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Hydrogen - Thermophysical Properties

Chemical, Physical and Thermal Properties of Hydrogen - H_2 .

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Hydrogen, H_2 , is a colorless, odorless gas.

Hydrogen is easily ignited. Once ignited it burns with a pale blue, almost invisible flame. The vapors are lighter than air. It is flammable over a wide range of vapor/air concentrations. Hydrogen is not toxic but is a simple asphyxiate by the displacement of oxygen in the air. Under prolonged exposure to fire or intense heat the containers may rupture violently and rocket.

Hydrogen is used to make other chemicals, in petroleum refining and in oxyhydrogen welding and cutting.

The phase diagram of hydrogen is shown below the table.

Chemical, physical and thermal properties of hydrogen:

Values at 25°C (77°F, 298 K) and atmospheric pressure

Molecular Weight	2.016
Specific Gravity, air = 1	0.070
Specific Volume (ft^3/lb , m^3/kg)	194, 12.1
Density of liquid at atmospheric pressure (lb/ft^3 , kg/m^3)	4.43, 71.0
Absolute Viscosity ($lb_m/ft\ s$, centipoises)	$6.05 \cdot 10^{-6}$, 0.009
Sound velocity in gas (m/s)	1315
Specific Heat - c_p - ($Btu/lb^{\circ}F$ or $cal/g^{\circ}C$, J/kgK)	3.42, 14310
Specific Heat Ratio - c_p/c_v	1.405
Gas constant - R - ($ft\ lb/lb^{\circ}R$, $J/kg^{\circ}C$)	767, 4126
Thermal Conductivity ($Btu/hr\ ft\ ^{\circ}F$, $W/m^{\circ}C$)	0.105, 0.182
Boiling Point - saturation pressure 14.7 psia and 760 mm Hg - ($^{\circ}F$, $^{\circ}K$)	-423, 20.4
Latent Heat of Evaporation at boiling point (Btu/lb , J/kg)	192, 447000
Freezing or Melting Point at 1 atm ($^{\circ}F$, $^{\circ}C$)	-434.6, -259.1
Latent Heat of Fusion (Btu/lb , J/kg)	25.0, 58000

Critical Temperature ($^{\circ}F$, $^{\circ}C$)	-399.8, -240.0
Critical Pressure ($psia$, MN/m^2)	189, 1.30
Critical Volume (ft^3/lb , m^3/kg)	0.53, 0.033
Flammable	yes
Heat of combustion (Btu/ft^3 , Btu/lb , kJ/kg)	320, 62050, 144000

Follow the links below to get values for the listed **properties of hydrogen** at varying **pressure** and **temperature**:

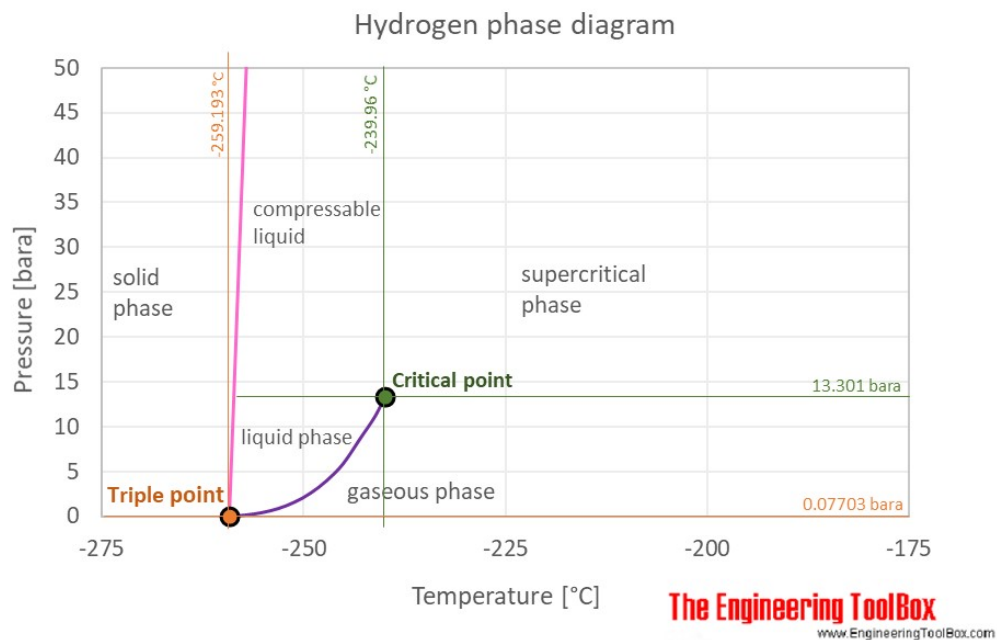
- [Density and specific weight](#)
- [Specific heat](#)
- [Thermal conductivity](#)

See also more about [atmospheric pressure](#) , and [STP - Standard Temperature and Pressure & NTP - Normal Temperature and Pressure](#) , as well as **Thermophysical properties** of: [Acetone](#) , [Acetylene](#) , [Air](#) , [Ammonia](#) , [Argon](#) , [Benzene](#) , [Butane](#) , [Carbon dioxide](#) , [Carbon monoxide](#) , [Ethane](#) , [Ethanol](#) , [Ethylene](#) , [Helium](#) , [Hydrogen sulfide](#) , [Methane](#) , [Methanol](#) , [Nitrogen](#) , [Oxygen](#) , [Pentane](#) , [Propane](#) , [Toluene](#) , [Water](#) and [Heavy water, D₂O](#) .

