Designation: D2889 – 95 (Reapproved 2015)

Standard Test Method for Calculation of True Vapor Pressures of Petroleum Distillate Fuels[1]

This standard is issued under the fixed designation D2889; 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 This test method describes the calculation of true vapor pressures of petroleum distillate fuels for which distillation data may be obtained in accordance with Test Method D86 without reaching a decomposition point prior to obtaining 90 volume % distilled.

1.2 The test method may be used to calculate vapor pressures at temperatures between the 0 % equilibrium flash temperature and the critical temperature of the fuel. Provision is included for obtaining a calculated critical temperature for fuels for which it is not known.

1.3 Critical pressure-temperature data are usually not available for petroleum fuels. However, if both the critical pressure and critical temperature are known, the values shall be used as the coordinates in Fig. 1 to establish a critical point to be used instead of the focal point established as described in 6.5.4; and the calculations described in 6.5 through 6.5.4 are not required. If either a determined true boiling point or determined equilibrium flash vaporization temperature at 0 % distilled at atmospheric pressure is known, the determined value shall be used to establish the lower limit of the bubble-point line referred to in 6.4.

1.4 The method is not reliable for distillate fuels having a boiling range of less than 100 °F (38 °C) between the Test Method D86 10 volume % and 90 volume % distilled temperatures.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *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:*[2]

D86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure

D287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)

2.2 *ASTM Adjuncts:*

Temperature Pressure Conversion Chart (16 by 20 in. drawings)[3]

3. Summary of Test Method

3.1 Equilibrium flash vaporization (EFV) temperatures are calculated from distillation data (Test Method D86) determined on the sample. The distillation data, calculated EFV data, and API gravity of the sample are used with a graphical correlation procedure to obtain two pairs of temperature-pressure coordinates through which the bubble-point line of the phase diagram for the sample may be drawn. The calculated true vapor pressure at a specified temperature is obtained by reading the pressure at the intersection of the bubble-point line and specified temperature.

NOTE 1—Details of the procedure and data substantiating its validity for establishing equilibrium flash vaporization temperatures have been published.[4]

4. Significance and Use

4.1 The true vapor pressure of a distillate fuel is a relative measurement, both of the tendency of the most volatile portion of the fuel to gasify, and of the restraining pressure required to prevent gasification of the most volatile portion. Thus the measurement is of importance when a fuel is to be utilized in applications where no gasification may be tolerated, and

[1] This test method is under jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.04.0K on Correlative Methods.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from ASTM International Headquarters. Order Adjunct No. ADJD2889. Original adjunct produced in 1987.

[4] Edmister, W. C., and Okamoto, K. K., "Applied Hydrocarbon Thermodynamics, Part 12: Equilibrium Flash Vaporization Correlations for Petroleum Fractions," *Petroleum Refiner*, PEREA, Vol 38, No. 8, 1959, p. 117.

