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HVAC and Refrigeration Reference Pack

Refrigerant PT chart, heat transfer units, power and tons, pressure, temperature and energy in one printable PDF

For: HVAC and refrigeration technicians, building services engineers, apprentices and students

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By Miguel Coelho · Edition 2.0
9 November 2026

Six sheets for the service van or the plant room: pressure–temperature tables for R-410A, R-32, R-454B, R-22, R-134a, R-404A, R-407C and R-290; heat transfer units including U-value, R-value and RSI; power in kW, BTU/h and tons of refrigeration; pressure units; temperature; and energy in kWh, BTU and therms. Each sheet is also available on its own.

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Conversion values in this pack are generated by the AllUnitConversions conversion library and automatically checked against exact definitions (NIST SP 811, BIPM SI Brochure, 1959 International Yard and Pound Agreement) before the PDF is produced. Reference data taken from standards and regulations is cited to its source on each sheet. Free to print, copy and share with attribution (CC BY 4.0).

Printing tip: print double-sided and staple at the top left, or print single sheets from each chart's own page.

Refrigerant PT Chart

Saturation pressure–temperature tables for R-22, R-32, R-134a, R-290, R-404A, R-407C, R-410A and R-454B

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BASIS	KEY RELATIONSHIP	READING THE TABLE	WORKED EXAMPLE
Saturation pressure at each temperature; liquid (bubble) and vapour (dew) for blends with glide	Superheat = suction-line temp − dew temp; subcooling = bubble temp − liquid-line temp	Find the gauge pressure in the column, read the saturation temperature in the first column	R-410A at 40 °F: 118.8 psig, so a suction line at 50 °F has 10 °F superheat

psig to 0.1 at sea level (14.696 psia); bar(g) on 1.01325 bar. ″ vac = inches of mercury below atmospheric.

Single-component and near-azeotropic refrigerants (psig)

R-410A has a glide below 0.5 psi; the liquid value is shown.

°F	R-22	R-32	R-134a	R-290	R-410A
-40	0.6	11.0	14.8″ vac	1.4	10.8
-35	2.6	14.4	12.5″ vac	3.4	14.1
-30	4.9	18.2	9.8″ vac	5.7	17.8
-25	7.4	22.3	6.9″ vac	8.1	21.9
-20	10.2	26.8	3.7″ vac	10.7	26.3
-15	13.2	31.7	0.1″ vac	13.6	31.2
-10	16.5	37.1	1.9	16.7	36.5
-5	20.1	42.9	4.1	20.1	42.2
0	24.0	49.3	6.5	23.7	48.4
5	28.3	56.1	9.1	27.6	55.2
10	32.8	63.5	11.9	31.8	62.4
15	37.8	71.4	15.0	36.3	70.3
20	43.1	80.0	18.4	41.1	78.7
25	48.8	89.2	22.1	46.3	87.7
30	55.0	99.1	26.1	51.8	97.4
35	61.5	109.7	30.4	57.7	107.7
40	68.6	121.0	35.0	63.9	118.8
45	76.1	133.0	40.1	70.6	130.6
50	84.1	145.8	45.4	77.6	143.1
55	92.6	159.5	51.2	85.1	156.5
60	101.6	174.0	57.4	93.0	170.7
65	111.2	189.5	64.0	101.4	185.8
70	121.4	205.8	71.1	110.2	201.7
75	132.2	223.2	78.7	119.5	218.6
80	143.6	241.5	86.7	129.3	236.5
85	155.7	260.9	95.2	139.7	255.4
90	168.4	281.3	104.3	150.5	275.3
95	181.8	302.9	113.9	161.9	296.4
100	195.9	325.7	124.2	173.9	318.5
105	210.8	349.6	135.0	186.5	341.9
110	226.4	374.9	146.4	199.6	366.5
115	242.8	401.4	158.4	213.4	392.3
120	260.0	429.3	171.2	227.8	419.5

°F	R-22	R-32	R-134a	R-290	R-410A
125	278.0	458.7	184.6	242.9	448.0
130	296.9	489.5	198.7	258.7	478.0
135	316.7	521.8	213.6	275.1	509.5
140	337.4	555.8	229.2	292.3	542.6
145	359.0	591.4	245.7	310.2	577.4
150	381.7	628.8	262.9	328.9	613.9

Blends with glide: liquid and vapour pressure (psig)

Use the vapour (dew) pressure for superheat and the liquid (bubble) pressure for subcooling.

