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R 616

DETERMINATION OF THE SHATTER INDICES OF COKE

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September 1967

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BRIEF HISTORY

The ISO Recommendation R 616, *Determination of the Shatter Indices of Coke*, was drawn up by Technical Committee ISO/TC 27, *Solid Mineral Fuels*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1955 and led, in 1962, to the adoption of a Draft ISO Recommendation.

In June 1963, this Draft ISO Recommendation (No. 572) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Argentina	India	Spain
Australia	Iran	Switzerland
Austria	Italy	Turkey
Belgium	Netherlands	United Kingdom
Canada	New Zealand	U.S.S.R.
Chile	Poland	Yugoslavia
Czechoslovakia	Portugal	
Denmark	Romania	

Three Member Bodies opposed the approval of the Draft:

France
Germany
Republic of South Africa

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in September 1967, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 616 September 1967

DETERMINATION OF THE SHATTER INDICES OF COKE

1. SCOPE

This ISO Recommendation describes the method of determining the strength of coke by the shatter test.

2. PRINCIPLE

A representative sample of the coke above a certain specified size is dropped under standard conditions, the resistance to breakage being measured by the percentage of the coke which remains on sieves of different sizes after the test, or by a mathematical expression of these values.

3. APPARATUS

3.1 **Shatter test apparatus** (see Fig. 1, page 4), mounted on a concrete base. It consists of the following parts (see Note below).

NOTE. — In this test inch dimensions are conventional, because it has been developed and mainly used in inch-using countries. These dimensions are given first and rounded metric equivalents are added for information.

3.1.1 *Box.* The box is 28 in (71 cm) long, 18 in (46 cm) wide and 15 in (38 cm) deep. It is supported by pulleys and wire ropes so that the inside of the bottom is exactly 6 ft (183 cm) above the base plate when the coke is dropped.

The bottom of the box consists of two doors, hinged lengthwise and provided with a latch for rapid opening. The doors are of $^1/_4$ in (6 mm) plate and swing open rapidly so as not to impede the fall of the coke. A suitable form of latch, which prevents movement of the box on lifting the latch, is illustrated in Figure 1, page 4.

The sides of the box are made of plate at least $^1/_8$ in (3 mm) thick. Guides, fastened to the end plates of the box, engage with the main vertical side supports of the apparatus which are fastened to the side plates surrounding the base plate.

3.1.2 *Base plate.* It is essential that the base plate should be rigid; a steel plate not less than $^1/_2$ in (13 mm) thick, 48 in (122 cm) long and 38 in (97 cm) wide is suitable. Plates at least 8 in (20 cm) high and $^3/_8$ in (10 mm) thick are fitted on all sides to prevent loss of coke during the test. The back plate (see Note below) and side plates are rigidly fixed and the front plate is removable so as to facilitate shovelling the coke from the base plate into the box after each drop; for convenience, it may be hinged and fitted with latches.

Rigidity of the base plate is ensured by one of the following two methods, of which the first is the simpler:

(*a*) The base plate is supported solidly on concrete, and the side and back plates and the vertical supports are welded to it.

(*b*) The base plate is suspended above the ground, and is welded or riveted to a lower framework of 3 in × 3 in × $^3/_8$ in (8 cm × 8 cm × 10 mm) angle-iron; the side and back plates are welded or riveted to this framework and also to a vertical piece of angle-iron at each of the two back corners.

NOTE. — The orientation of the "front" and "back" of the apparatus is defined by having the counterweight on the right-hand side.

