Designation: ~~D2421 – 18~~ D2421 – 19

Standard Practice for Interconversion of Analysis of C_5 and Lighter Hydrocarbons to Gas-Volume, Liquid-Volume, or Mass Basis[1]

This standard is issued under the fixed designation D2421; 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 practice describes the procedure for the interconversion of the analysis of C_5 and lighter hydrocarbon mixtures to gas-volume (mole), liquid-volume, or mass basis.

1.2 The computation procedures described assume that gas-volume percentages have already been corrected for nonideality of the components as a part of the analytical process by which they have been obtained. These are numerically the same as mole percentages.

1.3 The procedure assumes the absence of nonadditivity corrections for mixtures of the pure liquid compounds. This is approximately true only for mixtures of hydrocarbons of the same number of carbon atoms, and in the absence of diolefins and acetylenic compounds.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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. Source of Data

2.1 The basic values for the relative density 15.6 °C/15.6 °C (60 °F/60 °F) of the pure compounds have been obtained from TRC (formerly the Thermodynamics Research Center, and now part of NIST), except where otherwise noted. The values for methane, ethylene, and acetylene are not those of pure materials but are assumed to apply as a component of a liquid mixture.

2.2 The conversion factors for 1 mL of ideal gas at 15.6 °C (60 °F) and 101.325 kPa (760 mm Hg) to millilitres of liquid at 15.6 °C (60 °F) have been calculated as follows: For 1 mL gas at 15.6 °C (60 °F), 101.325 kPa (760 mm Hg),

~~$$L = (273.15\ \text{K}/288.71) \times (M/22414) \times [1/[(\text{relative density}) \times (0.999016)]]$$~~

~~$$= 4.2252 \times 10^{-5} \times (M/\text{relative density})$$~~

~~= millilitres liquid at 15.6 °C (60 °F)~~ (1)

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[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.H0 on Liquefied Petroleum Gas.

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***A Summary of Changes section appears at the end of this standard**

where:

L = calculated liquid volume, mL,
M = molecular weight, g-mol,
22414 = calculated from V=nRT/P,
n = 1 g-mol,
R = 8314.472 mL kPa K^{-1} g-mol^{-1},
T = 273.15 K, and
P = 101.325 kPa.

2.3 Where ideal gas volumes have been measured at temperatures and pressures different from 15.6 °C (60 °F) at 101.325 kPa (760 mm Hg), they shall be corrected to these conditions.

3. Significance and Use

3.1 For custody transfer and other purposes, it is frequently necessary to convert a component analysis of light hydrocarbon mixture from one basis (either gas volume, liquid volume, or mass) to another.

3.2 The component distribution data of light hydrocarbon mixtures can be used to calculate physical properties such as relative density, vapor-pressure, and calorific value. Consistent and accurate conversion data are extremely important when calculating vapor, liquid, or mass equivalence.

4. Procedure

4.1 To convert from the original to the desired basis, multiply or divide the percent of each compound in the original basis according to the schedule shown in Table 1. Perform the calculation, using the corresponding factor indicated in Table 2. Carry at least one more significant figure in all of the calculations than the number of significant figures in the original analysis.

4.1.1 The factors or percentages may be multiplied by any constant number for convenience (such as moving the decimal) without changing the end result.

4.2 Add the products or quotients obtained in accordance with 4.1.

4.3 Multiply the products or quotients obtained in accordance with 4.1 by 100 divided by the sum of the products or quotients. Round off the results so that the same number of significant figures is obtained in the final answer as was used in the original analysis.

TABLE 1 Conversion Factors Scheduled

Original Basis	Desired Basis	Operation	Factor Column in Table 2
Gas volume	mass	multiply by	1
Gas volume	liquid volume	multiply by	2
Mass	gas volume	divide by	1
Mass	liquid volume	divide by	3
Liquid volume	gas volume	divide by	2
Liquid volume	mass	multiply by	3

TABLE 2 Mass-Volume Data for Liquefied Petroleum Gases and Low Boiling Hydrocarbons[A]

