



**Designation: ~~D3402/D3402M—16~~ D3402/D3402M – 23**

## Standard Test Method for Tumbler Test for Coke<sup>1</sup>

This standard is issued under the fixed designation D3402/D3402M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This test method describes a procedure for obtaining a relative measure of the resistance to degradation of coke by impact and abrasion.

1.2 *Standard Procedure*—This procedure uses a coke sample ~~sized to  $-75$  mm [ $-3$  in.] and  $+50$  mm [ $+2$  in.]~~ that is sized to 75 mm by 50 mm [3.0 in. by 2 in.].

1.3 *Alternative Procedure*—This procedure ~~using coke~~ uses a composite coke sample that is comprised of coke sized 50 % of 63 by 50 mm [263 mm by 50 mm [2.5 in.  $\frac{1}{2}$  by 2 in.] 2 in.] and 50 % of 5050 mm by 37.5 mm [2 by 1[2 in. by 1.50 $\frac{1}{2}$  in.].

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other. Combining other, and values from the two systems may result in non-conformance with the standard; shall not be combined.

1.5 *This standard does not purport to address all of the safety ~~problems; concerns,~~ if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety and health~~safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

[D294 Method of Test for Tumbler Test for Coke; Replaced by D 3402 \(Withdrawn 1975\)](#)<sup>3</sup>

[D346/D346M Practice for Collection and Preparation of Coke Samples for Laboratory Analysis](#)

[E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves](#)

### 3. Summary of Test Method

3.1 A sample of dry coke of designated size is tumbled in a rotating drum at a specified turning rate for a specified number of

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D05 on Coal and Coke and is the direct responsibility of Subcommittee D05.15 on Metallurgical Properties of Coal and Coke.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](#), or contact ASTM Customer Service at [service@astm.org](#). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](#).

revolutions. Two indexes of its strength, the stability factor and the hardness factor, are determined by sieve analysis of the coke after treatment. Studies have indicated that there is no real difference in the stability factor as determined by the standard and alternative procedures. The alternative procedure produces hardness factor results averaging slightly higher than the standard procedure.

#### 4. Significance and Use

4.1 Coke undergoes various degrees of degradation during removal from coke ovens, transportation, and its descent within a blast furnace to the combustion zone. These processes subject the coke to impact and abrasion. This test method is a relative measure of the resistance of coke to breakage when subjected to these degradation processes.

#### 5. Apparatus

5.1 *Tumbler Machine* (see Fig. 1)—The tumbler machine consisting of a cylindrical steel drum 910 mm [36 in.] in inside diameter and 455 mm [17.9 in.] in inside width and made of plate at least 6 mm [0.25 in.] thick. The machine may be constructed as a double drum mounted on a common shaft so that duplicate coke samples may be tested at the same time. Two equally spaced 50 by 50 by 6 mm [2 in. by 2 in. by 1/4 in.] steel angles extending across the width of each drum are solidly fastened inside each drum as shown. These angles are fastened to the shell so that the attached legs point away from the direction of rotation, thus giving a clear unobstructed shelf for lifting the coke. At least one door must be provided in each drum for charging and discharging the coke sample. This door preferably should extend nearly across the width of each drum. As an alternative, a door in the side of the drum is permissible. During the test the door must be fastened rigidly to the shell and must fit into the shell in order to have a smooth continuous inner surface. A dust-tight gasket must be provided to prevent loss of the abraded fines during the test. To provide for rotation, the drum is mounted on stub axles about 37.5 mm [1.48 in.] in diameter by means of flanges welded or bolted to the ends of the drum providing smooth inner surfaces. It is desirable that the apparatus be fitted with a revolution counter and preferably be equipped with an automatic device to stop the drum after the specified number of revolutions (1400). The tumbler drum must be replaced when the wear reduced the thickness to 3 mm [0.1 in.] in any area. The lift angles must be replaced when they wear to less than 48 mm [1.9 in.]

