Designation: ~~D1250 – 08 (Reapproved 2013)$^{\varepsilon 1}$~~ D1250 – 19

Designation: ~~200/08~~200/19

Standard Guide for the Use of the ~~Petroleum Measurement Tables~~Joint API and ASTM Adjunct for Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils: API MPMS Chapter 11.1[1]

This standard is issued under the fixed designation D1250; 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 U.S. Department of Defense.

~~ε[1] NOTE—Adjunct ADJD1250-E-PDF information was corrected editorially in October 2015.~~

INTRODUCTION

This guide, ASTM D1250, provides information related to the algorithm and implementation procedure for the correction of temperature and pressure effects on density and volume of liquid hydrocarbons as outlined in API *MPMS* Chapter 11.1, Physical Properties Data—Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils. The algorithms and implementation procedure are published in an adjunct (supplementary) product called the Adjunct for Volume Correction Factors (VCF).

~~This guide~~ASTM D1250 ~~discusses the use of temperature and pressure~~ is not the API standard and all instructions, procedures, and examples for calculating volume correction factors for generalized crude oils, refined products, and ~~lubricating oils, developed jointly by ASTM International, the American Petroleum~~lubrication oils are found in the standard, API ~~*Institute*~~*MPMS* ~~(API) and the Energy Institute.~~Chapter 11.1-2004, Addendum 1-2007, and Addendum 2-2019.

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,~~ Prior to 2004, the factors ~~have been~~ were listed in tabular format called ~~the~~ASTM D1250, Petroleum Measurement Tables ~~(hence the appearance of this term in the title),~~ and published as an API ~~Standard/Adjunct~~ Standard Chapter 11.1/Adjunct to IP 200/Adjunct to ASTM D1250. However, ~~since the 1980 revision the~~the current standard, API ~~*actual*~~*MPMS* ~~standard has been a set of implementation procedures, not printed tables nor simply a set of equations.~~Chapter 11.1-2004, Addendum 1-2007, and Addendum 2-2019 replaced the previous printed tables.

This ~~revised standard, API~~current Adjunct for ~~MPMS~~VCF ~~Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM~~ establishes a set of implementation ~~D1250–04 (ADJD1250-E-PDF), 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~~15 °C, 60 °F, or ~~20°C,~~20 °C, by use of a volume correction factor (VCF). The ~~standard, API~~Adjunct for ~~MPMS~~VCF ~~Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D1250–04 (ADJD1250-E-PDF),~~ also provides methods for making conversions to alternate conditions from base ~~conditions~~condition and

[1] This guide is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, 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 Hydrocarbon Measurement for Custody Transfer (Joint ASTM-API). This guide has been approved by the sponsoring committees and was accepted by the Cooperating Societies in accordance with established procedures.

Current edition approved ~~Oct. 1, 2013~~May 1, 2019. Published ~~October 2013~~September 2019. Originally approved in 1952, replacing former D206 and D1090. Last previous edition approved in ~~2008~~2013 as ~~D1250 – 08.~~D1250 – 08 (2013)$^{\varepsilon 1}$. DOI: ~~10.1520/D1250-08R13E01.~~10.1520/D1250-19.

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 D1250–80 (provided in its entirety in Annex A1[3]).~~

USAGE GUIDELINES

~~The revised standard, API *MPMS* Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D1250–04 (ADJD1250-E-PDF), 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[3]), then it shall be considered in compliance with the revised standard/adjunct(s).~~

The current Adjunct for VCF is effective upon the date of publication and supersedes the previous edition of the standard/adjunct(s). Once the current year version of the standard(s) and adjunct are implemented in a particular application, the previous versions should no longer be used in that application. However, the use of the ~~API~~standard(s) ~~MPMS~~and ~~Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM~~ adjunct ~~D1250–04 (ADJD1250-E-PDF)~~ 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.

~~2007~~2019 UPDATE

Some minor modifications to the API *MPMS* Chapter ~~11.1–2004/Adjunct~~11.1-2004/Adjunct to IP 200/04/Adjunct to ASTM D1250–04 (ADJD1250-E-PDF) Addendum 1-2007 have been issued ~~in~~as Addendum ~~1-2007.~~2-2019. These modifications to the adjunct necessitated a realignment with ASTM Standard Guide D1250, hence ~~an –07~~a –19 version has been approved and published.

