



Designation: E 201 – 96

# Standard Test Method for Calculation of Volume and Weight of Industrial Chemical Liquids<sup>1</sup>

This standard is issued under the fixed designation E 201; 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 Tables and equations presented in this test method are for use in calculating the volume and weight of the following industrial chemical liquids:

### 1.1.1 Alcohols and Polyols:

|                                |         |
|--------------------------------|---------|
|                                | Tables  |
| Glycerin, high-gravity         | Table 1 |
| Hexylene glycol                | Table 2 |
| Isobutyl alcohol               | Table 3 |
| Isopropyl alcohol, anhydrous   | Table 4 |
| Isopropyl alcohol, 91 volume % | Table 5 |

### 1.1.2 Chlorinated Compounds:

|                     |         |
|---------------------|---------|
| Epichlorohydrin     | Table 6 |
| Ethylene dichloride | Table 7 |
| Perchloroethylene   | Table 8 |

### 1.1.3 Esters:

|                               |         |
|-------------------------------|---------|
| Ethyl acetate, 85–88 weight % | Table 9 |
|-------------------------------|---------|

### 1.1.4 Glycol Ethers:

|                                  |          |
|----------------------------------|----------|
| Ethylene glycol monomethyl ether | Table 10 |
|----------------------------------|----------|

### 1.1.5 Ketones:

|                        |          |
|------------------------|----------|
| Acetone                | Table 11 |
| Methyl ethyl ketone    | Table 12 |
| Methyl isobutyl ketone | Table 13 |

1.2 A test method is given for calculating the volume at 60°F from a volume observed at another temperature,  $t^{\circ}\text{F}$ .

NOTE 1—Tables at 20°C can be calculated from the data and information provided.

1.3 A test method is given for determining the weight in pounds per U.S. gallon (in air) at 60°F from an observed specific gravity, and to compute therefrom the weight in pounds of a given volume of the liquid in U.S. gallons at 60°F.

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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 891 Test Methods for Specific Gravity, Apparent, of Liquid Industrial Chemicals<sup>2</sup>
- D 1085 Practice for Gaging Petroleum and Petroleum Products<sup>3</sup>
- D 1086 Method for Measuring the Temperature of Petroleum and Petroleum Products<sup>3</sup>
- D 1217 Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer<sup>3</sup>
- E 12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases<sup>3</sup>
- E 300 Practice for Sampling Industrial Chemicals<sup>2</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 The relationships involved in this test method are defined to conform to the current revision of Terminology E 12, as follows:

3.1.2 *density*—the mass of a unit volume of a material at a specified temperature. The units shall be stated, such as grams per millilitre, grams per cubic centimetre, pounds per cubic foot, or other. The form of the expression shall be

$$\text{Density at } x \dots \quad (1)$$

where  $x$  is the temperature of the material.

3.1.3 *density, apparent*—the weight in air of a unit volume of a material at a specified temperature. The units shall be stated. The form of expression shall be

$$\text{Apparent density at } x \dots \quad (2)$$

where  $x$  is the temperature of the material.

3.1.4 *specific gravity or relative density*—the ratio of the mass of a unit volume of a material at a stated temperature to the mass of the same volume of gas-free distilled water at a stated temperature. The form of expression shall be

$$\text{Specific gravity } x/y \dots \quad (3)$$

where:

$x$  = temperature of the material,

$y$  = temperature of the water, and

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E-15 on Industrial Chemicals and is the direct responsibility of Subcommittee E15.23 on Physical Properties.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 15.05.

<sup>3</sup> Annual Book of ASTM Standards, Vol 05.01.

$t$  = temperature scale, °F or °C.

3.1.5 *specific gravity, apparent*—the ratio of the weight in air of a unit volume of a material at a stated temperature to the weight in air of equal density of an equal volume of gas-free distilled water at a stated temperature. The form of expression shall be

$$\text{Apparent specific gravity } x/y \quad (4)$$

where:

$x$  = temperature of the material,

$y$  = temperature of the water, and

$t$  = temperature scale, °F or °C.

## 4. Significance and Use

4.1 For accurate survey of large shipments and for purposes of inventory measurement and control, it is often desirable to determine the volume of a known weight or the weight of a known volume of an industrial-chemical liquid. The tables and equations presented in this test method can be used to calculate the volume and weight of the liquid chemicals listed in 1.1.1 to 1.1.5.

