Designation: ~~D1937 – 21~~ D1937 – 23

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 of 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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:*[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.

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.

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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.

Current edition approved ~~Nov. 1, 2021~~May 1, 2023. Published ~~December 2021~~May 2023. Originally approved in 1962. Last previous edition approved in ~~2018~~2021 as ~~D1937 – 18.~~D1937 – 21. DOI: ~~10.1520/D1937-21.~~10.1520/D1937-23.

[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.

5. Apparatus

5.1 *Mass Strength Tester,* [3] with a compression chamber comprising:

5.1.1 *Hollow Compression Cylinder,* of 95.25 mm (3.75 in.) depth and 52.4 mm (2.06 in.) diameter, made of stainless steel.

5.1.2 *Plunger,* of 50.8 mm (2 in.) diameter and a central bore of 12.7 mm (0.5 in.) diameter and 19 mm (0.75 in.) depth, made of stainless steel.

5.1.3 *Force Application Mechanism,* allowing the application of a controllable force onto the plunger.

5.2 *Powder Funnel,* to completely fill the cylinder.

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

5.4 *Brush,* approximately 40 mm (1.5 in.), stiff bristle.

6. Sampling

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

7. Calibration

7.1 The manufacturer will typically calibrate the instrument's measurement system before delivery. Load cells are typically calibrated or verified using a reference load cell or calibrated masses, or both. Traceability is recommended for all calibration devices. Follow the manufacturer's recommendations for calibration frequency and procedure.

8. Procedure

8.1 Compress the sample using a mass strength tester per the manufacturer instructions. A general procedure for compressing carbon black involves the following steps:

8.1.1 Clean the cylinder with a brush to remove any adhering carbon black. With the sliding door (cylinder trap door) closed and the funnel 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.

8.1.2 Select the force to be applied. 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 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 is suggested.

8.1.3 Activate the plunger, to start the compression. The timer shall be set to allow a total plunger application time of 10 s on the sample.

8.1.4 After the plunger returns to the rest position above the sample, open the sliding door carefully 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 8.1.1 – 8.1.4.

NOTE 2—The increments of increased force are discretionary. Steps of 50 or 100 N are appropriate.

8.2 Once a bridge of pressed carbon black is formed, the end point has been reached or exceeded. An additional test should be performed at lower pressure(s) in increments of 25 N to confirm the end point has not been exceeded. The end point is the lowest number of Newtons required to produce a ring or bridge of pressed carbon black in the cylinder.

[3] For information about known sources of supply of mass strength tester instruments, please contact ASTM International at service@astm.org.

9. Report

9.1 Report the following information:

9.1.1 Proper identification of the ~~sample and,~~sample, and

9.1.2 Result obtained from an individual determination reported to the nearest 25 N.

NOTE 3—Data obtained in lbf can be converted to N as follows: 1 lbf = 4.448 N.

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).

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 %.~~14.6 %. 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 4—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.

NOTE 5—The mass strength data is not normally distributed so the standard deviation values should be used with great caution.

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

~~Note—Units = N~~

NOTE—Units = N

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 %**~~
N774	Aug 2020	25	63.6	3.57	10.11	**15.9**	45.66	129.22	**203.1**
~~N774~~	~~Fall 2002~~	~~16~~	~~62.4~~	~~5.0~~	~~14.1~~	~~**22.6 %**~~	~~39.6~~	~~112.2~~	~~**179.7 %**~~
SRB-9D	Mar 2018	33	72.8	10.03	28.37	**39.0**	89.62	253.64	**348.6**
~~HS Tread~~	~~Fall 2003~~	~~28~~	~~102.5~~	~~6.5~~	~~18.3~~	~~**17.9 %**~~	~~55.3~~	~~156.4~~	~~**152.6 %**~~
SRB-9C	Aug 2019	30	88.0	7.17	20.30	**23.1**	80.41	227.56	**258.6**
~~SRB6C~~	~~Spring 2003~~	~~28~~	~~103.6~~	~~6.9~~	~~19.4~~	~~**18.7 %**~~	~~46.2~~	~~130.9~~	~~**126.3 %**~~
N650	Aug 2021	20	110.5	7.26	20.55	**18.6**	74.28	210.21	**190.2**
~~SRB6A~~	~~Fall 2004~~	~~36~~	~~262.8~~	~~8.3~~	~~23.5~~	~~**9.0 %**~~	~~92.6~~	~~262.0~~	~~**99.7 %**~~
SRB-9A2	Aug 2018	32	140.3	7.75	21.94	**15.6**	109.28	309.27	**220.4**
SRB-9B2	Mar 2019	22	151.7	4.96	14.05	**9.3**	130.62	369.65	**243.6**
SRB-9H2	Mar 2021	15	237.9	6.11	17.31	**7.3**	181.28	513.03	**215.7**
SRB-9H	Mar/Apr 2020	15	240.6	8.26	23.37	**9.7**	162.91	461.04	**191.6**
~~Average~~			~~114.8~~						
Average			138.2						
~~Pooled Values~~				~~6.3~~	~~17.8~~	~~**15.5 %**~~	~~56.5~~	~~159.8~~	~~**139.2 %**~~
Pooled Values				7.14	20.20	**14.6**	117.53	332.61	**240.7**