1. Scope

1.1 ~~The API~~This guide provides information related to the algorithm and implementation procedure but does not contain the full set of algorithms. The algorithms, ~~MPMS~~instructions, ~~Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM~~procedures, and examples are located in the ~~D1250–04 (ADJD1250-E-PDF) for~~ associated supplementary adjuncts. The Adjunct for Volume Correction Factors (VCF) for temperature and pressure volume correction factors for generalized crude oils, refined products, and lubricating ~~oils,~~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 Correction for Temperature and~~consideration in this standard but may be found in API *~~Pressure~~MPMS* ~~of a Liquid (CTPL). The temperature portion of this correction is termed the Correction for the effect of Temperature on Liquid (CTL), also historically known as VCF (Volume Correction Factor). The pressure portion is termed the Correction for the effect of Pressure on Liquid (CPL). As this standard~~ Chapter 11.2.4/GPA 8217 Temperature Correction for NGL and LPG. As this Adjunct for VCF will be applied to a variety of applications, the output parameters ~~specified in this standard/adjunct(s) (CTL,~~ of CTL, F_p, CPL, and ~~CTPL)~~CTPL may be used as specified in other standards.

1.2 Including the pressure correction in ~~API~~the ~~MPMS~~Adjunct ~~Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM~~ for VCF ~~D1250–04 (ADJD1250-E-PDF)~~ 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)~~pressure), then there is no pressure correction and the standard/adjunct(s) will give CTL values consistent with the 1980 Petroleum Measurement Tables.

1.3 ~~API~~The ~~MPMS~~Adjunct ~~Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM~~ for VCF ~~D1250–04 (ADJD1250-E-PDF)~~ covers general procedures for the conversion of input data to generate CTL, F_p, CPL, and CTPL values at the ~~user-specified~~ user-specified base temperature and pressure (T_b,P_b). 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.~~

NOTE 1—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 in the Adjunct for VCF 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'~~groups' parameters may not adequately represent the thermal expansion properties of the liquid and a precise thermal expansion coefficient has been determined by experiment. Procedures for determining Volume Correction Factors (VCF) for Denatured Ethanol can be found in API *MPMS* Chapter 11.3.3, Miscellaneous Hydrocarbon Properties—Denatured Ethanol Density and Volume Correction Factors, 3rd edition. Procedures for determining Volume Correction Factors (VCF) for Gasoline and Denatured Ethanol Blends can be found in API *MPMS* Chapter 11.3.4, Miscellaneous Hydrocarbon Properties—Denatured Ethanol and Gasoline Component Blend Densities and Volume Correction Factors, 1st edition.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *API Standards:*[2]

API Manual of Petroleum Measurement Standards(MPMS):

Chapter 9 Density Determination (all sections)

[2] ~~The organization that publishes IP test methods and guides.~~Available from American Petroleum Institute (API), 200 Massachusetts Ave. NW, Washington, DC 20001, http://www.api.org.

Chapter ~~11.1–2004~~11.1-2004 Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils (including Addendum ~~1-2007)~~1-2007 and Addendum 2-2019)
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
Chapter 11.2.4 Temperature Correction for NGL and LPG
Chapter 11.3.3 Miscellaneous Hydrocarbon Properties—Denatured Ethanol Density and Volume Correction Factors
Chapter 11.3.4 Miscellaneous Hydrocarbon Properties—Denatured Ethanol and Gasoline Component Blend Densities and Volume Correction Factors
Chapter 11.5 Density/Weight/Volume Intraconversion
Part 1—Conversions of API Gravity at 60 °F
Part 2—Conversions for Relative Density (60/60 °F)
Part 3—Conversions for Absolute Density at 15 °C

2.2 *EI Standard:*[3]
IP 200 Guidelines for the Use of the Petroleum Measurement Tables