## 5. Procedure

5.1 *Use of Tables to Compute Volume at 60°F of Any Volume of Liquid Measured at an Observed Temperature,  $t^{\circ}\text{F}$ :*

5.1.1 Measure the volume of liquid by suitable methods as given in Practice D 1085. Report to the nearest U.S. gallon.

5.1.2 Measure the temperature of the liquid at enough points to establish the average temperature with an accuracy of  $\pm 1^{\circ}\text{F}$  by suitable methods as given in Method D 1086. Report to the nearest degree Fahrenheit.

5.1.3 Using the appropriate temperature correction table, convert the measured volume (5.1) to the corresponding volume at 60°F by multiplying the measured volume by the factor under the heading “volume corrected to 60°F” opposite the line corresponding to the average temperature determined in 5.2.

*Example*—What is the volume at 60°F of a tank car of acetone whose volume was found by measurement to be 10 240 U.S. gal at an average temperature of 38.2°F?

*Step 1*—In the temperature correction table for acetone, select a temperature of 38°F and note under the column entitled “volume corrected to 60°F” the multiplying factor 1.0172.

*Step 2*—Multiplying,  $10\,240 \times 1.0172 = 10\,416$  U.S. gal, the volume of the contents of the tank car at 60°F.

## 6. Procedure

6.1 *Use of Tables to Compute Weight (Pounds in Standard Air) of a Measured Volume of Liquid:*

6.1.1 Determine the volume in U. S. gallons at 60°F in a

manner described in Section 5 for the quantity of liquid under consideration.

6.1.2 Take a representative sample of the liquid by suitable methods as given in Practice E 300.

6.1.3 Determine the specific gravity of the representative sample by suitable methods as given in Test Methods D 891 or Test Method D 1217.

6.1.3.1 If a hydrometer is used, report the specific gravity at 60/60°F.

6.1.3.2 If pycnometers are used, report the apparent specific gravity at 20/20°C.

6.1.4 Using the appropriate bulk weight table, select the specific gravity nearest the value determined in 6.1.3. Opposite this value obtain the corresponding value for pounds (air) per U.S. gallon at 60°F.

6.1.5 Multiply the weight in pounds per U.S. gallon (6.1.4) by the volume in U.S. gallons (determined in 5.1.3) to get the weight (in air) in pounds of the bulk of liquid under consideration.

*Example*—What is the weight in pounds (in air) of a tank car of acetone whose volume at 60°F was found to be 10 416 U.S. gal and whose contents were found to have a specific gravity at 20/20°C of 0.7928?

*Step 1*—In the bulk weight table for acetone, opposite a specific gravity at 20/20°C of 0.7928 read the apparent density of 6.636 lb/U.S. gal at 60°F.

*Step 2*—Multiplying  $10\,416 \times 6.636 = 69\,121$  lb, the net weight of the carload of acetone.

NOTE 2—It is recognized that the use of a fixed value of 0.0012 g/mL for air buoyancy introduces a theoretical possibility for error in the calculation of the weight of material. However, for all practical purposes, variations of air density from the chosen standard may safely be ignored.

## 7. Precision and Bias <sup>4</sup>

7.1 Calculations are derived from density data furnished by the various laboratories contributing to this program; hence the precision and accuracy of the equation will not necessarily be identical for all of the compounds reported.

NOTE 3—The purchaser and the supplier are expected to agree upon a reasonable policy in regard to rounding of final numbers in all computations. Rounding the final weight or volume to not more than five significant digits is, in most cases, consistent with the experimental reliability of the data.

7.2 The bias of this test method has not been determined due to the unavailability of suitable reference materials.

## 8. Keywords

8.1 density; specific gravity; volume; weight

<sup>4</sup> Supporting data are available from ASTM Headquarters. Request RR:E15-1032.

**TABLE 1 Glycerin, High-Gravity**

NOTE 1—Expansion constants in this table were derived from selected density data developed on high-gravity glycerin by ASTM Committee E-15; constant term was adjusted to a mean value of density of average production.

