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An American National Standard

Standard Practice for Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis[1]

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[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.H on Liquified Petroleum Gas.

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1. Scope

1.1 This practice covers, by compositional analysis, the approximate determination of the following physical characteristics of commercial propane and special-duty propane (covered by Specification D 1835): vapor pressure, relative density, and motor octane number (MON).

1.2 This practice is not applicable to any product exceeding specifications for nonvolatile residues. (See Test Method D 2158.)

1.3 For calculating motor octane number, this practice is applicable only to mixtures containing 20 % or less of propene.

1.4 For calculated motor octane number in method, this practice is based on mixtures containing only components shown in Table 1.

1.5 The values stated in SI units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1267 Test Method for Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method)[2]

D 1657 Test Method for Density or Relative Density of Liquid Hydrocarbons by Pressure Thermohydrometer[2]

D 1835 Specification for Liquefied Petroleum (LP) Gases[2]

D 2158 Test Method for Residues in Liquefied Petroleum (LP) Gases[2]

D 2163 Test Method for Analysis of Liquefied Petroleum (LP) Gases and Propane Concentrates by Gas Chromatography[2]

D 2421 Practice for Interconversion of Analysis of C_5 and Lighter Hydrocarbons to Gas-Volume, Liquid-Volume, or Weight Basis[2]

3. Summary of Practice

3.1 The composition of a sample of LP-gas is obtained by using Test Method D 2163 or other acceptable method. From the

[2] *Annual Book of ASTM Standards,* Vol 05.01.

TABLE 1 Factors for Determining the Physical Characteristics of LP-Gases[A]

Component	Vapor Pressure Blend Factor, kPa (psig) at 37.8°C (100°F)	Relative Density at 15.6°C (60°F)	MON Blend Value
~~Ethane~~	~~4826 (700)~~	~~0.35618~~	~~. . .~~
Ethane	17547 (2545)	0.3	. . .
Ethane	4213 (611)	0.35639	100.7
~~Propane~~	~~1200 (174)~~	~~0.50699~~	~~97.1~~
Propane	1200 (174)	0.50736	97.1
~~Propene~~	~~1469 (213)~~	~~0.52095~~	~~84.9~~
Propene	1469 (213)	0.52264	84.9
~~*n*-Butane~~	~~255 (37)~~	~~0.58401~~	~~89.6~~
n-Butane	255 (37)	0.58407	89.6
~~*i*-Butane~~	~~400 (58)~~	~~0.56287~~	~~97.6~~
i-Butane	400 (58)	0.56293	97.6

[A] Constants for vapor pressure and motor octanes are empirical values to be used only in the calculation procedures described in this test method.

analysis (expressed in liquid volume percent), the vapor pressure, relative density, and motor octane number of the sample may be determined.

3.2 Conversion of a compositional analysis from mole, gas-volume, or weight basis to liquid-volume is obtained by using ~~Test Method~~ Practice D 2421 or other suitable method.

4. Significance and Use

4.1 Vapor pressure is an important specification property of commercial propane and special duty propane that assures adequate vaporization, safety, and compatibility with commercial appliances. Relative density, while not a specification criterion, is necessary for determination of filling densities and custody transfer. The motor octane number (MON) is useful in determining the products' suitability as a fuel for internal combustion engines.

5. Calculation

5.1 *Calculated LP-Gas Vapor Pressure* (see Test Method D 1267):

5.1.1 Calculate the partial gage vapor pressure due to each component in the mixture as follows:

$$\text{Partial gage vapor pressure} = (vp' \times C)/100 \quad (1)$$

where:

vp' = vapor pressure factor of specific component at 37.8°C (100°F) (see Table 1), and

C = liquid volume percent of component in the mixture.

5.1.2 Add the partial gage vapor pressures due to all components, rounding to the nearest 7kPa (1psi). The total is reported as the LP-gas vapor pressure of the sample, kPa gage at 37.8°C (100°F).

5.2 *Calculated Relative Density* (see Test Method D 1657):

5.2.1 Calculate the relative mass of each component in the mixture as follows:

$$\text{Relative mass of component} = (sg' \times C)/100 \quad (2)$$

where:

sg' = relative density of the pure component at 15.6°C (60°F) (see Table 1), and

C = liquid volume percent of component in the mixture.

5.2.2 Add the relative mass of all components, rounding the total to three decimal places. The total is reported as the relative density of the mixture.

5.3 *Calculated Motor Octane Number* (see ASTM Data Series DS 4B, Physical Constants of Hydrocarbons and Nonhydrocarbon Compounds).[3]

5.3.1 Calculate the partial motor octane number of each component in the mixture to the nearest 0.1 MON as follows:

$$\text{Partial motor octane number of component} = (m \times C)/100 \quad (3)$$

where:

m = motor octane number of component (see Table 1), and

C = liquid volume percent of component in mixture.

5.3.2 Add the partial motor octane numbers of all components and round the total to the nearest one-half number. The total is reported as the calculated motor octane number of the mixture.

6. Keywords

6.1 liquified petroleum gases; motor octane; relative density; vapor pressure

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[3] Available from ASTM International Headquarters.