2.3 *ISO ~~Standards:~~Standard:*
ISO ~~91–1:1992~~91:2017 Petroleum ~~measurement tables—Part 1: Tables based on reference temperatures of 15°C and 60°F~~and Related Products—Temperature and Pressure Volume Correction Factors (Petroleum Measurement Tables) and Standard Reference Conditions
~~ISO 91–2:1991 Petroleum measurement tables—Part 2: Tables based on a reference temperature of 20°C~~

2.4 *ASTM Adjuncts:*
Adjunct ~~to ASTM~~for Volume ~~D1250:~~Correction ~~ADJD1250-E-PDF—Temperature~~ Factors (VCF): (API *MPMS* Chapter 11.1)—Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils[4]
Adjunct to ASTM D1250: ~~ADJD1250CD2~~(API ~~=~~*MPMS* ~~Density/Weight/Volume~~ Chapter 11.5)—Density/Weight/Volume Intraconversion[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *adjunct, n*—data or material that supplements and supports a standard which due to its size, volume, physical makeup, or nature, is not included in the text of a standard, but is made available separately.

3.1.1.1 *Discussion*—

An adjunct contains additional information that may be either a mandatory or nonmandatory part of the standard. (Examples of adjuncts are detailed drawings, charts, technical data, reference radiographs and photographs, videotapes, software packages, or any three-dimensional material.)

3.1.2 *adjunct for volume correction factors (VCF), n*—algorithm and implementation procedure for the correction of temperature and pressure effects on density and volume of liquid hydrocarbons as defined in API *MPMS* Chapter 11.1-2004, Addendum 1-2007, Addendum 2-2019/Adjunct to IP 200/08/Adjunct to ASTM D1250–08 (2013).[4]

3.1.3 *correction for the effect of pressure on liquid (CPL), n*—the combination of density and volume correction factors for both pressure only.

3.1.4 *correction for the effect of temperature on liquid (CTL), n*—the combination of density and volume correction factors for both temperature only.

3.1.5 *correction for temperature and pressure of a liquid (CTPL), n*—the combination of density and volume correction factors for both temperature and pressure.

3.1.5.1 *Discussion*—

Historically, the CTPL is known as the VCF (Volume Correction Factor) and for many applications, the CPL was assumed to be unity, hence many applications tended to treat the VCF and CTL interchangeably.

[3] ~~The 1980 edition of the Petroleum Measurement Tables may still be in use (see the Introduction and Usage Guidelines). For that reason, Guide D1250–80 has been included as this mandatory annex.~~
[3] Available ~~on CD-ROM from API. Order Product Number H11013.~~from Energy Institute, 61 New Cavendish St., London, W1G 7AR, U.K., http://www.energyinst.org.
[5] ~~Available on CD-ROM from API. Order Product Number H1105CD.~~
[4] Available from ASTM International Headquarters. Order Adjunct No. ADJD1250-E-PDF. Original adjunct produced in 2004. Adjunct last revised in ~~2007.~~2019.

3.1.6 *volume correction factor, n*—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.

4. SponsorshipDevelopment

4.1 The revision of the ASTM/API/IP set of implementation procedures iswas the result of close cooperation between ASTM International, the American Petroleum Institute (API), and the Energy Institute.Institute (EI).[5] To meet the objective of worldwide standardized measurement practices, it is expected to result in the acceptance of the revised tablesthe revised standard has been accepted by the International Organization for Standardization (ISO), and specifically ISO/TC 28/SC 3,2, as revisions to International Standards ISO 91–1 and ISO 91–2. APIStandard ISO 91:2017. The Adjunct for VCF MPMS Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM D1250–04 (ADJD1250-E-PDF) applies to all crude oils, refined products, and lubricants previously covered by ASTM D1250, 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. 11.1-2004, Addendum 1-2007, and Addendum 2-2019. The IP designation for the complete set of implementation procedures is the Adjunct to IP 200.

5. Significance and Use

5.1 The expanded limits of APIthe MPMSAdjunct Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF D1250–04 (ADJD1250-E-PDF) 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).

5.2 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.

