

Liquid Hydrogen

Colorless, odorless, tasteless, and highly flammable.

CAS Number	1333-74-0
UN Number	1966
Shipping Name	Hydrogen Refrigerated Liquid
Hazard Class	2.1
Label	FLAMMABLE GAS

Applications

Liquid hydrogen is used in large volumes in the space program as a primary rocket fuel for combustion with oxygen or fluorine, and as a propellant for nuclear powered rockets and space vehicles. Although used more commonly in the gaseous state, hydrogen is stored and transported as a liquid. Hydrogen is a raw material for innumerable chemical processes ranging

from the manufacturing of high-density polyethylene and polypropylene to the hydrogenation of food-grade oils. In the metallurgical industry, hydrogen is used to reduce metal oxides and prevent oxidation in heat treating certain metals and alloys. Hydrogen is also used by semiconductor manufacturers.

Physical Properties

Gas	Normal Hydrogen (75% ortho, 25% para)
Density-lb/cu ft 32°F 1 atm	0.005611
g/l, 0°C, 1 atm	0.08988
lb/cu ft, 70°F 1 atm	0.005209
g/l, 21.11°C, 1 atm	0.08344
lb/cu ft, b.p., 1 atm	0.083133
g/l, b.p., 1 atm	1.3317
lb/cu ft, triple point	0.007941
g/l, triple point	0.1272
Specific volume-cu ft/lb, 70°F, 1 atm	192.0
l/kg, 21.11°C, 1 atm	11.98
Heat Capacity-BTU/lb-mole-°F, 77°F, 1 atm	6.895
cal/g-mole-°C, 25°C, 1 atm	6.895
Heat-capacity ratio	
77°F, 1 atm	1.405
25°C, 1 atm	1.405
Thermal conductivity-BTU/°F-ft-hr, 1 atm	97.30x10 ⁻³
cal/°C-cm-sec, 1 atm	402.2x10 ⁻⁶
Dielectric constant x 10 ⁶ -at 77°F, 1 atm	251.8
at 25°C, 1 atm	251.8
Viscosity-lbm /ft-sec, 77°F, 1 atm	6.005x10 ⁻⁶
micropoise, 25°C, 1 atm	89.37
Sound velocity-ft/sec, 44.33°F, 1 atm	4186.4
m/sec, 6.85°C, 1 atm	1276.0
Refractive index x 10 ⁶ - at 32°F, 1 atm	136.0
at 0°C, 1 atm	136.0
Liquid	Para-hydrogen
Density-lb/cu ft, b.p., 1 atm	4.419
g/cc, b.p., 1 atm	0.07078
lb/cu ft, triple point	4.808
g/cc, triple point	0.07702

Temperature-°F, b.p., 1 atm	-423.19
°C, b.p., 1 atm	-252.88
°K, b.p., 1 atm	20.268
Specific volume-cu ft/lb, b.p., 1 atm	0.2263
l/kg, b.p., 1 atm	14.128
Heat capacity, saturated vapor-	
BTU/lb-mole-°F,-423.67°F, 1 atm	4.551
cal/g-mole-°C, 20°K, 1 atm	4.551
Heat of vaporization-BTU/lb-mole, b.p., 1 atm	386.5
cal/g-mole, b.p., 1 atm	214.7
Thermal conductivity-	
BTU/°F-ft-hr, -423.67°F, 1 atm	68.15x10 ⁻³
cal/°K-cm-sec, 20°K, 1 atm	281.7x10 ⁻⁶
Viscosity-lbm/ft-sec,-423.67°F, 1 atm	9.098x10 ⁻⁶
millipoise, 20°K, 1 atm	0.1354
Sound velocity-ft/sec, b.p., 1 atm	3645.0
m/sec, b.p., 1atm	1111.0
Surface tension-lb1/ft, b.p., 1 atm	1.322x10 ⁻⁴
dyne/cm, b.p., 1 atm	1.930
Critical and Triple Points	Para-hydrogen
Density - lb/cu ft, critical point	1.96
g/cc, critical point	0.0314
Temperature-°F, critical point	-400.315
°C, critical point	-240.17
°K, critical point	32.976
Pressure - atm, critical point	12.759
Temperature-°F, triple point	-434.825
°C, triple point	-259.35
°K, triple point	13.803
Pressure-atm, triple point	0.0695

Liquid Hydrogen *(continued)*

Hydrogen Specifications (Units in ppm [v/v] unless shown otherwise)

Limiting Characteristics	Gaseous CGA G-5.3 Type I, Grade B	Liquid CGA G-5.3 Type I, Grade A	Liquid* MTG Typical
Hydrogen Min %	99.95	99.995	99.999
Water	32	-	0.1
Dewpoint, °F	-60	-	-
Total Hydrocarbons	10	9.0	0.1
Oxygen	10	1.0	0.2
Argon	-	1.0	0.2
Nitrogen	400	9.0	0.3
Helium	-	39	-A20
Carbon Dioxide	10	1.0	0.1
Carbon Monoxide	10	1.0	0.1
Para Content min %	-	95	-
Permanent Particulate	-	Filtering Required	-

For vaporized liquid the MTG Typical analyses are hydrogen, 99.995%; O₂/Ar, 1.0 ppm; N₂/total hydrocarbons, 9.0 ppm; CO₂/CO 1.0 ppm

Conversion Data

	WEIGHT		GAS		LIQUID	
	POUNDS Lb	KILOGRAMS Kg	CUBIC FEET SCF	CUBIC METERS Nm ³	GALLONS Gal	LITERS L
1 Pound	1.0	0.4536	192.00	5.047	1.6928	6.408
1 Kilogram	2.205	1.0	423.3	11.126	3.733	14.128
1 SCF Gas	0.005209	0.002363	1.0	0.02628	0.008820	0.03339
1 Nm ³ Gas	0.19815	0.08988	38.04	1.0	0.3355	1.2699
1 Gal Liquid	0.5906	0.2679	113.41	2.981	1.0	3.785
1 L Liquid	0.15604	0.07078	29.99	0.7881	0.2642	1

SCF (standard cubic feet) gas measured at 1 atmosphere and 70°F.

Liquid measured at 1 atmosphere and boiling temperature.

All values rounded to nearest 4/5 significant numbers.

Nm³ (normal cubic meter) gas measured at 1 atmosphere and 0°C.