INTERNATIONAL

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Standard Test Methods for Specific Gravity, Apparent, of Liquid Industrial Chemicals[1]

This standard is issued under the fixed designation D 891; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 These test methods cover the determination of the specific gravity, apparent, of liquid industrial chemicals. Two test methods are covered as follows:

1.1.1 *Test Method A*, specific gravity, apparent, by means of a hydrometer.

1.1.2 *Test Method B*, specific gravity, apparent, by means of a pycnometer.

NOTE 1—Test Method D 4052 describes an instrumental procedure.

1.2 In common usage the term specific gravity, apparent, is understood to mean specific gravity. Since this test method is to be in conformity with Terminology E 12, all terms reading specific gravity were changed to specific gravity, apparent, without altering the meaning of specific gravity and, the term apparent could be dropped in everyday operations after establishing the use term equivalency.

1.3

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in these test methods with the exception of Fahrenheit (°F) in 5.1 as an example of a possible industrial specification unit.

1.4 *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.*

1.45 Review the current Materials Safety Data Sheets (MSDS) for detailed information concerning toxicity, first aid procedures, handling, and safety precautions.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D 1193 Specification for Reagent Water

D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter

E 1 Specification for ASTM Liquid-in-Glass Thermometers

E 12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases[3]

E 100 Specification for ASTM Hydrometers

E 202 Test Methods for Analysis of Ethylene Glycols and Propylene Glycols

E 302 Test Methods for Monobasic Organic Acids[0]

E 346 Test Methods for Analysis of Methanol

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:* [4]

3.1.1 *specific gravity, apparent*—the ratio of the weight in air of a unit volume of a material at a stated temperature to the weight

[1] These test methods are under the jurisdiction of ASTM Committee E15 on Industrial and Specialty Chemicals and are the direct responsibility of Subcommittee E15.01 on General Standards.

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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] Withdrawn.

[4] For a high degree of accuracy, the following paper discusses an apparatus and method of much merit: Lipkin and Associates, "Pycnometer for Volatile Liquids," *Industrial and Engineering Chemistry*, Analytical Edition, Vol 36, Jan. 15, 1944, pp. 55–58.

[4] These definitions conform to those in Terminology E 12 with this explanation modified as follows: specific gravity corresponds to apparent specific gravity as defined in Terminology E 12 and absolute specific gravity corresponds to specific gravity as defined in Terminology E 12.

***A Summary of Changes section appears at the end of this standard.**

in air of equal density of an equal volume of gas-free distilled water (see Note 2) at a stated temperature. It shall be stated as follows:

$$\text{Specific gravity, apparent, } x/y°C \quad (1)$$

where x is the temperature of the material and y is the temperature of the water.

NOTE 2—Gas-free distilled water is distilled water that has been boiled to eliminate dissolved gases.

4. Significance and Use

4.1 Specific gravity, apparent, may be used as a qualitative test in establishing the identity of a chemical. It may be used to calculate the volume occupied by a product whose weight is known, or to calculate the weight of a product from its volume. It may be used to determine the composition of binary mixtures of pure chemicals. In the case of most refined industrial chemicals specific gravity, apparent, is of minimal value in defining quality, although it may detect gross contamination.

4.2 Of the two test methods described, the pycnometer method (Test Method B, 1.1.2) is the most accurate and precise. For this reason it is the preferred method in case of disputes. The hydrometer method (Test Method A, 1.1.1) is the least accurate and precise, but it is also the simplest and fastest to perform and is often entirely satisfactory for many purposes. If the sample is too viscous to permit the hydrometer to float freely, the pycnometer test method should be used.

5. Test Temperatures

5.1 Specifications for industrial chemicals often specify different temperatures at which specific gravity, apparent, shall be measured, for example:

Specific gravity, apparent, at 15.56/15.56°C,
Specific gravity, apparent, at 20/20°C,
Specific gravity, apparent, at 25/25°C, or
Specific gravity, apparent, at 60/60°F

Where precision is desired, it is necessary to determine the specific gravity, apparent, at the temperature prescribed in the specifications for the material to be tested and to use instruments that have been calibrated and standardized at the specified temperature.

5.2 The expression "specific gravity, apparent, at 25.0/15.56°C," for example, means the ratio of the weight in air of a unit volume of a material at 25.0°C to the weight in air of equal density of an equal volume of gas-free distilled water at 15.56°C.

5.3 It is possible to convert the specific gravity, apparent, at x/T_1°C to the corresponding value at x/T_2°C by multiplying the value at T_1 by the factor given in Table 1. For example, a liquid has a specific gravity, apparent, of 0.9500 at 20/20°C and the value at 20/4°C is desired: 0.9500 × 0.9982336 = 0.9483, the value at 20/4°C. The values in Table 1 are the ratios of the density of water at the appropriate temperatures.

5.4 If the change in specific gravity, apparent, with temperature of the liquid is known, the specific gravity, apparent, at T_1/y may be converted to that at T_2/y by the following equation:

$$\text{Specific gravity, apparent, at } T_2/y = (T_1 - T_2)k + \text{specific gravity, apparent, at } T_1/y \quad (2)$$

where:

T_1 = original temperature, °C,
T_2 = the second temperature, °C, and
k = change in specific gravity, apparent, per °C.

Example: The specific gravity, apparent, of *n*-butanol at 20/20°C is 0.8108 and the change in specific gravity, apparent, is 0.00074/°C. What is the specific gravity, apparent, at 4/20°C?

$$\text{Specific gravity, apparent, at } 4/20°C = [(20 - 4)0.00074] + 0.8108 = 0.8226 \quad (3)$$

TEST METHOD A—SPECIFIC GRAVITY, APPARENT, BY MEANS OF A HYDROMETER

6. Summary of Test Method

6.1 The specific gravity, apparent, of the sample is determined by immersing a calibrated hydrometer in the sample at the test temperature. The displacement of the hydrometer is a function of the specific gravity, apparent, of the sample that is read on the hydrometer scale at the level of the meniscus of the sample.

TABLE 1 Conversion of Specific Gravities, Apparent, from Basis x/T_1 to Basis x/T_2°C

Specific Gravities, Apparent, on Basis x/T_1	Multiplied by This Factor Gives Specific Gravities, Apparent, on Basis x/T_2				
	t/4	t/15	t/15.56	t/20	t/25
t/4	1	1.0008722	1.0009586	1.0017695	1.0029335
t/15	0.9991286	1	1.0000864	1.0008966	1.0020595
t/15.56	0.9990423	0.9999136	1	1.0008101	1.0019730
t/20	0.9982336	0.9991042	0.9991905	1	1.0011619
t/25	0.9970751	0.9979447	0.9980309	0.9988395	1