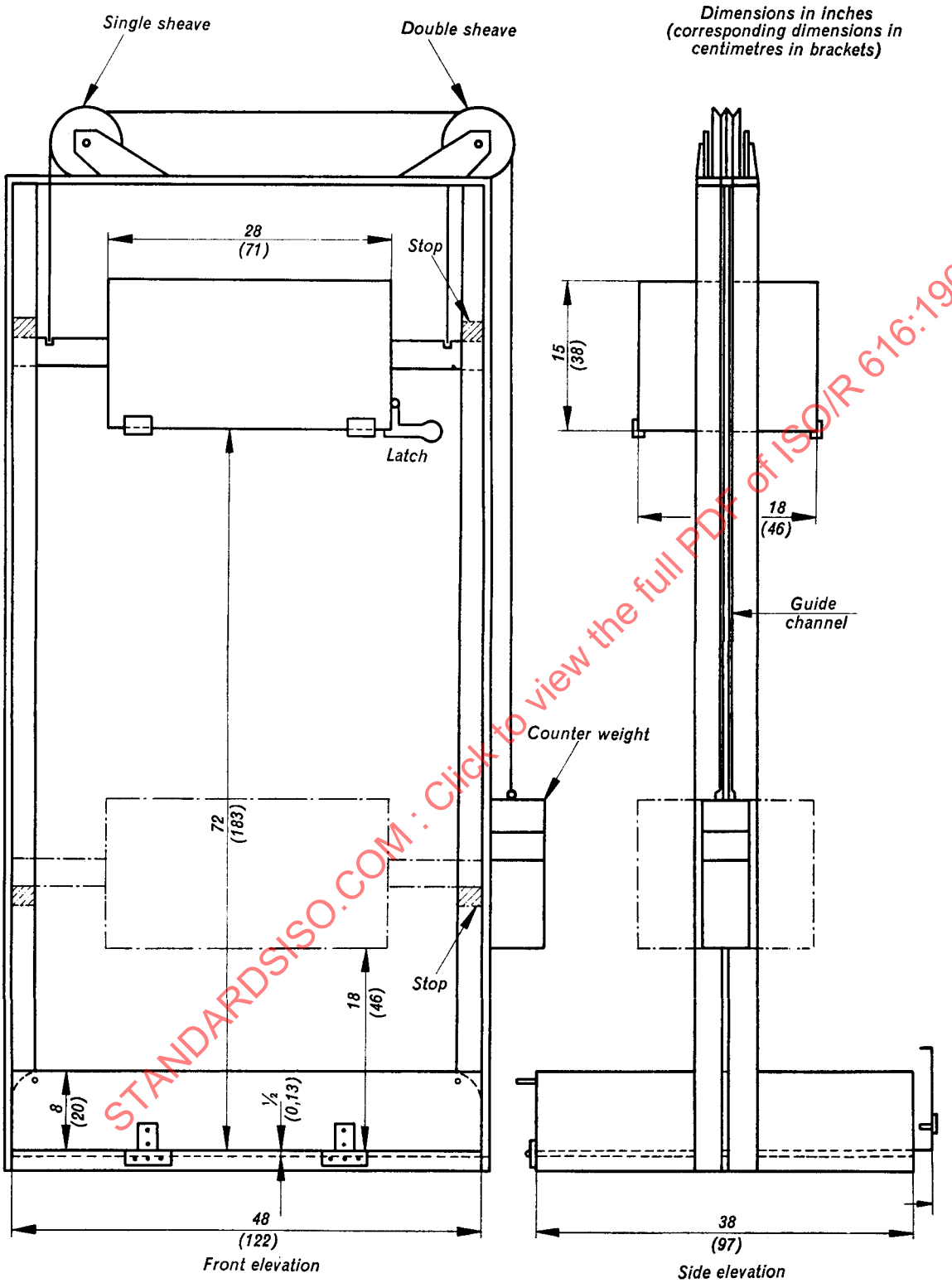

FIG. 1. — **Apparatus for determination of shatter indices.**

3.1.3 *Framework*

(*a*) *Vertical supports and box guides.* The main vertical supports are fastened to the outside of the side plates of the base plate, and also to a top plate supporting the pulleys from which the box is suspended. The vertical supports are kept outside the base plate to facilitate shovelling the coke after each drop. If the plate is supported on a framework of angle-iron, the vertical supports should be riveted or welded to the angle-iron to assist rigidity. Guides, approximately 10 in (25 cm) long, are fitted to the end plates of the box to engage with the main vertical supports.

Each vertical support may be built up in either of two ways, as follows. In one type, each vertical support consists of a T-section 6 in (15 cm) wide with a $2\,^1/_2$ in (6 cm) web, in which case the box guides are double to run on either side of the web of the T-section, the web of which is removed where it is fastened to the side plate of the base plate. Alternatively, the vertical support consists of two 3 in × 3 in (8 cm × 8 cm) angles set $^1/_2$ in (13 mm) apart so that a $^1/_4$ in (6 mm) guide plate from the box can move in the slot between the two angles.

