Designation: D1937 – 13

Standard Test Method for Carbon Black, Pelleted—Mass Strength[1]

This standard is issued under the fixed designation D1937; 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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the mass strength of pelleted carbon black. It is designed to determine the force required to pack a cylindrical column with pelleted carbon black. The results of this test are believed to relate to the ability of the carbon black to flow in bulk handling systems.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1799 Practice for Carbon Black—Sampling Packaged Shipments

D1900 Practice for Carbon Black—Sampling Bulk Shipments

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

3. Summary of Test Method

3.1 A sample of carbon black is placed in a vertical cylinder and pressed with a plunger for 10 s after which the bottom of the cylinder is opened, whereupon all of the carbon black either falls out the bottom or forms a ring or bridge in the cylinder. The process is repeated with a new sample until the minimum force required for the carbon black to form a ring or bridge is found. The resultant force is called mass strength and is reported in Newtons (lbf).

4. Significance and Use

4.1 Mass strength gives an indication of the flowability in bulk handling. It is affected by pellet properties such as hardness, size, shape, and especially fines content. Due to the influence of other variables, the user and the producer must determine an acceptable mass strength level.

5. Apparatus

5.1 *Mass Strength Tester,* [3] with a flat compression cylinder of 50.8 mm (2 in.) diameter.

5.2 *Calibrating Block,* made from a cylindrical wooden shaft, 47 mm (1.8 in.) in diameter and 250 mm (10 in.) long.

5.3 *Platform Scale,* [4] to 50-kg (100 lb) capacity with a sensitivity of 0.1 kg (0.02 lb) for air pressure gage calibration.

5.4 *Overflow Cup to Fit Around Cylinder,* normally part of the apparatus delivery.

5.5 *Spatula,* with a straight edge of at least 55 mm (2.2 in.).

6. Sampling

6.1 Samples shall be taken in accordance with Practices D1799 or D1900.

7. Calibration

7.1 Remove the original faceplate from the pressure gage and replace with a blank plate made from aluminum or other suitable material.

7.2 Place the platform scale under the cylinder. With the sliding door in an open position, pass the calibrating block through the cylinder so it will rest on the platform of the platform scale. The top of the calibrating block shall be near the cylinder top. The calibrating block must fit freely in the cylinder and not bind against any inside surface. Adjust the platform scale for zero position with the calibrating block in place. Mark the zero position on the blank plate.

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[1] This test method is under the jurisdiction of ASTM Committee D24 on Carbon Black and is the direct responsibility of Subcommittee D24.51 on Carbon Black Pellet Properties.

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[2] 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.

[3] The sole source of supply of the mass strength tester known to the committee at this time is Titan Specialties, Inc., P.O. Box 2316, Pampa, TX 79066-2316. Test Method D1937 – 84 contains details for the construction of this apparatus. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[4] A Fairbanks Morse platform scale, Model 41–1000 (beam suffix FM) is suitable for this purpose.

7.3 Adjust the air-flow regulator until the needle on the air pressure gage has moved from rest or zero position, to one-third or more of total gage capacity.

7.4 Activate the timer, allowing the plunger to press against the calibrating block. Measure the equivalent mass produced by the plunger with the platform scale.

7.5 Repeat 7.4, adjusting the regulator until even multiples of 50 N or 10 lbf are obtained. Mark the plate at these values.

7.6 Between each 50 N or 10 lbf mark on the plate, place graduations representing each 10 N or 2 lbf. This may be done from measurement, since the gage should be linear in calibration. Check these marks for accuracy with the platform scale.

7.7 From this calibrated gage plate, another gage plate may be prepared by making the graduations coincide with those measured on the calibrated plate. All graduations shall be checked with the platform scale for accuracy.

7.8 The calibrated air pressure gage shall be recalibrated at least once a month, or more frequently as deemed necessary.

8. Procedure

8.1 Clean the cylinder with a brush to remove any adhering carbon black. With the sliding door closed and the overflow cup in position, pour carbon black pellets into the cylinder until an excess of pellets forms a cone above the rim. Level the surface with a single sweep of a straightedge or spatula held perpendicular to, and in firm contact with the top of the cylinder. The top surface of the carbon black column shall be level to prevent unequal pressure on the column.

8.2 Select the force to be applied by adjusting the air-flow regulator until the calibrated gage indicates the desired value. The setting for the initial press is discretionary and is based usually on lab experience.

NOTE 1—Soft pellets with irregular shape and high fines tend to have low mass strength. For these materials an initial setting of 100 N or 20 lbf is suggested. More spherical pellets with higher pellet hardness and low fines tend to have high mass strength. For these materials an initial setting of 250 N or 50 lbf is suggested.

8.3 Press the timer switch activating the mechanism, allowing air flow to the air cylinder. The timer shall be set to allow a total plunger application time of 10 s on the sample.

