Manual of Petroleum Measurement Standards Chapter 11—Physical Properties Data

Section 2, Part 5—A Simplified Vapor Pressure Correlation for Commercial NGLs

GPA 8117

SEPTEMBER 2007

REAFFIRMED, AUGUST 2017

AMERICAN PETROLEUM INSTITUTE

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Measurement Coordination

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Foreword

The purpose of this procedure is to provide a simplified means of estimating equilibrium vapor pressures of various natural gas liquids (NGLs) from a knowledge of the fluid's relative density (60°F/60°F) and process temperature. The intended application of this procedure is to provide the values of P_e (equilibrium vapor pressure) required to determine the pressure effect contributions to volume correction factors as specified in the American Petroleum Institute *Manual of Petroleum Measurement Standards* (*MPMS*) Chapter 11.1-2004[1] (which superseded Chapter 11.2.1-1984[2]) and Chapter 11.2.2[3]. It is realized that other equations of state are currently in use for specific custody transfer applications and that such methods will continue to be used as acceptable for both buyer and seller.

This procedure is applicable to four major classifications of petroleum fluid mixtures: commercial propanes, commercial butanes, natural gasolines, and light end fluids.The latter consists of EP mixes and high ethane content fluids. It covers the relative density range of 0.350 to 0.675 over a temperature range of –50°F through 140°F. This procedure is an extension of GPA Technical Publication TP-15 (1988)[9]/API *MPMS* Addendum to Chapter 11.2.2-1994[4] to include light end fluids in the relative density range of 0.350 to 0.490.

Variations from the computed vapor pressures to the actual values are to be expected because of the infinite number of possible compositions that can result in the same relative density product. Representative and extreme compositions were selected to develop the correlations, but it is realized that additional streams with compositions from among the infinite potential may well behave differently. This potential for variation is especially true at relative densities in the neighborhood of 0.500. For example, at a relative density of 0.505 the fluid could be propane or Y-grade mix, each having significantly different compositions and vapor pressure behaviors.

As is always the case in correlations published for custody transfer and settlement purposes, additional accuracy may be obtained by developing a modified correlation for certain specific applications if agreed to by all contracting parties. An equation to improve the accuracy of the generalized correlation at 100°F is also included.

It is important to note that the application of the correlations presented in this document to conditions or fluids not specified, will result in untested and unknown results which could contain significant errors.

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Table of Contents

List of Tables

List of Figures

A Simplified Vapor Pressure Correlation for Commercial NGLs

0 Implementation Guidelines

This Revised Standard/Technical Publication is effective upon the date of publication and supersedes all previous revisions of the Standard/Technical Publication and API *MPMS* 11.2.2A/GPA TP-15. However, due to the nature of the changes in this Revised Standard/Technical Publication and the fact that it is or may be incorporated by reference in various regulations, 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 this Revised Standard/Technical Publication be utilized on all new and existing applications no later than TWO YEARS after the publication date. An application, for this purpose, is defined as the point where the calculation is applied.

Once the Revised Standard/Technical Publication is implemented in a particular application, the Previous Standard/Technical Publication will no longer be used in that application.

However, the use of API standards and ASTM and GPA technical publications remains voluntary and the decision on when to utilize a standard/technical publication is an issue that is subject to the negotiations between the parties involved in the transaction.

1 Background

The transfer of ownership of liquids is usually based on the volume of liquid at agreed upon standard conditions, usually 60°F for the U.S. customary system of units and the greater of one atmosphere pressure or the equilibrium vapor pressure of the liquid. Actual measurement of the liquid volumes and the their associated densities occurs at flowing or process conditions. Thus these measurements must be converted to equivalent values at the standard conditions. Once the liquid densities are converted, the conversion of the volumes becomes a trivial exercise. Densities are normally converted from measured conditions to standard conditions by equations of the form:

$$\gamma_{60} = F_t \times F_p \times \gamma \qquad \textbf{Equation 1}$$

Where:

γ_{60} Relative Density at 60°F and the greater of one atmosphere pressure or the equilibrium vapor pressure of the liquid

γ Relative Density at measured conditions

F_t Correction factor for temperature effects

F_p Correction factor for pressure effects

Two methods used for calculation of the F_p term were standardized by the American Petroleum Institute: *MPMS* Chapter 11.2.1-1984[2] (now superseded by Chapter 11.1-2004[1]) and *MPMS* Chapter 11.2.2-1986[3]. These methods require a knowledge of the equilibrium bubble point pressure (vapor pressure) at the measured conditions. However, the vapor pressure of the process liquid is generally not measured. The vapor pressure can also be calculated from compositional information, but the composition is not always measured for natural gas liquids, NGLs.