NOTE 2— To obtain volume at 60°F, multiply measured volume by volume correction factor corresponding to the measured temperature of bulk volume; round observed temperatures to the nearest 1°F.

| Temperature,<br>°F | Volume Corrected<br>to 60°F | Temperature,<br>°F | Volume Corrected<br>to 60°F | Temperature,<br>°F | Volume Corrected<br>to 60°F |
|--------------------|-----------------------------|--------------------|-----------------------------|--------------------|-----------------------------|
| 45                 | 1.0041                      | 80                 | 0.9945                      | 115                | 0.9847                      |
| 46                 | 1.0038                      | 81                 | 0.9942                      | 116                | 0.9844                      |
| 47                 | 1.0036                      | 82                 | 0.9939                      | 117                | 0.9841                      |
| 48                 | 1.0033                      | 83                 | 0.9937                      | 118                | 0.9838                      |
| 49                 | 1.0030                      | 84                 | 0.9934                      | 119                | 0.9836                      |
| 50                 | 1.0027                      | 85                 | 0.9931                      | 120                | 0.9833                      |
| 51                 | 1.0025                      | 86                 | 0.9928                      | 121                | 0.9830                      |
| 52                 | 1.0022                      | 87                 | 0.9925                      | 122                | 0.9827                      |
| 53                 | 1.0019                      | 88                 | 0.9923                      | 123                | 0.9824                      |
| 54                 | 1.0016                      | 89                 | 0.9920                      | 124                | 0.9821                      |
| 55                 | 1.0014                      | 90                 | 0.9917                      | 125                | 0.9819                      |
| 56                 | 1.0011                      | 91                 | 0.9914                      | 126                | 0.9816                      |
| 57                 | 1.0008                      | 92                 | 0.9912                      | 127                | 0.9813                      |
| 58                 | 1.0006                      | 93                 | 0.9909                      | 128                | 0.9810                      |
| 59                 | 1.0003                      | 94                 | 0.9906                      | 129                | 0.9807                      |
| 60                 | 1.0000                      | 95                 | 0.9903                      | 130                | 0.9804                      |
| 61                 | 0.9997                      | 96                 | 0.9900                      | 131                | 0.9802                      |
| 62                 | 0.9995                      | 97                 | 0.9898                      | 132                | 0.9799                      |
| 63                 | 0.9992                      | 98                 | 0.9895                      | 133                | 0.9796                      |
| 64                 | 0.9989                      | 99                 | 0.9892                      | 134                | 0.9793                      |
| 65                 | 0.9986                      | 100                | 0.9889                      | 135                | 0.9790                      |
| 66                 | 0.9984                      | 101                | 0.9886                      | 136                | 0.9787                      |
| 67                 | 0.9981                      | 102                | 0.9884                      | 137                | 0.9785                      |
| 68                 | 0.9978                      | 103                | 0.9881                      | 138                | 0.9782                      |
| 69                 | 0.9975                      | 104                | 0.9878                      | 139                | 0.9779                      |
| 70                 | 0.9973                      | 105                | 0.9875                      | 140                | 0.9776                      |
| 71                 | 0.9970                      | 106                | 0.9872                      | 141                | 0.9773                      |
| 72                 | 0.9967                      | 107                | 0.9869                      | 142                | 0.9770                      |
| 73                 | 0.9964                      | 108                | 0.9867                      | 143                | 0.9767                      |
| 74                 | 0.9961                      | 109                | 0.9864                      | 144                | 0.9765                      |
| 75                 | 0.9959                      | 110                | 0.9861                      | 145                | 0.9762                      |
| 76                 | 0.9956                      | 111                | 0.9858                      | 146                | 0.9759                      |
| 77                 | 0.9953                      | 112                | 0.9855                      | 147                | 0.9756                      |
| 78                 | 0.9950                      | 113                | 0.9853                      | 148                | 0.9753                      |
| 79                 | 0.9948                      | 114                | 0.9850                      | 149                | 0.9750                      |

 **E 201**
**Bulk Weight Calculation:**

Note—To compute pounds correct measured volume in U.S. gallons to 60°F and multiply by the factor for pounds (air) per U.S. gallon corresponding to values of density at 20°C in this table. Interpolate to 0.0001 unit of density:

