



Standard Test Method for Estimation of Solubility of Gases in Petroleum and Other Organic Liquids¹

This standard is issued under the fixed designation D 3827; 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 covers a procedure for estimating the equilibrium solubility of several common gases in petroleum and synthetic lubricants, fuels, and solvents, at temperatures between 0 and 488 K.

1.2 This test method is limited to systems in which polarity and hydrogen bonding are not strong enough to cause serious deviations from regularity. Specifically excluded are such gases as HCl, NH₃, and SO₂, and hydroxy liquids such as alcohols, glycols, and water. Estimating the solubility of CO₂ in nonhydrocarbons is also specifically excluded.

1.3 Highly aromatic oils such as diphenoxy phenylene ethers violate the stated accuracy above 363 K, at which point the estimate for nitrogen solubility is 43 % higher than the observation.

1.4 Lubricants are given preference in this test method to the extent that certain empirical factors were adjusted to the lubricant data. Estimates for distillate fuels are made from the lubricant estimates by a further set of empirical factors, and are less accurate. Estimates for halogenated solvents are made as if they were hydrocarbons, and are the least accurate of the three.

1.5 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

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:

- D 1218 Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids²
- D 1250 Guide for Petroleum Measurement Tables²
- D 1298 Test Method for Density, Relative Density (Specific

TABLE 1 Solubility Parameters of Gaseous Solutes

Gas	M_2	δ_2 at 298 K	Fuel Factor
He	4	3.35	1.27
Ne	20	3.87	1.37
H ₂	2	5.52	1.27
N ₂	28	6.04	1.70
Air	29	6.67	1.44
CO	28	7.47	1.37
O ₂	32	7.75	1.28
Ar	40	7.71	1.37
CH ₄	16	9.10	1.42
Kr	84	10.34	1.37
CO ₂	44	14.81	1.14

Gravity) or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method²

D 2502 Test Method for Estimation of Molecular Weight (Relative Molecular Mass) of Petroleum Oils from Viscosity Measurements²

D 2503 Test Method for Molecular Weight (Relative Molecular Mass) of Hydrocarbons by Thermoelectric Measurement of Vapor Pressure²

3. Terminology

3.1 Definitions:

3.1.1 *Bunsen coefficient*—the solubility of a gas, expressed as the gas volume reduced to 273 K (32°F) and 0.10 MPa (1 atm), dissolved by one volume of liquid at the specified temperature and 0.10 MPa.

3.1.2 *Ostwald coefficient*—the solubility of a gas, expressed as the volume of gas dissolved per volume of liquid when both are in equilibrium at the specified partial pressure of gas and at the specified temperature.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *distillate fuel*—a petroleum product having a molecular weight below 300 g/mol.

3.2.2 *halogenated solvent*—a partially or fully halogenated hydrocarbon having a molar volume below 300 mL/mol.

3.2.3 *solubility parameter*—the square root of the internal energy change (heat absorbed minus work done) of vaporization per unit volume of liquid, at 298 K.

3.2.3.1 *Discussion*—For gases in Table 1, the liquid is hypothetical and the values were calculated from actual solubility data.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.11 on Engineering Sciences of High Performance Fluids and Solids.

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