SOLUBILITY OF SELECTED GASES IN WATER

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The values in this table are taken almost exclusively from the International Union of Pure and Applied Chemistry "Solubility Data Series". Unless noted, they comprise evaluated data fitted to a smoothing equation. The data at each temperature are then derived from the smoothing equation which expresses the mole fraction solubility X_1 of the gas in solution as:

$$\ln X_1 = A + B/T^* + C \ln T^*$$

where

$$T^* = T/100\ \text{K}$$

All values refer to a partial pressure of the gas of 101.325 kPa (one atmosphere).

The equation constants, the standard deviation for $\ln X_1$ (except where noted), and the temperature range over which the equation applies are given in the column headed Equation constants. There are two exceptions. The equation for methane has an added term, DT^*. The equation for H_2Se and H_2S takes the form,

$$\ln X_1 = A + B/T + C \ln T + DT$$

where T is the temperature in kelvin.

Solubilities given for those gases which react with water, namely ozone, nitrogen oxides, chlorine and its oxides, carbon dioxide, hydrogen sulfide, hydrogen selenide and sulfur dioxide, are recorded as bulk solubilities; i.e., all chemical species of the gas and its reaction products with water are included.

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
Hydrogen (H_2)	288.15	1.510×10^{-5}	$A = -48.1611$	1
$M_r = 2.01588$	293.15	1.455×10^{-5}	$B = 55.2845$	
	298.15	1.411×10^{-5}	$C = 16.8893$	
	303.15	1.377×10^{-5}	Std. dev. = ± 0.54%	
	308.15	1.350×10^{-5}	Temp. range = 273.15—353.15	
Deuterium (D_2)	283.15	1.675×10^{-5} ± 0.57%	Averaged experimental values	1
$M_r = 4.0282$	288.15	1.595×10^{-5} ± 0.57%		
	293.15	1.512×10^{-5} ± 0.78%	Temp. range = 278.15—303.15	
	298.15	1.460×10^{-5} ± 0.52%		
	303.15	1.395×10^{-5} ± 0.37%		
Helium (He)	288.15	7.123×10^{-6}	$A = -41.4611$	2
$A_r = 4.0026$	293.15	7.044×10^{-6}	$B = 42.5962$	
	298.15	6.997×10^{-6}	$C = 14.0094$	
	303.15	6.978×10^{-6}	Std. dev. = ±0.54%	
	308.15	6.987×10^{-6}	Temp. range = 273.15—348.15	
Neon (Ne)	288.15	8.702×10^{-6}	$A = -52.8573$	2
$A_r = 20.1797$	293.15	8.395×10^{-6}	$B = 61.0494$	
	298.15	8.152×10^{-6}	$C = 18.9157$	
	303.15	7.966×10^{-6}	Std. dev. = ±0.47%	
	308.15	7.829×10^{-6}	Temp. range = 273.15—348.15	
Argon (Ar)	288.15	3.025×10^{-5}	$A = -57.6661$	3
$A_r = 39.948$	293.15	2.748×10^{-5}	$B = 74.7627$	
	298.15	2.519×10^{-5}	$C = 20.1398$	
	303.15	2.328×10^{-5}	Std. dev. = ±0.26%	
	308.15	2.169×10^{-5}	Temp. range = 273.15—348.15	
Krypton (Kr)	288.15	5.696×10^{-5}	$A = -66.9928$	4
$A_r = 83.80$	293.15	5.041×10^{-5}	$B = 91.0166$	
	298.15	4.512×10^{-5}	$C = 24.2207$	
	303.15	4.079×10^{-5}	Std. dev. = ±0.32%	
	308.15	3.725×10^{-5}	Temp. range = 273.15—353.15	
Xenon (Xe)	288.15	10.519×10^{-5}	$A = -74.7398$	4
$A_r = 131.29$	293.15	9.051×10^{-5}	$B = 105.210$	
	298.15	7.890×10^{-5}	$C = 27.4664$	
	303.15	6.961×10^{-5}	Std. dev. = ±0.35%	
	308.15	6.212×10^{-5}	Temp. range = 273.15—348.15	