| Specific Gravity                 |                                  | Density (true)<br>at 20°C, | Pounds <sup>A</sup><br>(air) per U.S.<br>gallon at<br>60°F | Specific Gravity                 |                                  | Density (true)<br>at 20°C,<br>g/mL | Pounds <sup>A</sup><br>(air) per U.S.<br>gallon at<br>60°F |
|----------------------------------|----------------------------------|----------------------------|------------------------------------------------------------|----------------------------------|----------------------------------|------------------------------------|------------------------------------------------------------|
| At 60/60°F<br>(vac) <sup>B</sup> | At 20/20°C<br>(vac) <sup>B</sup> |                            |                                                            | At 60/60°F<br>(vac) <sup>B</sup> | At 20/20°C<br>(vac) <sup>B</sup> |                                    |                                                            |
| 1.2644                           | 1.2627                           | 1.2604                     | 10.532                                                     | 1.2654                           | 1.2637                           | 1.2614                             | 10.540                                                     |
| 1.2645                           | 1.2628                           | 1.2605                     | 10.532                                                     | 1.2655                           | 1.2638                           | 1.2615                             | 10.541                                                     |
| 1.2646                           | 1.2629                           | 1.2606                     | 10.533                                                     | 1.2656                           | 1.2639                           | 1.2616                             | 10.542                                                     |
| 1.2647                           | 1.2630                           | 1.2607                     | 10.534                                                     | 1.2657                           | 1.2640                           | 1.2617                             | 10.542                                                     |
| 1.2648                           | 1.2631                           | 1.2608                     | 10.535                                                     | 1.2658                           | 1.2641                           | 1.2618                             | 10.543                                                     |
| 1.2649                           | 1.2632                           | 1.2609                     | 10.536                                                     | 1.2659                           | 1.2642                           | 1.2619                             | 10.544                                                     |
| 1.2650                           | 1.2633                           | 1.2610                     | 10.537                                                     | 1.2660                           | 1.2643                           | 1.2620                             | 10.545                                                     |
| 1.2651                           | 1.2634                           | 1.2611                     | 10.537                                                     | 1.2661                           | 1.2644                           | 1.2621                             | 10.546                                                     |
| 1.2652                           | 1.2635                           | 1.2612                     | 10.538                                                     | 1.2662                           | 1.2645                           | 1.2622                             | 10.547                                                     |
| 1.2653                           | 1.2636                           | 1.2613                     | 10.539                                                     | 1.2663                           | 1.2646                           | 1.2623                             | 10.547                                                     |

<sup>A</sup>To convert pounds to short tons, multiply by 0.0005; to long tons by 0.000 446 428.

<sup>B</sup>Calculated as if all weights are in vacuum; equivalent values at same temperatures for all weights in air may be approximated for ambient conditions by:  
 Apparent specific gravity =  $1.001\ 20 \times (\text{sp gr}) - 0.001\ 20$ .

**Computation Equations:**

Note—Table 1 is based on the following expressions for high-gravity glycerin whose density, at 20°C = 1.261 31 g/cm<sup>3</sup>:

| Terms in equation =                             | $D_o$         | $+ A \times 10^{-4} \times t$ | $+ B \times 10^6 \times t^2$ |
|-------------------------------------------------|---------------|-------------------------------|------------------------------|
| Basic constants, g/cm <sup>3</sup> at t°C       | 1.273 733 3   | −6.153 3                      | −0.289 55                    |
| Density in air, <sup>A</sup> lb/U.S. gal at t°F | 10.710 110 57 | −28.051                       | −0.745 783                   |
| Volume correction factor, from t°F to 60°F      | 1.016 209 02  | −2.659 1                      | −0.070 696                   |

<sup>A</sup>These are pounds in air; for “pounds (air) per Imperial gallon,” multiply all terms by 1.200 950 4.

**Density Measurement:**

For the laboratory determination of density, use Test Method D 1217.



E 201

TABLE 2 Hexylene Glycol

NOTE 1—The expansion constants on which this table is based are believed to be valid at 20°C with increasing uncertainty as temperatures depart from this point.

NOTE 2—To obtain volume at 60°F, multiply measured volume by the volume correction factor corresponding to the measured temperature of bulk volume; round observed temperatures to the nearest 1°F.