°F	R-404A liquid	R-404A vapour	R-407C liquid	R-407C vapour	R-454B liquid	R-454B vapour
-40	4.9	4.3	2.7	4.6″ vac	9.5	8.4
-35	7.5	6.8	5.1	0.9″ vac	12.7	11.4
-30	10.3	9.6	7.7	1.6	16.2	14.8
-25	13.4	12.7	10.6	3.9	20.1	18.5
-20	16.8	16.0	13.7	6.5	24.3	22.6
-15	20.5	19.7	17.2	9.3	28.9	27.0
-10	24.6	23.6	20.9	12.3	33.9	31.8
-5	28.9	27.9	25.0	15.7	39.4	37.0
0	33.7	32.6	29.5	19.4	45.3	42.7
5	38.8	37.7	34.3	23.5	51.7	48.8
10	44.3	43.1	39.5	27.9	58.5	55.4
15	50.2	49.0	45.2	32.7	66.0	62.6
20	56.6	55.3	51.2	37.9	73.9	70.3
25	63.4	62.1	57.7	43.5	82.5	78.5
30	70.7	69.3	64.7	49.6	91.7	87.4
35	78.6	77.1	72.2	56.1	101.5	96.9
40	86.9	85.4	80.2	63.2	112.0	107.0
45	95.8	94.2	88.8	70.7	123.1	117.8
50	105.3	103.6	97.9	78.8	135.0	129.3
55	115.3	113.6	107.6	87.5	147.7	141.6
60	126.0	124.2	117.9	96.8	161.1	154.6
65	137.3	135.5	128.9	106.7	175.4	168.5
70	149.3	147.4	140.5	117.3	190.5	183.1
75	162.0	160.1	152.8	128.5	206.5	198.7
80	175.4	173.4	165.8	140.5	223.4	215.2
85	189.5	187.5	179.6	153.2	241.2	232.6
90	204.5	202.4	194.1	166.7	260.0	251.0
95	220.2	218.1	209.4	181.0	279.9	270.4
100	236.8	234.7	225.5	196.1	300.8	290.9
105	254.2	252.1	242.4	212.1	322.8	312.5
110	272.6	270.4	260.2	229.0	345.9	335.2
115	291.8	289.7	278.9	246.9	370.2	359.1
120	312.1	309.9	298.6	265.8	395.7	384.3
125	333.4	331.2	319.2	285.6	422.4	410.8
130	355.7	353.6	340.7	306.6	450.5	438.7
135	379.1	377.1	363.3	328.7	479.9	468.0
140	403.7	401.7	387.0	352.0	510.7	498.8
145	429.6	427.7	411.7	376.6	543.0	531.3
150	456.8	455.0	437.5	402.5	576.8	565.4

Single-component and near-azeotropic refrigerants (bar gauge, °C)

°C	R-22	R-32	R-134a	R-290	R-410A
-40	0.04	0.76	−0.50	0.10	0.74
-35	0.31	1.20	−0.35	0.36	1.18
-30	0.63	1.72	−0.17	0.67	1.69
-25	1.00	2.33	0.05	1.02	2.29
-20	1.44	3.04	0.31	1.43	2.99
-15	1.95	3.87	0.63	1.90	3.80
-10	2.53	4.81	0.99	2.44	4.73
-5	3.20	5.89	1.42	3.05	5.79
0	3.97	7.12	1.91	3.73	6.99
5	4.83	8.50	2.48	4.50	8.35
10	5.80	10.06	3.13	5.35	9.87
15	6.88	11.79	3.87	6.30	11.57
20	8.09	13.73	4.70	7.35	13.46
25	9.43	15.88	5.64	8.51	15.56
30	10.91	18.26	6.69	9.78	17.88
35	12.53	20.89	7.86	11.17	20.43
40	14.32	23.77	9.15	12.68	23.24
45	16.28	26.93	10.59	14.33	26.32
50	18.41	30.40	12.17	16.12	29.70
55	20.74	34.19	13.90	18.06	33.39
60	23.26	38.32	15.80	20.15	37.41