5.2 *Sieves*, for sieving the coke before and after the tumbler test. Square-mesh sieves having 75 mm [3 in.], 63 mm [2.5 in.], 50 mm [2 in.], 37.5 mm [1.5 in.], 25 mm [1 in.], and 6.3 mm [0.25 in.] actual openings between the wires to be used. The sieves shall conform to Specification E11.

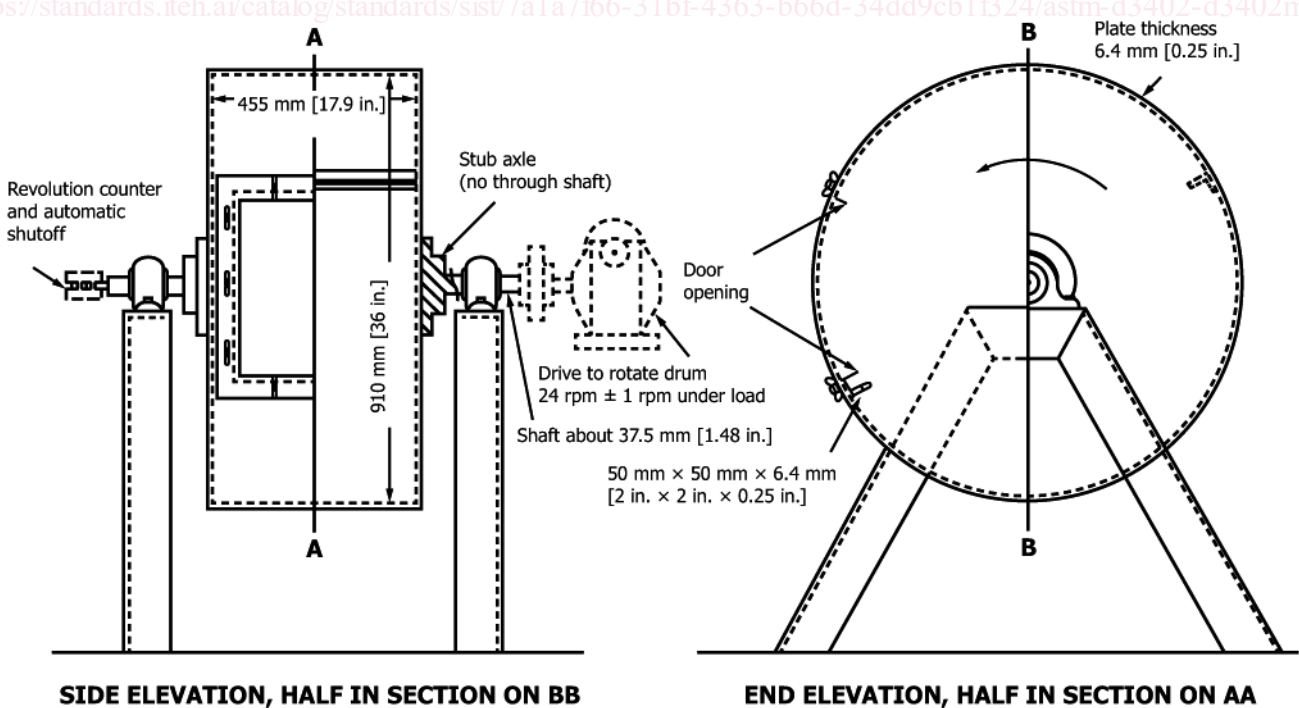


FIG. 1 Tumbler Test Apparatus

NOTE 1—User’s attention is called to the fact that yields of certain sizes that determine the stability and hardness factors of ~~75 by 50 mm [3 by 2 in.]~~ 75 mm by 50 mm [3.0 in. by 2 in.] coke cannot be compared directly with results obtained by using sieves as specified prior to the 1950 revision of Method ~~D294~~ (predecessor of D3402/D3402M). The stability factor (percent remaining on ~~25 mm [1 in.]~~ 25 mm [1.0 in.] sieve after tumbling) will be slightly higher than comparable previous results using the formerly specified ~~26.5 mm [1.06 in.]~~ 26.5 mm [1.04 in.] sieve.