| Temperature, °F | Volume Corrected to 60°F | Temperature, °F | Volume Corrected to 60°F | Temperature, °F | Volume Corrected to 60°F | Temperature, °F | Volume Corrected to 60°F |
|-----------------|--------------------------|-----------------|--------------------------|-----------------|--------------------------|-----------------|--------------------------|
| ...             | ...                      | 20              | 1.0176                   | 60              | 1.0000                   | 100             | 0.9830                   |
| ...             | ...                      | 21              | 1.0171                   | 61              | 0.9996                   | 101             | 0.9826                   |
| ...             | ...                      | 22              | 1.0167                   | 62              | 0.9991                   | 102             | 0.9822                   |
| ...             | ...                      | 23              | 1.0162                   | 63              | 0.9987                   | 103             | 0.9818                   |
| ...             | ...                      | 24              | 1.0158                   | 64              | 0.9983                   | 104             | 0.9814                   |
| ...             | ...                      | 25              | 1.0153                   | 65              | 0.9979                   | 105             | 0.9810                   |
| ...             | ...                      | 26              | 1.0149                   | 66              | 0.9974                   | 106             | 0.9805                   |
| ...             | ...                      | 27              | 1.0144                   | 67              | 0.9970                   | 107             | 0.9801                   |
| ...             | ...                      | 28              | 1.0140                   | 68              | 0.9966                   | 108             | 0.9797                   |
| ...             | ...                      | 29              | 1.0136                   | 69              | 0.9961                   | 109             | 0.9793                   |
| ...             | ...                      | 30              | 1.0131                   | 70              | 0.9957                   | 110             | 0.9789                   |
| ...             | ...                      | 31              | 1.0127                   | 71              | 0.9953                   | 111             | 0.9785                   |
| ...             | ...                      | 32              | 1.0122                   | 72              | 0.9949                   | 112             | 0.9781                   |
| ...             | ...                      | 33              | 1.0118                   | 73              | 0.9944                   | 113             | 0.9776                   |
| ...             | ...                      | 34              | 1.0113                   | 74              | 0.9940                   | 114             | 0.9772                   |
| ...             | ...                      | 35              | 1.0109                   | 75              | 0.9936                   | 115             | 0.9768                   |
| ...             | ...                      | 36              | 1.0105                   | 76              | 0.9931                   | 116             | 0.9764                   |
| ...             | ...                      | 37              | 1.0100                   | 77              | 0.9927                   | 117             | 0.9760                   |
| ...             | ...                      | 38              | 1.0096                   | 78              | 0.9923                   | 118             | 0.9756                   |
| ...             | ...                      | 39              | 1.0091                   | 79              | 0.9919                   | 119             | 0.9752                   |
| ...             | ...                      | 40              | 1.0087                   | 80              | 0.9914                   | 120             | 0.9748                   |
| ...             | ...                      | 41              | 1.0083                   | 81              | 0.9910                   | ...             | ...                      |
| ...             | ...                      | 42              | 1.0078                   | 82              | 0.9906                   | ...             | ...                      |
| ...             | ...                      | 43              | 1.0074                   | 83              | 0.9902                   | ...             | ...                      |
| ...             | ...                      | 44              | 1.0070                   | 84              | 0.9898                   | ...             | ...                      |
| 5               | 1.0243                   | 45              | 1.0065                   | 85              | 0.9893                   | ...             | ...                      |
| 6               | 1.0238                   | 46              | 1.0061                   | 86              | 0.9889                   | ...             | ...                      |
| 7               | 1.0234                   | 47              | 1.0056                   | 87              | 0.9885                   | ...             | ...                      |
| 8               | 1.0229                   | 48              | 1.0052                   | 88              | 0.9881                   | ...             | ...                      |
| 9               | 1.0225                   | 49              | 1.0048                   | 89              | 0.9876                   | ...             | ...                      |
| 10              | 1.0220                   | 50              | 1.0043                   | 90              | 0.9872                   | ...             | ...                      |
| 11              | 1.0216                   | 51              | 1.0039                   | 91              | 0.9868                   | ...             | ...                      |
| 12              | 1.0211                   | 52              | 1.0035                   | 92              | 0.9864                   | ...             | ...                      |
| 13              | 1.0207                   | 53              | 1.0030                   | 93              | 0.9860                   | ...             | ...                      |
| 14              | 1.0202                   | 54              | 1.0026                   | 94              | 0.9855                   | ...             | ...                      |
| 15              | 1.0198                   | 55              | 1.0022                   | 95              | 0.9851                   | ...             | ...                      |
| 16              | 1.0193                   | 56              | 1.0017                   | 96              | 0.9847                   | ...             | ...                      |
| 17              | 1.0189                   | 57              | 1.0013                   | 97              | 0.9843                   | ...             | ...                      |
| 18              | 1.0184                   | 58              | 1.0009                   | 98              | 0.9839                   | ...             | ...                      |
| 19              | 1.0180                   | 59              | 1.0004                   | 99              | 0.9835                   | ...             | ...                      |
| 20              | 1.0176                   | 60              | 1.0000                   | 100             | 0.9830                   | ...             | ...                      |