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
Radon-222(^{222}Rn)	288.15	2.299×10^{-4}	$A = -90.5481$	
$A_r = 222$	293.15	1.945×10^{-4}	$B = 130.026$	
	298.15	1.671×10^{-4}	$C = 35.0047$	
	303.15	1.457×10^{-4}	Std. dev. = ±1.02%	
	308.15	1.288×10^{-4}	Temp. range = 273.15—373.15	
Oxygen (O_2)	288.15	2.756×10^{-5}	$A = -66.7354$	5
$M_r = 31.9988$	293.15	2.501×10^{-5}	$B = 87.4755$	
	298.15	2.293×10^{-5}	$C = 24.4526$	
	303.15	2.122×10^{-5}	Std. dev. = ±0.36%	
	308.15	1.982×10^{-5}	Temp. range = 273.15—348.15	
Ozone (O_3)	293.15	1.885×10^{-6} ± 10%	Experimental value derived	5
$M_r = 47.9982$		pH = 7.0	from Henry's Law Constant Equation	
Nitrogen (N_2)	288.15	1.386×10^{-5}	$A = -67.3877$	6
$M_r = 28.0134$	293.15	1.274×10^{-5}	$B = 86.3213$	
	298.15	1.183×10^{-5}	$C = 24.7981$	
	303.15	1.108×10^{-5}	Std. dev. = ±0.72%	
	308.15	1.047×10^{-5}	Temp. range = 273.15—348.15	
Nitrous oxide (N_2O)	288.15	5.948×10^{-4}	$A = -60.7467$	7
$M_r = 44.0129$	293.15	5.068×10^{-4}	$B = 88.8280$	
	298.15	4.367×10^{-4}	$C = 21.2531$	
	303.15	3.805×10^{-4}	Std. dev. = ±1.2%	
	308.15	3.348×10^{-4}	Temp. range = 273.15—313.15	
Nitric oxide (NO)	288.15	4.163×10^{-5}	$A = -62.8086$	7
$M_r = 30.0061$	293.15	3.786×10^{-5}	$B = 82.3420$	
	298.15	3.477×10^{-5}	$C = 22.8155$	
	303.15	3.222×10^{-5}	Std. dev. = ±0.76%	
	308.15	3.012×10^{-5}	Temp. range = 273.15—358.15	
Carbon monoxide (CO)	288.15	2.095×10^{-5}	Derived from Henry's	8
$M_r = 28.0104$	293.15	1.918×10^{-5}	Law Constant Equation	
	298.15	1.774×10^{-5}	Std. dev. = ±0.043%	
	303.15	1.657×10^{-5}	Temp. range = 273.15—328.15	
	308.15	1.562×10^{-5}		
Carbon dioxide (CO_2)	288.15	8.21×10^{-4}	Derived from Henry's	9
$M_r = 44.0098$	293.15	7.07×10^{-4}	Law Constant Equation	
	298.15	6.15×10^{-4}	Std. dev. = ±1.1%	
	303.15	5.41×10^{-4}	Temp. range = 273.15—353.15	
	308.15	4.80×10^{-4}		
Hydrogen selenide (H_2Se)	288.15	1.80×10^{-3}	$A = 9.15$	10
$M_r = 80.976$	298.15	1.49×10^{-3}	$B = 974$	
	308.15	1.24×10^{-3}	$C = -3.542$	
			$D = 0.0042$	
			Std. dev. = $\pm 2.3 \times 10^{-5}$	
			Temp. range = 288.15—343.15	
Hydrogen sulfide (H_2S)	288.15	2.335×10^{-3}	$A = -24.912$	10
$M_r = 34.082$	293.15	2.075×10^{-3}	$B = 3477$	
	298.15	1.85×10^{-3}	$C = 0.3993$	
	303.15	1.66×10^{-3}	$D = 0.0157$	
	308.15	1.51×10^{-3}	Std. dev. = $\pm 6.5 \times 10^{-5}$	
			Temp. range = 283.15—603.15	
Sulfur dioxide (SO_2)	288.15	3.45×10^{-2}	$A = -25.2629$	11
$M_r = 64.0648$	293.15	2.90×10^{-2}	$B = 45.7552$	

