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Standard Guide for Use of the Petroleum Measurement Tables¹

This standard is issued under the fixed designation D 1250; 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.

INTRODUCTION

This guide discusses the use of temperature and pressure volume correction factors for generalized crude oils, refined products, and lubricating oils, developed jointly by ASTM International, the American Petroleum Institute (API) and the Energy Institute.²

The volume correction factors, in their basic form, are the output of a set of equations derived from, and based on, empirical data relating to the volumetric change of hydrocarbons over a range of temperatures and pressures. Traditionally, the factors have been listed in tabular format called the Petroleum Measurement Tables (hence the appearance of this term in the title), and published as an API Standard/Adjunct to IP 200/Adjunct to ASTM D 1250. However, since the 1980 revision the actual standard has been a set of implementation procedures, not printed tables nor simply a set of equations.

This revised standard, API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD), establishes procedures for crude oils, liquid refined products, and lubricating oils, by which volume measurements taken at any temperature and pressure (within the range of the standard) can be corrected to an equivalent volume at base/standard conditions, normally 15°C, 60°F or 20°C, by use of a volume correction factor (VCF). The standard, API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD), also provides methods for making conversions to alternate conditions from base conditions and to alternate base temperatures. Densities can be corrected by using the inverse of the VCF.

See Section 5 for a list of significant changes from Guide D 1250–80 (provided in its entirety in Annex A1).

USAGE GUIDELINES

The revised standard, API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD), is effective upon the date of publication and supersedes the previous edition of the standard/adjunct(s). However, due to the nature of the changes in the revised standard/adjunct(s), it is recognized that guidance concerning an implementation period may be needed in order to avoid disruptions within the industry and ensure proper application. As a result, it is recommended that the revised standard/adjunct(s) be used on all new applications no later than *two years after the publication date* (May 2004). An application for this purpose is defined as the point where the calculation is applied.

Once the revised standard/adjunct(s) is implemented in a particular application, the previous standard will no longer be used in that application.

If an existing application complies with the previous standard/adjunct(s) (as referenced in Annex A1), then it shall be considered in compliance with the revised standard/adjunct(s).

However, the use of the API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) remains voluntary, and the decision on when to utilize a standard is an issue that is subject to the negotiations between the parties involved in the transaction.

1. Scope

1.1 The API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) for temperature and pressure volume correction factors for generalized crude oils, refined products, and lubricating oils, provides the algorithm and implementation procedure for the correction of temperature and pressure effects on density and volume of liquid hydrocarbons. Natural gas liquids (NGLs) and liquefied petroleum gases (LPGs) are excluded from consideration. The combination of density and volume correction factors for both temperature and pressure is collectively referred to in the standard/adjunct(s) as a Volume Correction Factor (VCF). The temperature portion of this correction is termed the Correction for the effect of Temperature on Liquid (CTL). The pressure portion is termed the Correction for the effect of Pressure on Liquid (CPL).

1.2 Including the pressure correction in API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) represents an important change from the “temperature only” correction factors given in the 1980 Petroleum Measurement Tables. However, if the pressure is one atmosphere (the standard pressure) then there is no pressure correction and the standard/adjunct(s) will give VCF values consistent with the 1980 Petroleum Measurement Tables.

1.3 API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) covers general procedures for the conversion of input data to a form that is consistent with the computation procedures used to generate VCF values. Two sets of procedures are included for computing volume correction factor: one set for data expressed in customary units (temperature in °F, pressure in psig); the other for the metric system of units (temperature in °C, pressure in kPa or bar). In contrast to the 1980 Petroleum Measurement Tables, the metric procedures require the procedure for customary units be used first to compute density at 60°F. This value is then further corrected to give the metric output. The metric procedures now incorporate the base temperature of 20°C in addition to 15°C.

1.4 The procedures recognize three distinct commodity groups: crude oil, refined products, and lubricating oils. A procedure is also provided for determining volume correction for special applications where the generalized commodity groups’ parameters may not adequately represent the thermal expansion properties of the liquid and a precise thermal expansion coefficient has been determined by experiment.