 **E 201**
**Bulk Weight Calculation:**

Note—To compute pounds correct measured volume in U.S. gallons to 60°F and multiply by the factor for pounds (air) per U.S. gallon corresponding to values of density at 20°C in this table. Interpolates to 0.0001 unit of density:

| Specific Gravity                 |                                  | Density<br>(true) at<br>20°C, g/cm <sup>3</sup> | Pounds <sup>A</sup><br>(air) per U.S. gal-<br>lon at 60°F | Specific Gravity                 |                                  | Density<br>(true) at<br>20°C, g/cm <sup>3</sup> | Pounds <sup>A</sup> (air)<br>per U.S. gal-<br>lon at 60°F |
|----------------------------------|----------------------------------|-------------------------------------------------|-----------------------------------------------------------|----------------------------------|----------------------------------|-------------------------------------------------|-----------------------------------------------------------|
| At 60/60°F<br>(vac) <sup>B</sup> | At 20/20°C<br>(vac) <sup>B</sup> |                                                 |                                                           | At 60/60°F<br>(vac) <sup>B</sup> | At 20/20°C<br>(vac) <sup>B</sup> |                                                 |                                                           |
| 0.9249                           | 0.9225                           | 0.9208                                          | 7.701                                                     | 0.9265                           | 0.9241                           | 0.9224                                          | 7.714                                                     |
| 0.9250                           | 0.9226                           | 0.9209                                          | 7.702                                                     | 0.9266                           | 0.9242                           | 0.9225                                          | 7.715                                                     |
| 0.9251                           | 0.9227                           | 0.9210                                          | 7.702                                                     | 0.9267                           | 0.9243                           | 0.9226                                          | 7.716                                                     |
| 0.9252                           | 0.9228                           | 0.9211                                          | 7.703                                                     | 0.9268                           | 0.9244                           | 0.9227                                          | 7.717                                                     |
| 0.9253                           | 0.9229                           | 0.9212                                          | 7.704                                                     | 0.9269                           | 0.9245                           | 0.9228                                          | 7.718                                                     |
| 0.9254                           | 0.9230                           | 0.9213                                          | 7.705                                                     | 0.9270                           | 0.9246                           | 0.9229                                          | 7.718                                                     |
| 0.9255                           | 0.9231                           | 0.9214                                          | 7.706                                                     | 0.9271                           | 0.9247                           | 0.9230                                          | 7.719                                                     |
| 0.9256                           | 0.9232                           | 0.9215                                          | 7.707                                                     | 0.9272                           | 0.9248                           | 0.9231                                          | 7.720                                                     |
| 0.9257                           | 0.9233                           | 0.9216                                          | 7.708                                                     | 0.9273                           | 0.9249                           | 0.9232                                          | 7.721                                                     |
| 0.9258                           | 0.9234                           | 0.9217                                          | 7.708                                                     | 0.9274                           | 0.9250                           | 0.9233                                          | 7.722                                                     |
| 0.9259                           | 0.9235                           | 0.9218                                          | 7.709                                                     | 0.9275                           | 0.9251                           | 0.9234                                          | 7.723                                                     |
| 0.9260                           | 0.9236                           | 0.9219                                          | 7.710                                                     | 0.9276                           | 0.9252                           | 0.9235                                          | 7.723                                                     |
| 0.9261                           | 0.9237                           | 0.9220                                          | 7.711                                                     | 0.9277                           | 0.9253                           | 0.9236                                          | 7.724                                                     |
| 0.9262                           | 0.9238                           | 0.9221                                          | 7.712                                                     | 0.9278                           | 0.9254                           | 0.9237                                          | 7.725                                                     |
| 0.9263                           | 0.9239                           | 0.9222                                          | 7.713                                                     | 0.9279                           | 0.9255                           | 0.9238                                          | 7.726                                                     |
| 0.9264                           | 0.9240                           | 0.9223                                          | 7.713                                                     | ...                              | ...                              | ...                                             | ...                                                       |

<sup>A</sup>To convert pounds to short tons, multiply by 0.0005; to long tons by 0.000 446 428.

<sup>B</sup>Calculated as if all weights are in vacuum; equivalent values at same temperatures for all weights in air may be approximated for ambient conditions by:  
Apparent specific gravity = 1.001 20 × (sp gr) – 0.001 20.

**Computation Equations:**

Note—Table 2 is based on the following expressions for hexylene glycol whose density, at 20°C = 0.922 486 g/cm<sup>3</sup>:

| Terms in equation =                                | $D_o$        | $+ A \times 10^4 \times t$ | $+ B \times 10^6 \times t^2$ | $+ C \times 10^8 \times t^3$ |
|----------------------------------------------------|--------------|----------------------------|------------------------------|------------------------------|
| Basic constants, g/cm <sup>3</sup> at<br>t°C       | 0.936 983 32 | –7.357 7                   | 0.545 31                     | ...                          |
| Density in air, <sup>A</sup> lb/U.S. gal<br>at t°F | 7.919 930 46 | –35.011                    | 1.404 55                     | ...                          |
| Volume correction factor,<br>from t°F to 60°F      | 1.026 538 8  | –4.532 2                   | 0.181 82                     | ...                          |

<sup>A</sup>These are pounds in air; for "pounds (air) per Imperial gallon," multiply all terms by 1.200 950 4.

