the fire allowed to reach a third peak value of radiant intensity. The height of the third peak of radiant intensity shall be recorded. The fire shall not be de-ashed at any stage of the test and the fuel bed shall be disturbed as little as possible at each refuelling. The test requirements have been specified so as to take into account the effect of ash accumulation over a prolonged burning period.

E.3 Equipment

E.3.1 Setting. The setting shall consist of a box of 0.9 mm (0.036 in) mild steel into which is fitted a refractory fireback, preferably of the six-piece type generally in accordance with BS 1251¹⁴⁾, without the use of jointing material. The height of the knee of the fireback above the hearth shall be 520 ± 10 mm (20–21 in). The fireback shall be insulated by pouring exfoliated vermiculite into the space between it and the casing ensuring that, without exerting any pressure, no voids exist; the commercial 10 mm ($\frac{3}{8}$ in) size is suitable after removal of material passing a 3 mm ($\frac{1}{8}$ in) mesh sieve. The setting shall include a tiled hearth and surround 50 mm (2 in) thick, rigidly fixed to the frame, and shall be connected by means of a gather of 0.9 mm (0.036 in) mild steel to a cylindrical flue of internal diameter 150 mm (6 in) and length 1.4–1.8 m (4 ft 6 in to 6 ft).

Details of the setting are given in Figure 1 and Figure 2.

¹⁰⁾ BS 1016, “Methods for the analysis and testing of coal and coke”, Part 5, “Gross calorific value of coal and coke”.

¹¹⁾ BS 1016, “Methods for the analysis and testing of coal and coke”, Part 3, “Proximate analysis of coal”, Part 4, “Moisture, volatile matter and ash in the analysis sample of coke”.

¹²⁾ BS 1016, “Methods for the analysis and testing of coal and coke”, Part 1, “Total moisture of coal”, Part 2, “Total moisture of coke”.

¹³⁾ BS 1016 “Methods for analysis and testing of coal and coke”, Part 18, “Size analysis of coke”.

¹⁴⁾ BS 1251, “Open fireplace components”.