2. Referenced Documents

2.1 API Standards:

API Manual of Petroleum Measurement Standards (*MPMS*):
Chapter 11.1–2004 Temperature and Pressure Volume Cor-

rection Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils³

Chapter 11.2.1 Compressibility Factors for Hydrocarbons: 0–90° API Gravity Range

Chapter 11.2.1M Compressibility Factors for Hydrocarbons: 638–1074 Kilograms per Cubic Meter Range

2.2 ISO Standards:

ISO 91–1:1992 Petroleum measurement tables—Part 1:
Tables based on reference temperatures of 15°C and 60°F

ISO 91–2:1991 Petroleum measurement tables—Part 2:
Tables based on a reference temperature of 20°C

2.3 ASTM Adjuncts:

Adjunct to ASTM D 1250: ADJD1250CD—Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils⁴

3. Sponsorship

3.1 The revision of the ASTM/API/IP set of implementation procedures is the result of close cooperation between ASTM International, the American Petroleum Institute (API), and the Energy Institute.²To meet the objective of worldwide standardized measurement practices, it is expected to result in the acceptance of the revised tables by the International Organization for Standardization (ISO), and specifically ISO/TC 28/SC 3, as revisions to International Standards ISO 91–1 and ISO 91–2. API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) applies to all crude oils, refined products, and lubricants previously covered by Tables 5, 6, 23, 24, 53, 54, 59, and 60. The API designation for the complete set of implementation procedures is the Manual of Petroleum Measurement Standards (*MPMS*) Chapter 11 Section 1. The IP designation for the complete set of implementation procedures is the Adjunct to IP 200.

4. Significance and Use

4.1 The expanded limits of API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) are defined in a mixture of terms of customary and metric units. Table 1 shows the defining limits and their associated units in ***bold italics***. Also shown in Table 1 are the limits converted to their equivalent units (and, in the case of the densities, other base temperatures).

4.2 Note that only the precision levels of the defining values shown in Table 1 are correct. The other values showing converted units have been rounded to the significant digits shown; as rounded values, they may numerically fall just outside of the actual limits established by the defining values.

4.3 Table 2 provides a cross-reference between the historical table designations and the corresponding section in API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD). Note that procedure paragraphs 11.1.6.3 (U.S. customary units) and 11.1.7.3 (metric

¹ This guide is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and the API Committee on Petroleum Measurement, and is the direct responsibility of Subcommittee D02.02/COMQ, the joint ASTM-API Committee on Static Petroleum Measurement.

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² The organization that publishes IP test methods and guides.

³ Available on CD-ROM from API. Order Product Number H11013.

⁴ Available on CD-ROM from ASTM International Headquarters. Order Adjunct No. ADJD1250CD.

TABLE 1 Range Limits^A

Physical Units	Crude Oil	Refined Products	Lubricating Oils
<i>Density, kg/m³ @ 60°F</i>	<i>610.6 to 1163.5</i>	<i>610.6 to 1163.5</i>	<i>800.9 to 1163.5</i>
Relative Density @ 60°F	0.61120 to 1.16464	0.61120 to 1.16464	0.80168 to 1.1646
API Gravity @ 60°F	100.0 to -10.0	100.0 to -10.0	45.0 to -10.0
Density, kg/m ³ @ 15°C	611.16 to 1163.79	611.16 to 1163.86	801.25 to 1163.85
Density, kg/m ³ @ 20°C	606.12 to 1161.15	606.12 to 1160.62	798.11 to 1160.71
<i>Temperature, °C</i>	<i>-50.00 to 150.00</i>	<i>-50.00 to 150.00</i>	<i>-50.00 to 150.00</i>
Temperature, °F	-58.0 to 302.0	-58.0 to 302.0	-58.0 to 302.0
<i>Pressure, psig</i>	<i>0 to 1500</i>	<i>0 to 1500</i>	<i>0 to 1500</i>
kPa (gage)	0 to 1.034 × 10 ⁴	0 to 1.034 × 10 ⁴	0 to 1.034 × 10 ⁴
bar (gage)	0 to 103.4	0 to 103.4	0 to 103.4
<i>α₆₀, per °F</i>	<i>230.0 × 10⁻⁶ to 930.0 × 10⁻⁶</i>	<i>230.0 × 10⁻⁶ to 930.0 × 10⁻⁶</i>	<i>230.0 × 10⁻⁶ to 930.0 × 10⁻⁶</i>
α ₆₀ , per °C	414.0 × 10 ⁻⁶ to 1674.0 × 10 ⁻⁶	414.0 × 10 ⁻⁶ to 1674.0 × 10 ⁻⁶	414.0 × 10 ⁻⁶ to 1674.0 × 10 ⁻⁶

^A Defining limits and their associated units appear in ***bold italics***.