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Hydrogen is a *gas* at standard conditions. However, at very low temperature and/or high pressures the gas becomes a liquid or a solid.

The hydrogen phase diagram shows the phase behavior with changes in temperature and pressure. The curve between the critical point and the triple point shows the hydrogen boiling point with changes in pressure. It also shows the saturation pressure with changes in temperature.



At the **critical point** there is no change of state when pressure is increased or if heat is added.

The **triple point** of a substance is the temperature and pressure at which the three phases (gas, liquid, and solid) of that substance coexist in thermodynamic equilibrium.

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Related Topics

- **Material Properties** - Material properties of gases, fluids and solids - densities, specific heats, viscosities and more.

Related Documents

- **Acetone - Thermophysical Properties** - Chemical, physical and thermal properties of acetone, also called 2-propanone, dimethyl ketone and pyroacetic acid. Phase diagram included.
- **Benzene - Thermophysical properties** - Chemical, physical and thermal properties of benzene, also called benzol. Phase diagram included.
- **Combustion Heat** - Heat of combustion (energy content) for some common substances - with examples how to calculate heat of combustion.
- **Critical Temperatures and Pressures for some Common Substances** - Critical temperatures and pressures for some common substances like air, alcohol, ether, oxygen and more.
- **Cryogenic Fluids and Liquefied Gas Properties** - Cryogenic properties as density, boiling points and heat of evaporation for fluids like hydrogen, methane, oxygen, nitrogen, fluorine and helium.
- **Ethane - Thermophysical Properties** - Chemical, Physical and Thermal Properties of Ethane - C_2H_6 .
- **Ethylene - Thermophysical Properties** - Chemical, physical and thermal properties of ethylene, also called ethene, acetene and olefiant gas. Phase diagram included.
- **Fuel Gases - Heating Values** - Combustion heat values for gases like acetylene, blast

furnace gas, ethane, biogas and more - Gross and Net values.

- **Fuels and Chemicals - Autoignition Temperatures** - Autoignition points for fuels and chemicals like butane, coke, hydrogen, petroleum and more.
- **Gases - Densities** - Densities and molecular weights of common gases like acetylene, air, methane, nitrogen, oxygen and others.
- **Gases - Dynamic Viscosities** - Absolute (dynamic) viscosities of some common gases.
- **Gases - Explosion and Flammability Concentration Limits** - Flame and explosion limits for gases like propane, methane, butane, acetylene and more.
- **Gases - Ratios of Specific Heat** - Ratios of specific heat for gases with constant pressure and volume processes.
- **Gases - Specific Gravities** - Specific gravities of air, ammonia, butadiene, carbon dioxide, carbon monoxide and some other common gases.
- **Gases - Speed of Sound** - Speed of sound in some gases at zero degrees Celsius and atmospheric pressure.
- **Helium - Thermophysical Properties** - Chemical, Physical and Thermal Properties of Helium - *He*.
- **Hydrogen - Density and Specific Weight vs. Temperature and Pressure** - Online calculator, figures and tables showing density and specific weight of hydrogen, H_2 , at temperatures ranging from -260 to 325 °C (-435 to 620 °F) at atmospheric and higher pressure - Imperial and SI Units.
- **Hydrogen - Specific Heat** - Specific heat of Hydrogen Gas - H_2 - at temperatures ranging 175 - 6000 K.
- **Hydrogen - Thermal Conductivity vs. Temperature and Pressure** - Online calculator, figures and table showing thermal conductivity of hydrogen, H_2 , at varying temperature and pressure - Imperial and SI Units.
- **Molecular Weight of Substances** - Definition and molecular weight (molar mass) of some common substances.
- **Pentane - Thermophysical Properties** - Chemical, physical and thermal properties of pentane, also called n-pentane. Phase diagram included.
- **Solubility of Gases in Water vs. Temperature** - Solubility of Ammonia, Argon, Carbon Dioxide, Carbon Monoxide, Chlorine, Ethane, Ethylene, Helium, Hydrogen, Hydrogen Sulfide, Methane, Nitrogen, Oxygen and Sulfur Dioxide in water.

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- editor.engineeringtoolbox@gmail.com

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Unit Converter

Temperature

0.0

°C

°F

Convert!

Length

1.0

m

km

in

ft

yards

miles

naut miles

Convert!

Area

1.0

m²

km²

in²

ft²

miles²

acres

Convert!

Volume

1.0

m³

liters

in³

ft³

us gal

Convert!

Weight

1.0

- kg_f*
- N*
- lb_f*

Convert!

Velocity

1.0

- m/s*
- km/h*
- ft/min*
- ft/s*
- mph*
- knots*

Convert!

Pressure

1.0

- Pa (N/m²)*
- bar*
- mm H₂O*
- kg/cm²*
- psi*
- inches H₂O*

Convert!

Flow

1.0

- m³/s*
- m³/h*
- US gpm*
- cfm*

Convert!