(*b*) *Top plate and counterweights.* The top plate is 6 to 8 in (15 to 20 cm) wide and $^1/_4$ in (6 mm) thick; it supports two pulleys, from which the box is suspended by two wire ropes fastened to the box guides near the side supports, so as to interfere as little as possible with the reloading of the box after each drop (see Note below). A counterweight is suspended from the other ends of the two wire ropes, so that a double pulley is necessary at the right-hand end and a single pulley at the left-hand end. The counterweight consists of a fixed weight, of mass equal to that of the box, and two 28 lb ($12\,^1/_2$ kg) removable weights which are slotted on to a rod which passes through the centre of the fixed weight.

NOTE. — Central suspension of the box is not advised because of the interference with the reloading operation.

(*c*) *Box stops.* Stops are fitted to ensure that the inside of the bottom of the box is exactly 6 ft (183 cm) from the base plate when the box is raised and to prevent the box falling onto the coke when the box is lowered. A convenient distance between the bottom of the box and the base plate for reloading is 18 in (46 cm).

These stops may consist of plates filling the slot between the double angles, when these are used as the main vertical support. Alternatively, when the side supports consist of T-sections, the distance piece fixing the width of the slot between the double guides may be extended vertically to form a stop with the top plate; the stop to prevent the box falling on the coke is fixed on the web of the section.

3.2 **Sieves *.** The sieve plates are machine-stamped from mild steel plate with parallel rows of square apertures (see Note below). The sieve plates are made 2 ft (61 cm) square and supplied with $^3/_4$ in (19 mm) hardwood sides screwed to the plates and armoured with horizontal angle plates to prevent wear (see Fig. 2, page 6). The details of the sieves are given in Table 1. For foundry cokes, single apertures of a larger size may also be required.

NOTE. — Woven wire screens may be used, provided that they are known to give the same results as the recommended plate sieves to within the appropriate tolerance.

* The sieve plate thicknesses, wear tolerance and other details specified are to be reviewed after consultation with Technical Committee ISO/TC 24, *Sieves, Sieving and Other Sizing Methods.*

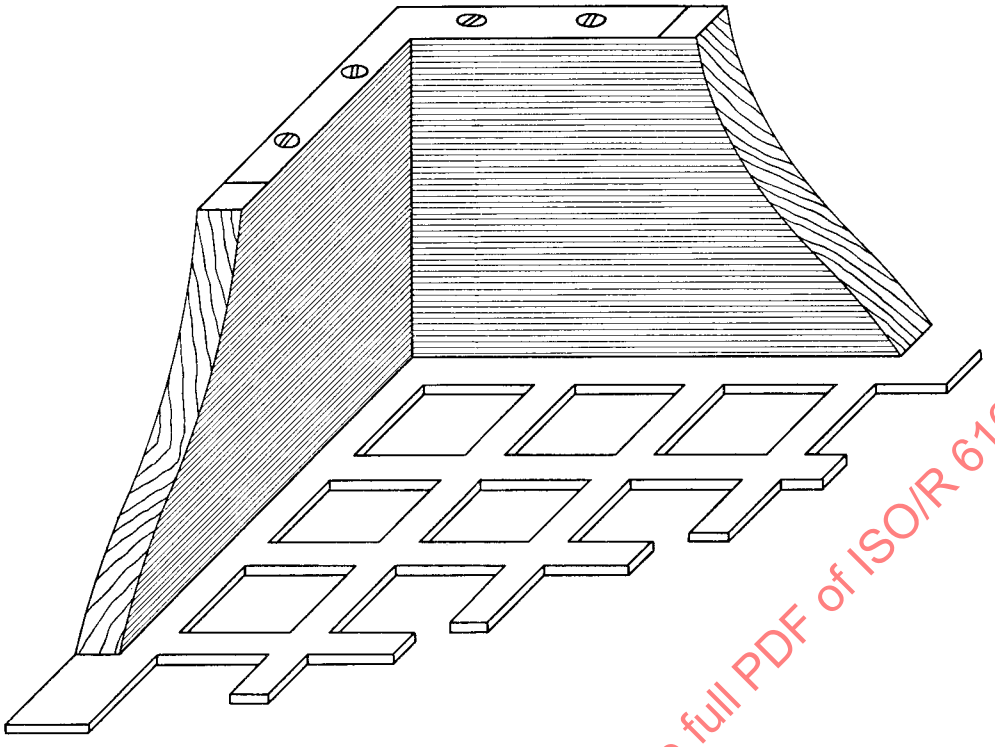

FIG. 2. — **Detail of sieve for determination of shatter indices.**

TABLE 1. — **Details of sieves used for size analysis and shatter test of coke.**

Aperture (square)		Thickness of plate		Width of bridge		Number of apertures per side	Depth of side frame	
in	mm	in	mm	in	mm		in	mm
5	127	3/16	5	1 1/4	32	3	5	127
4	102	3/16	5	1	25	4	5	127
3	76	1/8	3	3/4	19	6	5	127
2 1/2	64	1/8	3	5/8	16	7	4	102
2	51	1/8	3	1/2	13	9	4	102
1 1/2	38	1/8	3	3/8	10	12	4	102
1	25	1/8	3	1/4	6	18	3	76
1/2	13	1/8	3	1/4	6	30	3	76

When the wear on any aperture exceeds 2%, the aperture is blanked off or the test sieve changed.