**Density Measurement:**

For the laboratory determination of density, use Test Method D 1217.



TABLE 3 Isobutyl Alcohol

NOTE 1—Expansion constants in this table were derived from selected density data developed on isobutyl alcohol by ASTM Committee E-15; constant term was adjusted to a mean value of density of average production.

NOTE 2—To obtain volume at 60°F, multiply measured volume by volume correction factor corresponding to the measured temperature of bulk volume; round observed temperatures to the nearest 1°F.

| Temperature,<br>°F | Volume Corrected<br>to 60°F | Temperature,<br>°F | Volume Corrected<br>to 60°F | Temperature,<br>°F | Volume Corrected<br>to 60°F |
|--------------------|-----------------------------|--------------------|-----------------------------|--------------------|-----------------------------|
| 5                  | 1.0275                      | 40                 | 1.0101                      | 75                 | 0.9924                      |
| 6                  | 1.0270                      | 41                 | 1.0096                      | 76                 | 0.9919                      |
| 7                  | 1.0265                      | 42                 | 1.0091                      | 77                 | 0.9914                      |
| 8                  | 1.0260                      | 43                 | 1.0086                      | 78                 | 0.9909                      |
| 9                  | 1.0255                      | 44                 | 1.0081                      | 79                 | 0.9904                      |
| 10                 | 1.0250                      | 45                 | 1.0076                      | 80                 | 0.9899                      |
| 11                 | 1.0245                      | 46                 | 1.0070                      | 81                 | 0.9894                      |
| 12                 | 1.0240                      | 47                 | 1.0065                      | 82                 | 0.9889                      |
| 13                 | 1.0235                      | 48                 | 1.0060                      | 83                 | 0.9884                      |
| 14                 | 1.0230                      | 49                 | 1.0055                      | 84                 | 0.9879                      |
| 15                 | 1.0225                      | 50                 | 1.0050                      | 85                 | 0.9874                      |
| 16                 | 1.0221                      | 51                 | 1.0045                      | 86                 | 0.9869                      |
| 17                 | 1.0216                      | 52                 | 1.0040                      | 87                 | 0.9863                      |
| 18                 | 1.0211                      | 53                 | 1.0035                      | 88                 | 0.9858                      |
| 19                 | 1.0206                      | 54                 | 1.0030                      | 89                 | 0.9853                      |
| 20                 | 1.0201                      | 55                 | 1.0025                      | 90                 | 0.9848                      |
| 21                 | 1.0196                      | 56                 | 1.0020                      | 91                 | 0.9843                      |
| 22                 | 1.0191                      | 57                 | 1.0015                      | 92                 | 0.9838                      |
| 23                 | 1.0186                      | 58                 | 1.0010                      | 93                 | 0.9833                      |
| 24                 | 1.0181                      | 59                 | 1.0005                      | 94                 | 0.9828                      |
| 25                 | 1.0176                      | 60                 | 1.0000                      | 95                 | 0.9823                      |
| 26                 | 1.0171                      | 61                 | 0.9995                      | 96                 | 0.9818                      |
| 27                 | 1.0166                      | 62                 | 0.9990                      | 97                 | 0.9813                      |
| 28                 | 1.0161                      | 63                 | 0.9985                      | 98                 | 0.9808                      |
| 29                 | 1.0156                      | 64                 | 0.9980                      | 99                 | 0.9802                      |
| 30                 | 1.0151                      | 65                 | 0.9975                      | 100                | 0.9797                      |
| 31                 | 1.0146                      | 66                 | 0.9970                      | 101                | 0.9792                      |
| 32                 | 1.0141                      | 67                 | 0.9965                      | 102                | 0.9787                      |
| 33                 | 1.0136                      | 68                 | 0.9960                      | 103                | 0.9782                      |
| 34                 | 1.0131                      | 69                 | 0.9955                      | 104                | 0.9777                      |
| 35                 | 1.0126                      | 70                 | 0.9950                      | 105                | 0.9772                      |
| 36                 | 1.0121                      | 71                 | 0.9945                      | 106                | 0.9767                      |
| 37                 | 1.0116                      | 72                 | 0.9939                      | 107                | 0.9762                      |
| 38                 | 1.0111                      | 73                 | 0.9934                      | 108                | 0.9757                      |
| 39                 | 1.0106                      | 74                 | 0.9929                      | 109                | 0.9751                      |