5.3 ~~Weighing Scale, capable of weighing with a capacity of 11 kg [25 lb], sensitive to 0.025 kg [0.05 ± 0.025 kg [0.050 lb]].~~

## 6. Sampling

6.1 The gross sample of coke shall be collected in accordance with Practice ~~D346/D346M~~.

6.2 For the standard procedure, the quantity must be sufficient to obtain approximately 34 kg [75 lb] of coke passing a 75 mm ~~[3.0 in.]~~ and retained on a 50 mm [2 in.] square-mesh sieve.

6.3 For the alternative procedure sample, the quantity must be sufficient to obtain approximately 17 kg [38 lb] of coke passing a 63 mm ~~[2.5 in.]~~ and retained on a 25 mm [1 in.] square-mesh sieve and 17 kg [38 lb] of coke passing a 50 mm [2 in.] and retained on a 37.5 mm ~~[1.5 in.]~~ square-mesh sieve.

## 7. Preparation of Sample

7.1 Size the standard procedure sample on 75 mm ~~[3.0 in.]~~ and 50 mm [2 in.] square-mesh sieves, without crushing the larger pieces, in order to obtain a sample that will pass the ~~75 mm [3 in.]~~ 75 mm [3.0 in.] sieve and be retained on the 50 mm [2 in.] sieve. In sizing the sample, hand place to determine whether in any position a piece of coke passes the sieve. If it is necessary to crush ~~large coke (+75 mm or +3 in.)~~ coke larger than 75 mm [3.0 in.] in order to obtain sufficient coke for testing it so note in the report. Dry the coke to less than 1 % moisture.

7.2 Size the alternate procedure sample by the same procedure as described in 7.1 but obtain two fractions, ~~63 by 50 mm [2.5 in.]~~ 63 by 50 mm [2.5 in. ½ by 2 in.] and ~~50 by 37.5 mm [2 by 1.5 in.]~~ 50 by 37.5 mm [2 in. by 1.5 in.] ½ in.]

## 8. Procedure

8.1 ~~Accurately weigh~~ Determine the mass to the nearest 0.025 kg ~~[0.05 lb], 10 [0.050 lb], 10 kg ± 0.25 kg [22 ± 0.5 [22 lb ± 0.050 lb]~~ of the dried coke sample that has been sized in accordance with 7.1 or 55.0 kg ± 0.25 kg ~~[11 ± 0.5 [11 lb ± 0.50 lb]~~ of each of the sizes prepared in 7.2. Place the ~~weighed~~ sample in the drum of the tumbler machine. Rigidly fasten the cover and rotate the drum at ~~24~~ 24 rpm ± 1 rpm under load for a total of 1400 revolutions.

8.2 Remove all of the coke from the drum and sieve it using a 25 mm ~~[1.0 in.]~~ square-mesh sieve and a 6.3 mm ~~[0.25 in.]~~ square-mesh sieve. Shake the coke vigorously on the sieve in order to up-end the pieces until practically no more coke will pass through the openings (**Note 2**). ~~Weigh the~~ Determine the mass of coke remaining on each of the sieves and the coke that passes through the 6.3 mm ~~[0.25 in.]~~ sieve.

**TABLE 1 Limits for Repeatability (r) and Reproducibility (R) for the Hardness and Stability Factors of Coke using the Standard Preparation Procedure (75 by 50 mm Size Coke)**  
Units = mass fraction, %

Parameter	Range	Repeatability Limit (r)	Reproducibility Limit (R)
Hardness Factor	43.6 to 70.5	1.7	3.4
Stability Factor	43.4 to 65.0	2.2	4.5

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Hardness Factor, <i>HF</i>	43.6 to 70.5	1.7	3.4
Stability Factor, <i>SF</i>	43.4 to 65.0	2.2	4.5