TABLE 2 Historical Table Cross-Reference

Historical Table Designation	Procedure Paragraph in Current Standard	Historical Table Designation	Procedure Paragraph in Current Standard
5 A, B & D	11.1.6.2	53 A, B & D	11.1.7.2
23 A, B, & D	11.1.6.2	59 A, B, & D	11.1.7.2
6 A, B, C & D	11.1.6.1	54 A, B, C & D	11.1.7.1
24 A, B, C & D	11.1.6.1	60 A, B, C & D	11.1.7.1

units) provide methods for correcting on-line density measurements from live conditions to base conditions and then to compute VCF factors for continuous volume corrections to base conditions.

4.4 When a glass hydrometer is used to measure the density of a liquid, special corrections must be made to account for the thermal expansion of the glass when the temperature is different from that at which the hydrometer was calibrated. The 1980 CTL Tables had generalized equations to correct glass hydrometer readings, and these corrections were part of the printed odd-numbered tables. However, detailed procedures to correct a glass hydrometer reading are beyond the scope of API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD). The user should refer to the appropriate sections of API *MPMS* Chapter 9 or other appropriate density/hydrometer standards for guidance.

4.5 The set of correlations given in API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) is intended for use with petroleum fluids comprising either crude oils, refined products, or lubricating oils that are single-phase liquids under normal operating conditions. The liquid classifications listed here are typical terms used in the industry, but local nomenclature may vary. The list is illustrative and is not meant to be all-inclusive.

4.6 *Crude Oils*—A crude oil is considered to conform to the commodity group Generalized Crude Oils if its density falls in the range between approximately –10°API to 100°API. Crude oils that have been stabilized for transportation or storage purposes and whose API gravities lie within that range are considered to be part of the Crude Oil group. Also, aviation jet B (JP-4) is best represented by the Crude Oil correlation.

4.7 *Refined Products*—A refined product is considered to conform to the commodity group of Generalized Refined Products if the fluid falls within one of the refined product groups. Note the product descriptors are generalizations. The

commercial specification ranges of some products may place their densities partly within an adjacent class (for example, a low density diesel may lie in the jet fuel class). In such cases, the product should be allocated to the class appropriate to its density, not its descriptor. The groups are defined as follows:

4.7.1 *Gasoline*—Motor gasoline and unfinished gasoline blending stock with a base density range between approximately 50°API and 85°API. This group includes substances with the commercial identification of: premium gasoline, unleaded gasoline, motor spirit, clear gasoline, low lead gas, motor gasoline, catalyst gas, alkylate, catalytic cracked gasoline, naphtha, reformulated gasoline, and aviation gasoline.

4.7.2 *Jet Fuels*—Jet fuels, kerosene, and Stoddard solvents with a base density range between approximately 37°API and 50°API. This group includes substances with the commercial identification of: aviation kerosene K1 and K2, aviation jet A and A-1, kerosene, Stoddard solvent, JP-5 and JP-8.

4.7.3 *Fuel Oils*—Diesel oils, heating oils, and fuel oils with a base density range between approximately –10°API and 37°API. This group includes substances with the commercial identification of: No. 6 fuel oil, fuel oil PA, low sulfur fuel oil, LT (low temperature) fuel oil, fuel oil, fuel oils LLS (light low sulfur), No. 2 furnace oil, furnace oil, auto diesel, gas oil, No. 2 burner fuel, diesel fuel, heating oil, and premium diesel.

4.8 *Lubricating Oils*—A lubricating oil is considered to conform to the commodity group Generalized Lubricating Oils if it is a base stock derived from crude oil fractions by distillation or asphalt precipitation. For the purpose of API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD), lubricating oils have initial boiling points greater than 700°F (370°C) and densities in the range between approximately –10°API to 45°API.

