

Hydrogen

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	97.30×10^{-3}
cal/°C-cm-sec, 1 atm	402.2×10^{-6}
Dielectric constant $\times 10^6$ -at 77°F, 1 atm	251.8
at 25°C, 1 atm	251.8
Viscosity-lbm /ft-sec, 77°F, 1 atm	6.005×10^{-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 $\times 10^6$ - 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	68.15×10^{-3}
cal/°K-cm-sec, 20°K, 1 atm	281.7×10^{-6}
Viscosity-lbm/ft-sec,-423.67°F, 1 atm	9.098×10^{-6}
millipoise, 20°K, 1 atm	0.1354
Sound velocity-ft/sec, b.p., 1 atm	3645.0
m/sec, b.p., 1 atm	1111.0
Surface tension-lb1/ft, b.p., 1 atm	1.322×10^{-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

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.