



Standard Test Method for Determining Pore Volume Distribution of Catalysts and Catalyst Carriers by Mercury Intrusion Porosimetry¹

This standard is issued under the fixed designation D4284; 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 pore volume distributions of catalysts and catalyst carriers by the method of mercury intrusion porosimetry. The range of apparent diameters of pores for which it is applicable is fixed by the operant pressure range of the testing instrument. This range is typically between apparent pore entrance diameters of about 100 and 0.003 μm (3 nm).

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website—<http://www.epa.gov/mercury/faq.htm>—for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.

1.4 *This standard does not purport to address all of the safety problems, 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.* Specific hazard information is given in Section 8.

2. Referenced Documents

2.1 ASTM Standards:²

¹ This test method is under the jurisdiction of ASTM Committee D32 on Catalysts and is the direct responsibility of Subcommittee D32.01 on Physical-Chemical 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.

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E456 Terminology Relating to Quality and Statistics

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *apparent pore diameter*—the diameter of a pore, assumed to be cylindrical, that is intruded at a pressure, P , and is calculated with Eq 1.

3.1.2 *interparticle pores*—those pores that occur between particles when they are packed together and that are intruded during the test.

3.1.3 *intraparticle pores*—those pores lying within the envelopes of the individual catalyst particles and that are intruded during the test.

3.1.4 *intruded pore volume*—the volume of mercury that is intruding into the pores during the test after this volume has been corrected, if necessary, per 13.3.2.

4. Summary of Test Method

4.1 When a liquid does not wet a porous solid it will not voluntarily enter the pores in the solid by capillary attraction. The nonwetting liquid (mercury in this test method) must be forced into the pores by the application of external pressure. The size of the pores that are intruded is inversely proportional to the applied pressure. When a cylindrical pore model is assumed, the relationship between pressure and size is:

$$d = \frac{-4\gamma(\cos \theta)}{P} \quad (1)$$

where:

d = apparent diameter of the pore being intruded,

γ = surface tension of the mercury,

θ = contact angle between the mercury and the solid, and

P = absolute pressure causing the intrusion.

4.2 The volume of the intruded pores is determined by measuring the volume of mercury that is forced into them at various pressures. A single-pore size distribution determination involves increasing the pressure, either continuously or stepwise, and recording the measured intruded volume.