8.4 After the plunger returns to the rest position above the sample, open the sliding door and observe the inside of the cylinder. If no black remains in the cylinder, the end point has not been reached. The test is then repeated on untested portions of the sample using successively higher pressures following the test sequence in 8.1-8.4

NOTE 2—The increments of increased force are discretionary. Steps of 50 or 100 N (10 or 20 lbf) are appropriate.

8.5 Once a bridge of pressed carbon black is formed, the end point has been reached or exceeded. An additional test should be performed at a lower pressure to confirm the end point has not been exceeded. The end point is the lowest number of newtons (pounds-force) required to produce a ring or bridge of pressed carbon black in the cylinder.

9. Report

9.1 Report the following information:

9.1.1 Proper identification of the sample and,

9.1.2 Result obtained from an individual determination reported to the nearest 25 N (5 lbf).

10. Precision and Bias

10.1 These precision statements have been prepared in accordance with Practice D4483. Refer to this practice for terminology and other statistical details.

10.2 The precision results in this precision and bias section give an estimate of the precision of this test method with the materials used in the particular interlaboratory program described below. The precision parameters should not be used for acceptance or rejection testing of any group of materials without documentation that they are applicable to those particular materials and the specific testing protocols of the test method. Any appropriate value may be used from Table 1.

10.3 A type 1 inter-laboratory precision program was conducted as detailed in Table 1. Both repeatability and reproducibility represent short-term (daily) testing conditions. The testing was performed using two operators in each laboratory performing the test once on each material on each of two days (total of four tests).

TABLE 1 Precision Parameters for ASTM D1937, Carbon Black, Pelleted—Mass Strength (Type 1 Precision)

NOTE—Units = N (lbf)

Material	Period	Number of Laboratories	Mean Level	*Sr*	*r*	*(r)*	*SR*	*R*	*(R)*
LS Carcass	Spring 2004	26	42.9	3.8	10.8	25.2 %	24.7	70.0	163.1 %
			(9.6)	(0.86)	(2.43)		(5.56)	(15.73)	
N774	Fall 2002	16	62.4	5.0	14.1	22.6 %	39.6	112.2	179.7 %
			(14.0)	(1.12)	(3.17)		(8.91)	(25.21)	
HS Tread	Fall 2003	28	102.5	6.5	18.3	17.9 %	55.3	156.4	152.6 %
			(23.0)	(1.46)	(4.12)		(12.42)	(35.16)	
SRB6C	Spring 2003	28	103.6	6.9	19.4	18.7 %	46.2	130.9	126.3 %
			(23.3)	(1.54)	(4.36)		(10.39)	(29.42)	
SRB6A	Fall 2004	36	262.8	8.3	23.5	9.0 %	92.6	262.0	99.7 %
			(59.1)	(1.87)	(5.29)		(20.81)	(58.90)	
Average			114.8						
			(25.8)						
Pooled Values				6.3	17.8	15.5 %	56.5	159.8	139.2 %
				(1.41)	(4.00)		(12.69)	(35.93)	

10.4 The results of the precision calculations for this test are given in Table 1. The materials are arranged in ascending "mean level" order.

10.5 *Repeatability*—The **pooled relative** repeatability, *(r)*, of this test has been established as 15.5 %. Any other value in Table 1 may be used as an estimate of repeatability, as appropriate. The *difference* between two single test results (or determinations) found on identical test material under the repeatability conditions prescribed for this test will exceed the repeatability on an average of not more than once in 20 cases in the normal and correct operation of the method. Two single test results that differ by more than the appropriate value from Table 1 must be suspected of being from different populations and some appropriate action taken.

NOTE 3—Appropriate action may be an investigation of the test method procedure or apparatus for faulty operation or the declaration of a significant difference in the two materials, samples, and so forth, which generated the two test results.

10.6 *Reproducibility*—The **pooled relative** reproducibility, *(R)*, of this test has been established as 139.2 %. Any other value in Table 1 may be used as an estimate of reproducibility, as appropriate. The *difference* between two single and independent test results found by two operators working under the prescribed reproducibility conditions in different laboratories on identical test material will exceed the reproducibility on an average of not more than once in 20 cases in the normal and correct operation of the method. Two single test results produced in different laboratories that differ by more than the appropriate value from Table 1 must be suspected of being from different populations and some appropriate investigative or technical/commercial action taken.

10.7 *Bias*—In test method terminology, bias is the difference between an average test value and the reference (true) test property value. Reference values do not exist for this test method since the value or level of the test property is exclusively defined by the test method. Bias, therefore, cannot be determined.

11. Keywords

11.1 bulk handling systems; carbon black; flow in bulk handling systems; mass strength; pelleted carbon black