4.9 *Special Applications*—Liquids that are assigned the special applications category are generally relatively pure products or homogeneous mixtures with stable (unchanging)

chemical composition that are derived from petroleum (or are petroleum-based with minor proportions of other constituents) and have been tested to establish a specific thermal expansion factor for the particular fluid. These tables should be considered for use when:

4.9.1 The generalized commodity groups' parameters are suspected of not adequately representing the thermal expansion properties of the liquid.

4.9.2 A precise thermal expansion coefficient can be determined by experiment. A minimum of 10 temperature/density data points is recommended to use this method. See 11.1.5.2 of API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) for the procedure to calculate the thermal expansion coefficient from measured density data.

4.9.3 Buyer and seller agree that, for their purpose, a greater degree of equity can be obtained using factors specifically measured for the liquid involved in the transaction.

4.9.4 Specific Examples:

MTBE with an α_{60} value of $789.0 \times 10^{-6} \text{ } ^\circ\text{F}^{-1}$

Gasohol with an α_{60} value of $714.34 \times 10^{-6} \text{ } ^\circ\text{F}^{-1}$

4.10 Refer to paragraphs 11.1.2.4 and 11.1.2.5 in API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) for a complete description of the suitability of the implementation procedures for specific hydrocarbon liquids.

5. Historical Background

5.1 The 1980 Petroleum Measurement Tables were based on data obtained using the International Practical Temperature Scale 1968 (IPTS–68). This has been superseded by the International Temperature Scale 1990 (ITS–90). API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) takes this into account by correcting the input temperature values to an IPTS–68 basis before any other calculations are performed. Standard densities are also adjusted to take into account the small shifts in the associated standard temperatures.

5.2 The accepted value of the standard density of water at 60°F has changed slightly from the value used in the 1980 Petroleum Measurement Tables. This new water density only affects those tables based on relative density and API gravity, that is, the historical Tables 5, 6, 23 and 24. It also affects the intraconversion tables, API *MPMS* Chapter 11.1–1980 Volumes XI and XII/Adjunct to ASTM D 1250–80 (ADJD125011).⁵

5.3 In 1988 the IP produced implementation procedures for 20°C (Tables 59 A, B and D and 60 A, B and D) by extending the procedures used for the 15°C tables. This was in response to the needs of countries that use 20°C as their standard temperature. Although API never published these tables, they

were adopted internationally as the reference document for International Standard ISO 91–2. ISO 91–2 complements ISO 91–1, the International Standard for temperatures of 60°F and 15°C that is based on Volume X of API *MPMS* Chapter 11.1–1980/Adjunct to IP 200/Adjunct to ASTM D 1250–80 (ADJD125010).⁵ The 2004 revision to API *MPMS* Chapter 11.1/Adjunct to IP 200/Adjunct to ASTM D 1250 (ADJD1250CD) incorporates the 20°C tables. The procedures adopted for the metric tables give results that are identical to those obtained using the 60°F tables. Furthermore, these procedures may be adapted to provide tables at any desired temperature base.

5.4 Implementation procedures for the lubricating oil tables first appeared in the IP's Petroleum Measurement Paper No 2: Guidelines for Users of the Petroleum Measurement Tables (API Standard 2540; IP 200; ANSI/ASTM D 1250), and later in their 20°C tables. The implementation procedures are now incorporated in API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD).

5.5 Rounding of density in metric tables changed from 0.5 kg/m³ to 0.1 kg/m³ to improve discrimination.

5.6 To satisfy industry needs, the tables have been extended to lower temperatures and higher densities (that is, lower API gravities).

5.7 Real-time density measurement using density meters has become more prevalent in the industry. These density measurements are often made at pressures greater than atmospheric. This pressure effect must be taken into account simultaneously with any temperature effect when determining the density at standard conditions. Hence, pressure and temperature corrections have been combined into one procedure.

5.8 Rounding and truncation of initial and intermediate values have been eliminated. Rounding will only be applied to the final VCF values.

5.9 The final VCF values will now be rounded to a consistent 5 decimal digits. API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) also provides a mechanism to provide intermediate unrounded factors that, when combined, give the overall rounded CTPL (VCF).

5.10 The 1980 Petroleum Measurement Tables' implementation procedure used integer arithmetic in order to allow all existing computer equipment to achieve consistent results. This procedure now uses a double-precision floating-point math procedure.