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
	298.15	2.46×10^{-2}	C = 5.6855	
	303.15	2.10×10^{-2}	Std. dev. = ±1.8%	
	308.15	1.80×10^{-2}	Temp. range = 278.15—328.15	
Chlorine (Cl_2)	283.15	2.48×10^{-3} ± 2%	Experimental data	11
M_r = 70.9054	293.15	1.88×10^{-3} ± 2%	Temp. range = 283.15—333.15	
	303.15	1.50×10^{-3} ± 2%		
	313.15	1.23×10^{-3} ± 2%		
Chlorine monoxide (Cl_2O)	273.15	5.25×10^{-1} ± 1%	Experimental data	11
M_r = 86.9048	276.61	4.54×10^{-1} ± 1%	Temp. range = 273.15—293.15	
	283.15	4.273×10^{-1} ± 1%		
	293.15	3.353×10^{-1} ± 1%		
Chlorine dioxide (ClO_2)	288.15	2.67×10^{-2}	A = 7.9163	11
M_r = 67.4515	293.15	2.20×10^{-2}	B = 0.4791	
	298.15	1.823×10^{-2}	C = 11.0593	
	303.15	1.513×10^{-2}	Std. dev. = ±4.6%	
	308.15	1.259×10^{-2}	Temp. range = 283.15—333.15	
Methane (CH_4)	288.15	3.122×10^{-5}	A = −115.6477	12
M_r = 16.0428	293.15	2.806×10^{-5}	B = 155.5756	
	298.15	2.552×10^{-5}	C = 65.2553	
	303.15	2.346×10^{-5}	D = −6.1698	
	308.15	2.180×10^{-5}	Std. dev. = ±0.056%	
			Temp. range = 273.15—328.15	
Ethane (C_2H_6)	288.15	4.556×10^{-5}	A = −90.8225	13
M_r = 30.0696	293.15	3.907×10^{-5}	B = 126.9559	
	298.15	3.401×10^{-5}	C = 34.7413	
	303.15	3.002×10^{-5}	Std. dev. = ±0.13%	
	308.15	2.686×10^{-5}	Temp. range = 273.15—323.15	
Propane (C_3H_8)	288.15	3.813×10^{-5}	A = −102.044	14
M_r = 44.097	293.15	3.200×10^{-5}	B = 144.345	
	298.15	2.732×10^{-5}	C = 39.4740	
	303.15	2.370×10^{-5}	Std. dev. = ±0.012%	
	308.15	2.088×10^{-5}	Temp. range = 273.15—347.15	
Butane (C_4H_{10})	288.15	3.274×10^{-5}	A = −102.029	14
M_r = 58.123	293.15	2.687×10^{-5}	B = 146.040	
	298.15	2.244×10^{-5}	C = 38.7599	
	303.15	1.906×10^{-5}	Std. dev. = ±0.026%	
	308.15	1.645×10^{-5}	Temp. range = 273.15—349.15	
2-Methyl propane (Isobutane) (C_4H_{10})	288.15	2.333×10^{-5}	A = −129.714	14
M_r = 58.123	293.15	1.947×10^{-5}	B = 183.044	
	298.15	1.659×10^{-5}	C = 53.4651	
	303.15	1.443×10^{-5}	Std. dev. = ±0.034%	
	308.15	1.278×10^{-5}	Temp. range = 278.15—318.15	

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