



Designation: D4824 – 13

# Standard Test Method for Determination of Catalyst Acidity by Ammonia Chemisorption<sup>1</sup>

This standard is issued under the fixed designation D4824; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This test method involves the measurement of total catalyst acidity by chemisorption of ammonia in a static volumetric system. Acidity is a very important property in determining catalyst activity and selectivity in many commercial reactions. Zeolite based catalysts used in the petroleum industry for catalytic cracking are a prime example. This test method describes a simple procedure employing inexpensive equipment that could readily be assembled in most laboratories.

## 1. Scope

1.1 This test method covers the determination of acidity of catalysts and catalyst carriers by ammonia chemisorption. A volumetric measuring system is used to obtain the amount of chemisorbed ammonia.

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:*<sup>2</sup>

D3766 Terminology Relating to Catalysts and Catalysis

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

## 3. Terminology

3.1 *Definitions*—See Terminology D3766.

3.2 *Symbols*:

$V_k$  = calibrated expansion volume, cm<sup>3</sup>.  
 $T_1$  = temperature of  $V_k$  at initial ammonia pressure, K.  
 $T_2$  = temperature of  $V_k$  at final ammonia pressure, K.  
 $P_1$  = initial ammonia pressure, torr.  
 $P_2$  = final ammonia pressure, torr.  
 $W_s$  = mass of sample, g.  
 $W_1$  = tare of sample tube, g.  
 $W_2$  = sample mass plus tare of tube, g.  
 $P_{1T}$  = initial ammonia pressure corrected to standard temperature, torr.  
 $P_{2T}$  = final ammonia pressure corrected to standard temperature, torr.

## 4. Summary of Test Method

4.1 A sample is degassed by heating in a vacuum to remove adsorbed vapors from the surface. The sample is then exposed to an excess of gaseous ammonia and the excess ammonia is removed by freezing it into a trap cooled with liquid nitrogen. The chemisorbed ammonia is calculated as the difference between the volume of ammonia before exposure and the volume recovered in the liquid nitrogen trap.

## 5. Significance and Use

5.1 This test method can be used to determine the acidity of catalysts and catalyst carriers by ammonia chemisorption for materials specifications, manufacturing control, and research and development in the evaluation of catalysts.

## 6. Apparatus

6.1 A schematic diagram of one type of apparatus is shown in Fig. 1. It may be constructed of glass or metal and may operate manually or automatically. It has the following features:

<sup>1</sup> 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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<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.