5.11 Revised API *MPMS* Chapters 11.2.1 and 11.2.1M are now incorporated into API *MPMS* Chapter 11.1–2004. The 1984 versions of both will continue to be available on an historical basis.⁶

5.12 Previous editions of the printed tables were based on density measurements made using a glass hydrometer. API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D 1250–04 (ADJD1250CD) is based on the input of density values and no glass hydrometer corrections are applied. If density is measured using a glass hydrometer, hydrometer

⁵ When ordering from ASTM International, request ADJD125001 for Vol I; ADJD125002 for Vol II; ADJD125003 for Vol III; ADJD125004 for Vol IV; ADJD125005 for Vol V; ADJD125006 for Vol VI; ADJD125007 for Vol VII; ADJD125008 for Vol VIII; ADJD125009 for Vol IX; ADJD125010 for Vol X; and for Vol XI/XII-ADJD125011. The adjunct number for the complete set is ADJD1250CS.

⁶ Available from the American Petroleum Institute (API), 1220 L St., NW, Washington, DC 20005.

readings shall be corrected to density values before they are applied in the calculations.

6. Keywords

6.1 crude oil; density correction; lubricants; lubricating oils; Petroleum Measurement Tables; petroleum products; volume correction; volume correction factor

ANNEX

(Mandatory Information)

A1. GUIDE FOR PETROLEUM MEASUREMENT TABLES [ASTM D 1250–80, API MPMS Chapter 11.1–1980, IP 200/80 (90)]⁷

A1.1 Scope

A1.1.1 These Petroleum Measurement Tables⁵ are for use in the calculation of quantities of crude petroleum and petroleum products at reference conditions in any of three widely used systems of measurement. These tables are provided for standardized calculation of measured quantities of petroleum fluids regardless of point of origin, destination, or units of measure used by custom or statute.

A1.1.2 The Petroleum Measurement Tables published in 1980, except for Tables 33 and Tables 34 (which are being reissued without change), represent a major conceptual departure from previous versions. Inherent in the Petroleum Measurement Tables is the recognition of the present and future position of computers in the petroleum industry. The actual standard represented by the Petroleum Measurement Tables is neither the hardcopy printed tables nor the set of equations used to represent the density data but is an explicit implementation procedure used to develop computer subroutines for Tables 5, Tables 6, Tables 23, Tables 24, Tables 53, and Tables 54. The standardization of an implementation procedure implies the standardization of the set of mathematical expressions, including calculational sequence and rounding procedures, used within the computer code. Absolute adherence to the outlined procedures will ensure that all computers and computer codes of the future, meeting the stated specifications and restrictions, will be able to produce identical results. Hence, the published implementation procedures are the primary standard, the distributed subroutines are the secondary standard, and the published tables are produced for convenience.

NOTE A1.1—The present collection of tables supersedes all previous editions of the Petroleum Measurement Tables ANSI/ASTM D 1250, IP 200, and API Standard 2540.

⁷ The 1980 edition of the Petroleum Measurement Tables may still be in use (see the Introduction and Usage Guidelines). For that reason, Guide D 1250–80 has been included as this mandatory annex.

A1.2 Referenced Documents

D 287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)⁸
Petroleum Measurement Tables—1980⁹
Historical Edition Petroleum Measurement Table—1952¹⁰

A1.3 Sponsorship

A1.3.1 The complete collection of the new jointly issued ASTM-API-IP tables is the result of close cooperation between the American Society for Testing and Materials, American Petroleum Institute, and the Institute of Petroleum (London). To meet the objective of worldwide standardized measurement practices, the American National Standards Institute and the British Standards Institution have also been closely involved, resulting in the acceptance of the revised tables as an American National Standard and a British Standard. In addition, in their respective capacities as Secretariat of the International Organization for Standardization/TC 28 and of TC 28/SC 3, ANSI and BSI have been instrumental in progressing the revised tables toward their adoption as an International Standard by the International Organization for Standardization. The ASTM Designation D 1250 applies to all 35 tables described in Section A1.5. The Energy Institute designation for the complete set of tables is IP 200/80.

A1.4 Significance and Use

A1.4.1 This guide is expected to apply to crude petroleum regardless of source and to all normally liquid petroleum products derived therefrom. There are three primary sets of tables in current use. These are in terms of °API (Tables 5 and Tables 6), relative density (Tables 23 and Tables 24), and

⁸ 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.

