

Linde Oil and Gas Services. CO₂ and N₂ properties.



CO ₂ Weight	Volume of Liquid @-14°F		Volume of Gas @60°F, 1 atm
	lb	gal	barrels
1	0.114	.0027	8.59
8.80	1	.024	72.7
369.6	42	1	3053.6
2000	227.3	5.41	17190

Physical Constants of Carbon Dioxide

Molecular symbol	CO ₂
Molecular weight	44 g/mol
Triple point	-69.9°F and 60.43 psig
Sublimation temperature at one atmosphere*	-109.3°F
Critical temperature	87.8°F
Critical pressure	1051.3 psig
Latent heat of sublimation at -109.3°F and one atmosphere	246.2 btu/lb
Relative density compared to dry air at 32°F and one atmosphere	1.5290
Vapor density at 32°F and one atmosphere	0.12341 lb/ft ³
Vapor density at 60°F and one atmosphere	1.11630 lb/ft ³
Liquid density at -14°F	65.87 lb/ft ³ or 8.8 lb/gl
Liquid density at 80°F	42.67 lb/ft ³
Latent heat of liquid at -14°F and 225 psig	189.0 btu/lb
Gradient CO ₂ fluid column at -14°F	4571 psi/ft

psig indicates pounds per square inch gauge

*One atmosphere = 760 mm Hg = 14.70 psi

Nitrogen Physical Properties

Chemical Formula	N ₂	
Molecular Weight	28.0134 g/mol	
Color	Vapor Liquid	None None
Boiling Point	1 atm	-320.36 °F (-195.8 °C)
Specific Gravity, Gas (Air=1.0)	70°F (21.1°C), 1 atm	0.9669
Specific Volume, Gas	70°F (21.1°C), 1 atm	12.80 ft ³ /lb (0.8615 m ³ /kg)
Density, Gas	70°F (21.1°C), 1 atm Sat at 1 atm	0.07245 lb/ft ³ (1.161 kg/m ³) 0.2874 lb/ft ³ (4.604 kg/m ³)
Density, Liquid	Sat at 1 atm	50.47 lb/ft ³ (808.5 kg/m ³)
Critical Temperature		-232.40°F (-146.9°C)
Critical Pressure		492.9 psia (3398 kPa abs)
Triple Point	Temperature Pressure	-346.01°F (-210.0°C) 1.819 psia (12.54 kPa abs)
Latent Heat of Vaporization		85.6 btu/lb (199.1kJ/kg)
Specific Heat, Gas	70°F (21.1°C), 1 atm Constant Pressure, Cp Constant Volume, Cv Ratio, Cp/Cv	0.2484 btu/(lb °F)(1.04 kJ/(kg K)) 1774 btu/(lb °F)(0.743 kJ/(kg K)) 1.40
Dynamic Viscosity, Gas	70°F (21.1°C), 1 atm	1.19 X 10 ⁻⁵ lb/(ft s)(1.77 X 10 ⁻⁵ Pa s)
Viscosity, Liquid	Sat at 1 atm	1.02 X 10 ⁻⁴ lb/(ft s)(1.52 X 10 ⁻⁴ Pa s)
Thermal Conductivity, Gas	70°F (21.1°C), 1 atm	1.47 X 10 ⁻² btu/(h ft °F) (2.54 X 10 ⁻² Wm ⁻¹ K ⁻¹)
Thermal Conductivity, Liquid	Sat at 1 atm	7.73 X 10 ⁻² btu/(h ft °F) 1.35 X 10 ⁻¹ W/(m K)
Gas/Liquid Ratio	Gas at 70°F (21.1°C), Liquid at Sat, 1 atm V/V	696.5
Solubility In Water	g/kg at 32°F (0°C), 1 atm	0.023

*psia = pounds per square inch absolute

Conversion Data

Weight			Gas			Liquid ^d		
	Pounds lb	Kilograms kg	Cubic feet ^a scf	Cubic meters ^b m ³	Gallons gal	Liters l		
1 Pound	1.0	0.4536D	13.803	0.3627	0.1481	0.5606		
1 Kilogram	2.205	1.0	30.42	0.7996	0.3262	1.2349		
1 Ton	2,000	907.2	27,606	725.4	296.2	1,121		
1 scf Gas ^a	0.07245	0.03286	1.0	0.02628	0.01074	0.04065		
1 Nm ³ Gas ^b	2.757	1.2506	38.04	1.0	0.4080	1.5443		
1 Gal Liquid ^c	6.745	3.060	93.11	2.447	1.0	3.785		
1 L Liquid ^c	1.782	0.8083	24.60	0.6464	0.2642	1.0		

^ascf (standard cubic foot) gas, measured at 1 atm and 70°F.

^bNm³ (normal cubic meter) gas measure at 1 atm and 0°C.

^cLiquid measured at 1 atm and boiling temperature.

^dAll values rounded to nearest 4 or 5 significant numbers.

Typical Grades and Purities

Bulk Liquid	Standard Grade	VLSI Grade ^a
Nitrogen, min % (v/v)	99.999	99.9997
Oxygen, max ppm (v/v)	5	1
Water, max ppm (v/v)	2	1
Dew Point, max °F	-100	
Total Hydrocarbons as Methane, max ppm (v/v)	5	1

^aPrimarily used in semiconductor applications

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