



Standard Test Method for Estimation of Solubility of Gases in Petroleum Liquids¹

This standard is issued under the fixed designation D2779; 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 the estimation of the equilibrium solubility of several common gases encountered in the aerospace industry in hydrocarbon liquids. These include petroleum fractions with densities in the range from 0.63 to 0.90 at 288 K (59°F). The solubilities can be estimated over the temperature range 228 K (–50°F) to 423 K (302°F).

1.2 This test method is based on the Clausius-Clapeyron equation, Henry's law, and the perfect gas law, with empirically assigned constants for the variation with density and for each gas.

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

1.4 *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

D1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

3. Terminology

3.1 Definitions:

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

3.1.2 *Bunsen coefficient*—the solubility of a gas expressed as the volume, reduced to 273 K (32°F) and 101.3 kPa (1 atm), dissolved by 1 volume of liquid at the specified temperature and 101.3 kPa.

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.L0.07 on Engineering Sciences of High Performance Fluids and Solids.

Current edition approved May 1, 2007. Published June 2007. Originally approved in 1969. Last previous edition approved in 2002 as D2779 – 92 (2002). DOI: 10.1520/D2779-92R07.

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.

3.1.3 *Henry's law*—the principle that the ratio of partial pressure to mole fraction of gas in solution is a constant.

3.1.3.1 *Discussion*—In non-ideal systems the fugacity is used to replace the pressure, but the systems within the scope of this test method can be considered ideal within the limits of the accuracy statement.

3.2 Symbols:

d	= density of the liquid at 288 K (59°F), kg/L,
T	= specified temperature, K,
L_o	= Ostwald coefficient at 273 K for a liquid of $d = 0.85$,
L	= Ostwald coefficient at T for a liquid of $d = 0.85$,
L_c	= Ostwald coefficient at T for a liquid of the specified density,
p	= pressure of the gas, or mixed gases, MPa,
p_v	= vapor pressure of the liquid at the specified temperature, MPa,
$p_1, p_2 \dots p_i$	= partial pressures of the gases in a mixture, MPa,
G	= solubility, mg/kg,
B	= Bunsen coefficient at the specified d , p , and T ,
X	= mole fraction of gas in equilibrium solution,
L_m, B_m	= coefficients for mixture of gases,
M	= molecular weight of the gas, g/mol,
M_l	= molecular weight of the liquid, g/mol,
H	= Henry's law constant, MPa, and
C	= molarity, kg mol/m ³ .

4. Summary of Test Method

4.1 Correlations have been established by the National Aeronautics and Space Administration (formerly National Advisory Committee on Aeronautics) in NACA Technical Note 3276 (1956)³ Their work was extended to include most of the data published since that time, and extrapolated by semi-empirical methods into regions where no data are available.

4.2 The only data required are the density of liquid at 288 K (59°F) and the nature of the gas. These are used in the equations, with the specific constant for the gas from Table 1, or with Fig. 1, to estimate the Ostwald coefficient.

³ Available from National Aeronautics and Space Administration, Washington, DC.