⁹ Available from ASTM International Headquarters. Order Adjunct No. ADJD1250CS.

¹⁰ Available from ASTM International Headquarters. Order Adjunct No. ADJD1250AM.

density in kilogram per cubic metre (Tables 53 and Tables 54). To maximize accuracy and maintain convenience of use in primary tables (Tables 5, Tables 6, Tables 23, Tables 24, Tables 53, and Tables 54), crude oils and products are presented in separate tables. For example, for Table 6 there are: Table 6A, Generalized Crude Oils; Table 6B, Generalized Products; and Table 6C, Volume Correction Factors for Individual and Special Applications. The subsidiary tables are based on averages of the crude oil and product volume correction factors obtained from the primary tables and, hence are not included in the precision statement that encompass the primary tables.

A1.4.2 The ranges for the primary tables are as follows:

Table A		Table B	
°API	°F	°API	°F
0 to 40	0 to 300	0 to 40	0 to 300
40 to 50	0 to 250	40 to 50	0 to 250
50 to 100	0 to 200	50 to 85	0 to 200

Table C	
α^A	°F
270 to 510 $\times 10^{-6}$	0 to 300
510 to 530	0 to 250
530 to 930	0 to 200

^A Alpha is the coefficient of thermal expansion at 60 °F.

The ranges of the subsidiary tables, except Tables 33 and Tables 34, encompass the range of Table A.

A1.4.3 All tables that involve reduction of gravity to standard temperature are based on the assumption that the measurement has been made by means of a glass hydrometer (Test Method D 287), and that correction for the thermal expansion of standard hydrometer glass has been incorporated. To accommodate the growing use of on-line densitometers, which are not dependent on hydrometer corrections, the computer sub-routines optionally allow for the exclusion of the hydrometer correction.

A1.5 Available Tables

Volume I:

Table 5A—Generalized Crude Oils, Correction of Observed API Gravity to API Gravity at 60°F

Table 6A—Generalized Crude Oils, Correction of Volume to 60°F Against API Gravity at 60°F

Volume II:

Table 5B—Generalized Products, Correction of Observed API Gravity to API Gravity at 60°F

Table 6B—Generalized Products, Correction of Volume to 60°F Against API Gravity at 60°F

Volume III:

Table 6C—Volume Correction Factors for Individual and Special Applications, Volume Correction to 60°F Against Thermal Expansion Coefficients at 60°F

Volume IV:

Table 23A—Generalized Crude Oils, Correction of Observed Relative Density to Relative Density 60/60°F

Table 24A—Generalized Crude Oils, Correction of Volume to 60°F Against Relative Density 60/60°F

Volume V:

Table 23B—Generalized Products, Correction of Observed Relative Density to Relative Density 60/60°F

Table 24B—Generalized Products, Correction of Volume to 60°F Against Relative Density 60/60°F

Volume VI:

Table 24C—Volume Correction Factors for Individual and Special Applications, Volume Correction to 60°F Against Thermal Expansion Coefficients at 60°F

Volume VII:

Table 53A—Generalized Crude Oils, Correction of Observed Density to Density at 15°C

Table 54A—Generalized Crude Oils, Correction of Volume to 15°C Against Density at 15°C

Volume VIII:

Table 53B—Generalized Products, Correction of Observed Density to Density at 15°C

Table 54B—Generalized Products, Correction of Volume to 15°C Against Density at 15°C

Volume IX:

Table 54C—Volume Correction Factors for Individual and Special Applications, Volume Correction to 15°C Against Thermal Expansion Coefficients at 15°C

Volume X:

Background, Development, and Implementation Procedures
Volumes XI and XII:

Tables 2, Tables 3, Tables 4, Tables 8, Tables 9, Tables 10, Tables 11, Tables 12, Tables 13, Tables 14, Tables 21, Tables 22, Tables 26, Tables 27, Tables 28, Tables 29, Tables 30, Tables 31, Tables 51, Tables 52, and Tables 58

Reissued Without Change:

Table 33—Specific Gravity Reduction to 60°F for Liquefied Petroleum Gases and Natural Gas

Table 34—Reduction of Volume to 60°F Against Specific Gravity 60/60°F for Liquefied Petroleum Gases

A1.6 Keywords

density; gravity; hydrometer; temperature; volume correction

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