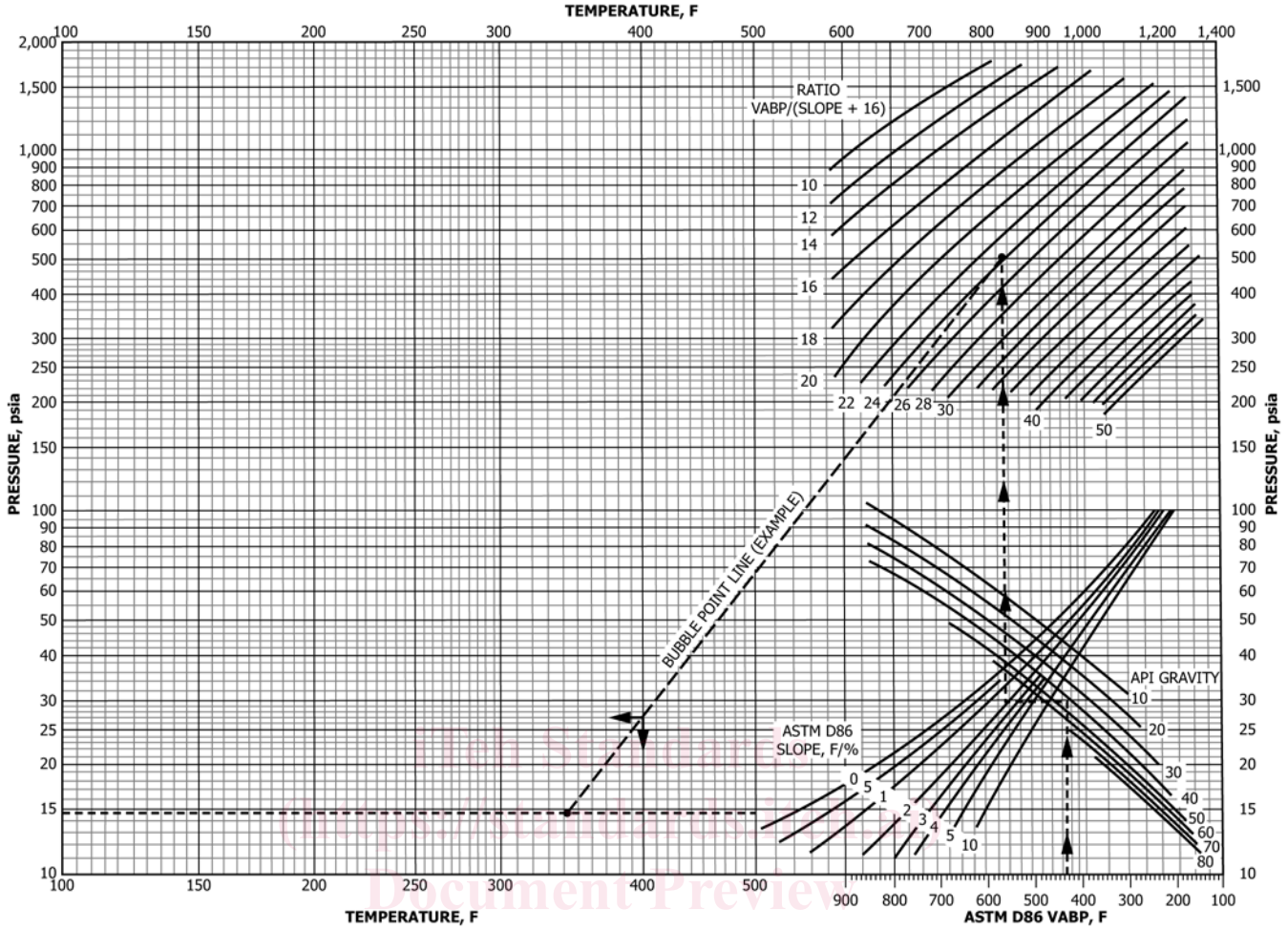

FIG. 1 Test Method D86 Distillation Temperature and Equalization Flash Vaporization Temperature Pressure Conversion Chart

temperature-pressure conditions are expected to be near the true vapor pressure of the fuel.

5. Data Requirements

5.1 Distillation temperatures at the initial boiling point (IBP) and 10 volume %, 30 volume %, 50 volume %, 70 volume %, and 90 volume % distilled obtained in accordance with Test Method D86.

5.2 API gravity determined in accordance with Test Method D287, or a method of equivalent accuracy.

6. Procedure

6.1 Calculate the 10/70 slope, °F/%, of the Test Method D86 distillation using the 10volume % and 70 volume % distilled temperature. Using this slope and the Test Method D86 50 volume % distilled temperature, obtain to the nearest ±1 °F a temperature difference, °F, from Fig. 2. Add °F to the Method D86 50 volume % temperature to obtain the equilibrium flash vaporization (EFV) 50 volume % temperature.

6.2 Calculate the differences between the Test Method D86 IBP and 10 volume %, the 10 volume % and 30 volume %, and the 30 volume % and 50 volume % temperatures. Using these differences, obtain to the nearest 1 °F, the temperature differences between corresponding EFV percentages from Fig. 3.

6.3 Calculate the EFV zero volume percent temperature by subtracting the sum of the three differences obtained from Fig. 3, from the EFV 50 volume % temperature calculated in accordance with 6.1.

6.4 Plot a point on Fig. 1[3,5] at the coordinates, 14.7 psia and the calculated EFV 0 % temperature. This point establishes the lower end of the phase boundary line commonly referred to as the bubble-point line. If the EFV 0 % temperature at atmospheric pressure has been measured, use the measured value instead of the calculated value.

6.5 Use the following procedure and the curves on the right portion of Fig. 1 to obtain coordinates for the upper end, or focal point, of the bubble-point line. If both the critical temperature and critical pressure of the fuel are known, the calculations described in 6.5.1 through 6.5.4 are not carried out. The critical temperature and critical pressure are used as

[5] Precision of the test method as given in Section 6 was obtained using 8½ by 11–in. charts and should be improved using the 16 by 20–in. charts.