Designation: D8353 – 20

Standard Guide for Determination of Individual Particle Strength of Low Surface Area Catalysts and Catalyst Carriers by Drop Test onto a Steel Plate[1]

This standard is issued under the fixed designation D8353; 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 The resistance to breakage of formed catalysts, catalyst carriers, or catalyst pieces is determined by dropping a quantity of sample through a 25 ft length of 1 in. internal diameter pipe onto a steel plate.

1.2 *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.*

1.3 *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]

D3766 Terminology Relating to Catalysts and Catalysis

D4058 Test Method for Attrition and Abrasion of Catalysts and Catalyst Carriers

D7084 Test Method for Determination of Bulk Crush Strength of Catalysts and Catalyst Carriers

2.2 *Other ASTM Documents:*[3]

STP447A Manual on Test Sieving Methods

IEEE/ASTM 10 American National Standard for Metric Practice

3. Terminology

3.1 *Definitions*—See Terminology D3766.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *low surface area, n*—describes material with measured surface areas of less than 10 m^2/g (see IEEE/ASTM 10).

4. Summary of Guide

4.1 The resistance to breakage of formed catalysts, catalyst carriers, or catalyst pieces is determined by dropping a quantity of sample through a 25 ft pipe of 1 in. internal diameter onto a steel plate. Particle strength is measured on a pass (no breakage) or fail (breakage) basis and is calculated as percentage passing the test without breakage.

5. Significance and Use

5.1 This guide is intended to provide information concerning the ability of formed catalysts or catalyst carriers to resist particle size reduction during use. It can be used by itself or in conjunction with other methods to assess catalytic material integrity, such as Test Methods D4058 and D7084.

5.2 There are no known restrictions on sample geometry, as spheres, pellets, and hollow cylinders are suitable for testing.

5.3 This guide, as written, is suitable for use for catalytic materials from about ⅛ in. to about ¾ in. It can also be used for larger parts, but this requires using a larger diameter pipe.

5.4 This guide is suitable for specification acceptance, manufacturing control, and research and development processes.

6. Apparatus

6.1 *Steel (or Plastic) Pipe,* 25 ft long by 1.25 in. outside diameter (1 in. inside diameter), mounted vertically about 6 in. above the metal plate.

6.2 *Steel Plate,* approximately 15 in. x 15 in, x 0.5 in.

6.3 *Bottom-less Box*—Users might find it helpful to surround the steel plate with a bottom-less box to retain the tested particles and facilitate cleanup.

[1] This guide is under the jurisdiction of ASTM Committee D32 on Catalysts and is the direct responsibility of Subcommittee D32.02 on Physical-Mechanical Properties.

Current edition approved Oct. 1, 2020. Published November 2020. DOI: 10.1520/D8353-20.

[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] Visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org.

7. Reagents and Materials

7.1 A reference material of similar composition to the samples to be tested, assigned a consensus value, and exchanged between the laboratories using the method.

8. Hazards

8.1 Small particles or chips may be produced when using this guide. Proper safety equipment and procedures should be used to ensure hands and eyes are protected during the test.

9. Sampling, Test Specimens, and Test Units

9.1 Test samples should be obtained from larger composites by riffling or splitting in accordance with STP447A (section 5.12) or some other suitable means with the aim of obtaining a sample that represents the size distribution of the large composites.

9.2 Remove any particle fragments from the sample before beginning the test.

9.3 Approximately 100 pieces of fully formed particles are required for this test.

10. Preparation of Apparatus

10.1 Make certain that the pipe is oriented in a vertical position to the steel plate and ground. Use a standard carpentry level or similar device to ensure alignment.

10.2 This test requires two people. One person is positioned at the top of the pipe to drop pieces into the pipe. The other person is positioned at the bottom of the pipe to recover the particle and determine its condition after impacting the steel plate.

11. Conditioning

11.1 If the materials to be analyzed have high surface area, greater than 10 m^2/g, then it will be necessary to perform an activation step to remove moisture prior to testing. This activation step entails heating the sample to 400 °C for a period of at least 3 h prior to testing.

12. Procedure

12.1 Place the steel plate directly beneath the bottom opening of the pipe.

12.2 Surround the steel plate with a bottom-less box or other means to contain the tested materials.

12.3 Drop each of the 100 particles, one at a time, down the 25 ft long pipe so that they impact the steel plate.

12.4 Recover each particle and determine whether it remains whole or whether it breaks.

NOTE 1—Breakage, although somewhat subjective, is usually obvious as the parts typically fail catastrophically.

12.5 Record on a data sheet a "0" for each piece that remains whole or an "X" for each piece that breaks.

13. Calculation or Interpretation of Results

13.1 Calculate the percentage of pieces that are unchanged after testing:

A = number of "0" (intact) particles recorded
B = total number of particles tested
Percentage "Passing" Test = [A/B] x 100

14. Report

14.1 If applicable, report the pretreatment conditions used to prepare the sample prior to testing.

14.2 Report the percentage of pieces that "pass" the test without breakage.

15. Keywords

15.1 catalysts; catalyst carriers; catalytic material; crush; hardness; impact resistance

APPENDIX

(Nonmandatory Information)

X1.1 See Fig. X1.1.

Sample ID/Designation = _____

Pretreat Temperature = _____ Pretreat Period = _____

1. For each particle, perform the test and record the condition of the particle afterwards as either 0 = intact (no change) or X = change (break, fracture, chip, etc.)

Particle #	Condition	Particle #	Condition	Particle #	Condition	Particle #	Condition
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

2. Calculate the percentage of particles that pass the test as follows:

A = number of "0" (intact) particles recorded

B = total number of particles tested

Percentage "Passing" Test = [A/B] × 100

FIG. X1.1 Worksheet for Data Collection and Calculation of Results