5.3 Table 2 provides a cross-reference between the historical table designations and the corresponding section in APIthe MPMSAdjunct Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF. D1250–04 (ADJD1250-E-PDF). Note that procedure paragraphs 11.1.6.3 (U.S. customary units) and 11.1.7.3 (metric units) provide methods for correcting on-line density measurements from live conditions to base conditions and then to compute CTPL factors for continuous volume corrections to base conditions.

5.4 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 APIthe MPMSAdjunct Chapter

TABLE 1 Range Limits[A]

Physical Units	Crude Oil	Refined Products	Lubricating Oils
Density, kg/m³ @ 60 °F	***610.6 to 1163.5***	***610.6 to 1163.5***	***800.9 to 1163.5***
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
API Gravity @ 60 °F	100.0 to –10.0	100.0 to –10.0	45.0 to –10.0
Density, kg/m³ @ 15 °C	611.16 to 1163.79	611.16 to 1163.86	801.25 to 1163.85
Density, kg/m³ @ 20 °C	606.12 to 1161.15	606.12 to 1160.62	798.11 to 1160.71
Temperature, °C	***–50.00 to 150.00***	***–50.00 to 150.00***	***–50.00 to 150.00***
Temperature, °F	–58.0 to 302.0	–58.0 to 302.0	–58.0 to 302.0
Pressure, psig	***0 to 1500***	***0 to 1500***	***0 to 1500***
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
α_{60}, per °F	***230.0 × 10^{-6} to 930.0 × 10^{-6}***	***230.0 × 10^{-6} to 930.0 × 10^{-6}***	***230.0 × 10^{-6} to 930.0 × 10^{-6}***
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}***

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	59 A, B, & D	11.1.7.2
23 A, B, & D	11.1.6.2	59 A, B, & D	11.1.7.2
24 A, B, C, & D	11.1.6.1	54 A, B, C, & D	11.1.7.1
60 A, B, C, & D	11.1.6.1	60 A, B, C, & D	11.1.7.1

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

[7] Available on CD-ROM from ASTM International Headquarters. Order Adjunct No. ADJD1250CD2. Original adjunct produced in 2009.

[8] 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.

[5] Available from the American Petroleum Institute (API), 1220 L St., NW, Washington, DC 20005.EI is the organization that publishes IP test methods and guides.

11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF. D1250–04 (ADJD1250-E-PDF). The user should refer to the appropriate sections of API *MPMS* Chapter 9 or other appropriate density/hydrometer standards for guidance.

5.5 The set of correlations given in APIthe MPMSAdjunct Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF D1250–04 (ADJD1250-E-PDF) 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.

5.6 *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 jetJet B (JP-4) is best represented by the Crude Oil correlation.

5.7 *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 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:

5.7.1 *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 low-lead gas, motor gasoline, catalyst gas, alkylate, catalytic cracked gasoline, naphtha, reformulated gasoline, and aviation gasoline.

5.7.2 *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 jetJet A and A-1, kerosene, Stoddard solvent, JP-5JP-5, and JP-8.

5.7.3 *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 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.

5.8 *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 APIthe MPMSAdjunct Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF, D1250–04 (ADJD1250-E-PDF), lubricating oils have initial boiling points greater than 700 °F (370 °C) and densities in the range between approximately –10°API to 45°API.

5.9 *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:

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

5.9.2 A precise thermal expansion coefficient can be determined by experiment. A minimum of 10ten temperature/density data points is recommended to use this method. See 11.1.5.2 of APIthe MPMSAdjunct Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF for D1250–04 (ADJD1250-E-PDF) for the procedure to calculate the thermal expansion coefficient from measured density data.

5.9.3 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 $789.0 \times 10^{-6}\ °F^{-1}$

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

5.10 Refer to paragraphs 11.1.2.4 and 11.1.2.5 in APIthe MPMSAdjunct Chapter 11.1–2004/Adjunct to IP 200/04/Adjunct to ASTM for VCF for D1250–04 (ADJD1250-E-PDF) for a complete description of the suitability of the implementation procedures for specific hydrocarbon liquids.

6. 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 D1250–04 (ADJD1250-E-PDF) 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.