PHYSICAL REFERENCE · CHEAT SHEET

Pressure *reference levels*.

Common pressure levels — atmospheric, blood pressure, tire pressure, hydraulic systems, deep-sea — all on one chart across **psi, bar, kPa, atm, mmHg, and inH₂O**.

The chart

PRESSURE	PSI	BAR	KPA	OTHER / CONTEXT
Vacuum (perfect)	0	0	0	0 atm, 0 torr — theoretical only
Ultra-high vacuum (lab)	—	—	10^{-7} to 10^{-11} Pa	Used in semiconductor / surface science
Medium vacuum (process)	—	—	0.1 to 100 Pa	Distillation, evaporation, vacuum pumps
Light vacuum (industrial)	−14 to −5	−1 to −0.3	−100 to −30 kPa	Vacuum cleaners, pneumatic gripping
Mt. Everest summit air	4.9	0.34	34	≈ 1/3 atm, 250 mmHg
Commercial cabin (cruise)	11.3	0.78	78	Equivalent altitude ~7,000 ft (2,100 m)
1 atm (sea level standard)	14.696	1.01325	101.325	≡ 760 mmHg ≡ 29.92 inHg (defined exact)
Bicycle tire (low end)	30-40	2.1-2.8	210-280	MTB / fat tire
Car tire (typical)	30-35	2.1-2.4	210-240	Check driver's door placard for exact
Truck tire (light truck)	50-80	3.4-5.5	340-550	Higher load capacity
Bicycle tire (road)	70-130	4.8-9	480-900	Narrower tire, higher pressure
Shop compressed air	90-125	6.2-8.6	620-860	Typical pneumatic tools

PRESSURE	PSI	BAR	KPA	OTHER / CONTEXT
Residential water (street)	40-80	2.8-5.5	280-550	Pressure-reducing valve to 50-60 psi for house
Residential gas (natural)	0.25	0.017	1.7	7 inH_2O — most residential supply
Espresso machine (brew)	130	9	900	Standard espresso brewing pressure
Pressure washer (consumer)	1500-3000	100-200	10,000-20,000	Cleaning automotive, decks
Pressure washer (industrial)	3000-7000	200-480	20-48 MPa	Surface prep, paint removal
Hydraulic system (mobile)	2000-3500	140-240	14-24 MPa	Excavators, loaders, machine tools
Hydraulic system (high-perf)	5000+	350+	35+ MPa	Press brakes, injection molding
Scuba tank (full)	3000	207	20.7 MPa	Most commonly used dive tank pressure
Scuba tank (high-pressure)	3442	237	23.7 MPa	DOT 3AA tanks, technical diving
CNG fuel tank	3000-3600	207-248	20-25 MPa	Compressed natural gas vehicles
Blood pressure (normal systolic)	2.3	0.16	16	120 mmHg — note: gauge pressure (above atm)
Blood pressure (normal diastolic)	1.5	0.10	10	80 mmHg
Hypertension threshold (systolic)	2.5	0.17	17	≥130 mmHg per current US guidelines
Intracranial pressure (normal)	0.07-0.29	0.005-0.020	0.5-2 kPa	5-15 mmHg
Boiler (residential)	12-30	0.8-2	80-200	Hydronic heating expansion tank
Boiler (commercial steam)	15-150	1-10	100-1000	Process steam
Ocean at 10 m depth	14.5	1.0	100	1 additional bar per 10 m depth
Ocean at 100 m	145	10	1.0 MPa	Recreational dive limit
Ocean at 1,000 m	1,450	100	10 MPa	Submarine operating depth

PRESSURE	PSI	BAR	KPA	OTHER / CONTEXT
Mariana Trench (deepest)	16,000	1,100	110 MPa	Mariana Trench at ~11 km depth

> **Gauge vs absolute.** Most pressure measurements (tire, blood, hydraulic, etc.) are *gauge* pressure — relative to atmospheric. Absolute pressure is gauge + 14.7 psi (1 atm). The values above are gauge where that's the conventional measurement (tire, blood, hydraulics) and absolute where that's conventional (barometric, vacuum). Always check which your application expects.

Common pitfalls

- **Tire pressure: cold vs hot.** Manufacturer specs are 'cold' pressure (before driving). Tire pressure rises 2-5 psi after 20 minutes of highway driving. Don't bleed off when hot — wait for cooldown.
- **Blood pressure 'over' is systolic / diastolic.** 120/80 means 120 mmHg peak (systolic, heart contracting) and 80 mmHg trough (diastolic, heart relaxing). Both are gauge pressures.
- **Hydraulic vs pneumatic confusion.** Hydraulic systems use incompressible liquid (oil), pneumatic systems use compressible gas (air). Hydraulic operates at much higher pressure (140-350 bar typical) than pneumatic (6-8 bar typical).
- **1 bar of water depth ≈ 10 m / 33 ft.** A useful diving rule. At 30 m depth: 1 atm surface + 3 atm water = 4 atm absolute = 60 psi.
- **Sea-level air pressure varies ±5%.** Standard atm is 1013.25 mbar. Weather systems push it up to 1050 (very high pressure / 'high') or down to 970 (storm). Hurricane pressure can drop below 920 mbar.

Common questions

Why does the weather report use different pressure units than my barometer?

Different fields kept their conventional units. US weather services use inches of mercury (29.92 inHg at sea level) and millibars (1013.25 mb). Europe uses hectopascals (1013.25 hPa = 1013.25 mb). Aviation uses inHg and hPa. Scuba uses bar or atmospheres. Engineering uses psi, kPa, or MPa. They all measure the same thing; just in different units.

Is 'gauge pressure' the same as 'absolute pressure'?

No. Gauge pressure is measured relative to atmospheric (atmospheric = 0 psig). Absolute pressure is measured from a vacuum (atmospheric = 14.7 psia). A tire reading 32 psig is actually 46.7 psia. Suffix matters: psig (gauge), psia (absolute), psid (differential). Confusing these has caused industrial accidents.

What's 'standard atmosphere' and why is it different from local?

Standard atmosphere is a global reference: 101.325 kPa (14.696 psi) at sea level. Local atmospheric pressure varies with weather (typically 980-1040 hPa) and elevation. Denver at 1600 m elevation has standard pressure of about 83 kPa, not 101 kPa. When precision matters, use local pressure, not standard.

How much pressure can a typical garden hose handle?

Standard residential hoses are rated 50-100 psi working pressure with burst pressures around 300-500 psi. Municipal water systems run 40-80 psi. If your house has unusually high pressure (over 80 psi), install a

pressure regulator — it'll save hoses, washing machines, and water heaters.

Why does altitude affect cooking time?

Water boils at a temperature where its vapor pressure equals atmospheric pressure. Lower altitude = higher atmospheric pressure = higher boiling point = faster cooking. At sea level water boils at 100°C; at 1500 m elevation it boils at about 95°C; at 3000 m at 90°C. Recipes from sea level take longer at altitude — adjust by 10-20% per 1000 m.

Sources

- **Standard atmosphere:** ISO 2533. Standard sea-level pressure = 101,325 Pa (defined exactly).
- **Blood pressure guidelines:** American College of Cardiology / American Heart Association 2017 guidelines.
- **Pressure unit definitions:** The bar = 100,000 Pa exactly; atm = 101,325 Pa exactly; 1 psi = 6894.757 Pa.
- **Hydraulic pressure ranges:** Industry conventions from Eaton, Parker, Bosch Rexroth catalogs.