3.3 **Containers.** A suitable container of 2 ft³ (57 litres) capacity, made of 0.06 in (1.5 mm) galvanized sheet, to hold 25 kg of shattered coke, is illustrated in Figure 3. A smaller container of 0.6 ft³ (17 litres) capacity, made of the same material, is also illustrated in Figure 3; this is suitable for holding separate single fractions in the size analysis if a good concrete floor is not available. A set of 3 large and 3 small containers is convenient. Each container should have its approximate mass marked on it, the actual mass being checked each time before use.

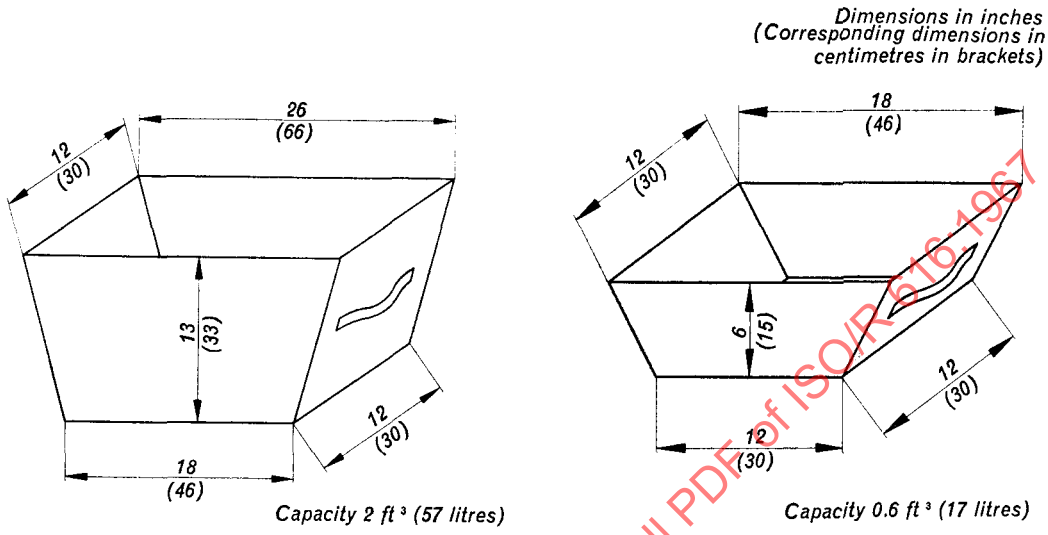

FIG. 3. — **Containers for use in determination of shatter indices.**

Material : Galvanized sheet 0.06 in (1.5 mm).

3.4 **Weighing machine.** A counter-platform weigher, reading to 25 g or less. The machine should turn with a mass of 10 g even though the minimum reading is 25 g, and should be re-calibrated at regular intervals.

4. SIZE ANALYSIS BEFORE THE SHATTER TEST

The coke used for the shatter test is over 2 in (51 mm) (square apertures) in size, but the distribution in sizes is the same as found in a preliminary size analysis of the whole of the gross sample.

If the coke contains 5% of moisture or more, it is dried to less than this amount because, when coke is wet, small particles under 1 mm may adhere to larger particles and lead to weighing errors (see Note 1, page 8).

The size analysis is carried out, for the most part, by hand-placing, a process in which each piece of coke is handled and counted as undersize if it will, in some position and without forcing, pass through the sieve.

It is usually convenient to start with a nest of sieves of 4, 3, 2 $^1/_2$, 2, 1 $^1/_2$, 1 and $^1/_2$ in (102, 76, 64, 51, 38, 25 and 13 mm) aperture. Should the "over 4 in" fraction exceed 5% of the gross sample, it is hand-placed on 5 in (127 mm) or larger apertures until not more than 5% is ungraded oversize.