Compound	Column 1 Molecular Mass	Column 2 Liquid Volume in mL of 1 mL of ideal gas at 15.6 °C (60 °F) and 101.325 kPa (760 mm Hg)	Column 3 Relative Density 15.6 °C/15.6 °C (60 °F/60 °F) (Vacuum)
Methane[B]	16.0425	0.0022594	0.3
~~Ethane[C]~~	~~30.0690~~	~~0.0035657~~	~~0.35630~~
Ethane[C]	30.0690	0.0035659	0.35628
~~Ethyne (acetylene)[B]~~	~~26.037~~	~~0.002601~~	~~0.423~~
Ethyne (acetylene)[B]	26.037	0.0025993	0.42323
~~Ethylene[B]~~	~~28.0532~~	~~0.0032~~	~~0.37[D]~~
Ethylene[B]	28.0532	0.0020861	0.56820[D]
~~Propane[C]~~	~~44.0956~~	~~0.0036733~~	~~0.50721~~
Propane[C]	44.0956	0.0036734	0.50719
~~Propene (propylene)[C]~~	~~42.0797~~	~~0.0034020~~	~~0.52262~~
Propene (propylene)[C]	42.0797	0.0034021	0.52260
~~Propadiene (allene)[C]~~	~~40.065~~	~~0.002844~~	~~0.5953~~
Propadiene (allene)[C]	40.065	0.0028438	0.59528
~~Propyne (methylacetylene)[C]~~	~~40.065~~	~~0.002698~~	~~0.6273~~
Propyne (methylacetylene)[C]	40.065	0.0026985	0.62733
~~*n*-Butane[C]~~	~~58.1222~~	~~0.004204~~	~~0.58420~~
n-Butane[C]	58.1222	0.0042037	0.58420
~~Methyl propane (isobutane)[C]~~	~~58.1222~~	~~0.0043630~~	~~0.56286~~
Methyl propane (isobutane)[C]	58.1222	0.0043633	0.56283
~~1-Butene[C]~~	~~56.106~~	~~0.003948~~	~~0.6004~~
1-Butene[C]	56.106	0.0039481	0.60044
~~*trans*-2-Butene[C]~~	~~56.106~~	~~0.003887~~	~~0.6099~~
trans-2-Butene[C]	56.106	0.0038843	0.61030
~~*cis*-2-Butene[C]~~	~~56.106~~	~~0.003778~~	~~0.62753~~
cis-2-Butene[C]	56.106	0.0037799	0.62716
~~2-Methyl propene (isobutylene)[C]~~	~~56.106~~	~~0.003948~~	~~0.60044~~
2-Methyl propene (isobutylene)[C]	56.106	0.0039481	0.60044
~~1,2-Butadiene[C]~~	~~54.090~~	~~0.003465~~	~~0.6595~~
1,2-Butadiene[C]	54.090	0.0034658	0.65941
~~1,3-Butadiene[C]~~	~~54.090~~	~~0.003647~~	~~0.6267~~
1,3-Butadiene[C]	54.090	0.0036467	0.62670
~~1-Butyne (ethylacetylene)[C]~~	~~54.090~~	~~0.003457~~	~~0.6610~~
1-Butyne (ethylacetylene)[C]	54.090	0.0034575	0.6610
~~*n*-Pentane~~	~~72.1488~~	~~0.004833~~	~~0.63071~~
n-Pentane	72.1488	0.0048333	0.63071
~~2-Methyl butane (isopentane)~~	~~72.1488~~	~~0.004876~~	~~0.62514~~
2-Methyl butane (isopentane)	72.1488	0.0048764	0.62514
~~Dimethyl propane (neopentane)[C]~~	~~72.1488~~	~~0.005114~~	~~0.59610~~
Dimethyl propane (neopentane)[C]	72.1488	0.0051208	0.59530
~~1-Pentene~~	~~70.133~~	~~0.004559~~	~~0.6500~~
1-Pentene	70.133	0.0045849	0.64631
~~*trans*-2-Pentene~~	~~70.133~~	~~0.004537~~	~~0.6531~~
trans-2-Pentene	70.133	0.0045370	0.65313
~~*cis*-2-Pentene~~	~~70.133~~	~~0.004490~~	~~0.660~~
cis-2-Pentene	70.133	0.0044939	0.65940
~~2-Methyl-1-butene~~	~~70.133~~	~~0.004519~~	~~0.6557~~
2-Methyl-1-butene	70.133	0.0045186	0.65579
~~3-Methyl-1-butene~~	~~70.133~~	~~0.004672~~	~~0.6342~~
3-Methyl-1-butene	70.133	0.0046719	0.63427
~~2-Methyl-2-butene~~	~~70.133~~	~~0.004461~~	~~0.6643~~
2-Methyl-2-butene	70.133	0.0044607	0.66430
~~Cyclopentane~~	~~70.133~~	~~0.003949~~	~~0.7503~~
Cyclopentane	70.133	0.0039485	0.75047
~~2-Methyl-1,3-butadiene (isoprene)~~	~~68.117~~	~~0.004201~~	~~0.6851~~
2-Methyl-1,3-butadiene (isoprene)	68.117	0.0042010	0.68510
~~1-*trans*-3-Pentadiene~~	~~68.117~~	~~0.004182~~	~~0.6883~~
1-*trans*-3-Pentadiene	68.117	0.0041814	0.6883
~~1-*cis*-3-Pentadiene~~	~~68.117~~	~~0.004134~~	~~0.6962~~
1-*cis*-3-Pentadiene	68.117	0.0041340	0.6962
~~1,2-Pentadiene~~	~~68.117~~	~~0.004125~~	~~0.6976~~
1,2-Pentadiene	68.117	0.0041257	0.6976

[A] Sources (except as noted):
Column 1, Molecular Mass—D2421–02, GPA ~~2145–09,~~2145–16, and GPSA Engineering Data Book (12th edition)
Column 2, Liquid Volume—Calculated from the relative density (column 3) and molecular mass (column 1), using Eq 1
Column 3, Relative Density—Provided by TRC ~~(NIST)~~(NIST), GPA 2145–16

[B] Apparent values for dissolved gas at 15.6 °C (60 °F).

[C] Property of liquid phase measured at its saturation pressure at 15.6 °C (60 °F).