**Bulk Weight Calculation:**

Note—To compute pounds correct measured volume in U.S. gallons to 60°F and multiply by the factor for pounds (air) per U.S. gallon corresponding to values of density at 20°C in this table. Interpolate to 0.0001 unit of density:

| Specific Gravity                 |                                  | Density (true)<br>at 20°C,<br>g/cm <sup>3</sup> | Pounds <sup>A</sup><br>(air) per U.S.<br>gallon at<br>60°F | Specific Gravity                 |                                  | Density (true)<br>at 20°C,<br>g/cm <sup>3</sup> | Pounds <sup>A</sup><br>(air) per U.S.<br>gallon at<br>60°F |
|----------------------------------|----------------------------------|-------------------------------------------------|------------------------------------------------------------|----------------------------------|----------------------------------|-------------------------------------------------|------------------------------------------------------------|
| At 60/60°F<br>(vac) <sup>B</sup> | At 20/20°C<br>(vac) <sup>B</sup> |                                                 |                                                            | At 60/60°F<br>(vac) <sup>B</sup> | At 20/20°C<br>(vac) <sup>B</sup> |                                                 |                                                            |
| 0.8052                           | 0.8026                           | 0.8012                                          | 6.703                                                      | 0.8063                           | 0.8036                           | 0.8022                                          | 6.712                                                      |
| 0.8053                           | 0.8027                           | 0.8013                                          | 6.704                                                      | 0.8064                           | 0.8037                           | 0.8023                                          | 6.713                                                      |
| 0.8054                           | 0.8028                           | 0.8014                                          | 6.705                                                      | 0.8065                           | 0.8038                           | 0.8024                                          | 6.713                                                      |
| 0.8055                           | 0.8029                           | 0.8015                                          | 6.707                                                      | 0.8067                           | 0.8039                           | 0.8025                                          | 6.714                                                      |
| 0.8056                           | 0.8030                           | 0.8016                                          | 6.708                                                      | 0.8068                           | 0.8040                           | 0.8026                                          | 6.715                                                      |
| 0.8058                           | 0.8031                           | 0.8017                                          | 6.709                                                      | 0.8069                           | 0.8041                           | 0.8027                                          | 6.716                                                      |
| 0.8059                           | 0.8032                           | 0.8018                                          | 6.710                                                      | 0.8070                           | 0.8042                           | 0.8028                                          | 6.717                                                      |
| 0.8060                           | 0.8033                           | 0.8019                                          | 6.711                                                      | 0.8072                           | 0.8043                           | 0.8029                                          | 6.718                                                      |
| 0.8061                           | 0.8034                           | 0.8020                                          |                                                            |                                  | 0.8044                           | 0.8030                                          | 6.718                                                      |
| 0.8062                           | 0.8035                           | 0.8021                                          |                                                            |                                  | 0.8045                           | 0.8031                                          | 6.719                                                      |

<sup>A</sup>To convert pounds to short tons, multiply by 0.0005; to long tons by 0.000 446 428.

<sup>B</sup>Calculated as if all weights are in vacuum; equivalent values at same temperatures for all weights in air may be approximated for ambient conditions by:  
Apparent specific gravity =  $1.001\ 20 \times (\text{sp gr}) - 0.001\ 20$ .

**Computation Equations:**

Note—Table 3 is based on the following expressions for isobutyl alcohol whose density, at 20°C = 0.802 088 g/cm<sup>3</sup>:

| Terms in equation =                             | $D_o$        | $+ A \times 10^4 \times t$ | $+ B \times 10^6 \times t^2$ |
|-------------------------------------------------|--------------|----------------------------|------------------------------|
| Basic constants, g/cm <sup>3</sup> at t°C       | 0.816 661 52 | -7.251 0                   | -0.179 76                    |
| Density in air, <sup>A</sup> lb/U.S. gal at t°F | 6.912 334 79 | -33.321 1                  | -0.462 99                    |
| Volume correction factor, from t°F to 60°F      | 1.029 995 86 | -4.958                     | -0.068 891                   |

<sup>A</sup>These are pounds in air; for "pounds (air) per Imperial gallon," multiply all terms by 1.200 950 4.

**Density Measurement:**

For the laboratory determination of density, use Test Method D 1217.