Blends with glide: liquid and vapour pressure (bar gauge, °C)

°C	R-404A liquid	R-404A vapour	R-407C liquid	R-407C vapour	R-454B liquid	R-454B vapour
-40	0.34	0.30	0.19	−0.16	0.66	0.58
-35	0.67	0.62	0.49	0.08	1.07	0.97
-30	1.06	1.01	0.86	0.37	1.56	1.44
-25	1.52	1.46	1.29	0.72	2.13	1.99
-20	2.06	1.99	1.79	1.13	2.79	2.63
-15	2.67	2.60	2.37	1.62	3.56	3.37
-10	3.38	3.29	3.03	2.18	4.44	4.21
-5	4.18	4.09	3.80	2.84	5.45	5.18
0	5.09	4.99	4.67	3.59	6.59	6.28
5	6.11	6.00	5.65	4.46	7.87	7.52
10	7.26	7.14	6.75	5.44	9.31	8.92
15	8.54	8.42	7.99	6.54	10.92	10.48
20	9.96	9.83	9.36	7.79	12.71	12.22
25	11.53	11.40	10.89	9.19	14.70	14.15
30	13.27	13.13	12.58	10.74	16.89	16.28
35	15.18	15.04	14.44	12.48	19.30	18.64
40	17.28	17.14	16.48	14.40	21.94	21.24
45	19.58	19.43	18.71	16.52	24.84	24.09
50	22.10	21.95	21.15	18.86	28.01	27.22
55	24.84	24.70	23.80	21.44	31.46	30.64
60	27.84	27.70	26.68	24.27	35.21	34.39

Refrigerant notes

Refrigerant	Type	Safety class	Critical temperature	Notes
R-22	HCFC	A1	96.1 °C	Ozone-depleting; new production banned in the US and EU (servicing only)
R-32	HFC	A2L	78.1 °C	Mildly flammable; common in new split air conditioners
R-134a	HFC	A1	101.1 °C	Chillers, older vehicle air conditioning, medium-temperature refrigeration
R-290	Propane (HC)	A3	96.7 °C	Highly flammable: small charges, sealed systems, trained technicians
R-404A	HFC blend	A1	72.1 °C	Low-temperature refrigeration; high GWP, being phased down
R-407C	HFC blend	A1	86.2 °C	Large glide (about 7 °C); R-22 replacement in air conditioning
R-410A	HFC blend	A1	71.3 °C	Near-azeotropic; being replaced by R-32 and R-454B in new equipment
R-454B	HFO/HFC blend	A2L	78.1 °C	Mildly flammable R-410A replacement; glide about 1 °C (1.7 °F)

Sources and method

- **Reference equations of state (as used in NIST REFPROP)** — R-22, R-32, R-134a, R-290; Lemmon (2003) pseudo-pure models for R-404A, R-407C and R-410A
- **CoolProp 8.0 (Bell et al., Ind. Eng. Chem. Res. 2014)** — Open-source property library used to evaluate IF97 and the refrigerant equations of state (coolprop.org/)
- **Chemours, Opteon XL41 (R-454B) thermodynamic properties, I/P units** — R-454B liquid and vapour pressures (NIST REFPROP 10)
- **Arkema, Forane pressure–temperature chart (05-2025)** — Second source: every refrigerant agrees within 0.1 psi at 40 °F and 100 °F

Pressures are calculated from the reference equations of state (R-454B transcribed from the manufacturer) and cross-checked against a second manufacturer's chart; no values are typed in except the R-454B data. Interactive version, corrections and more charts: **allunitconversions.com/refrigerant-pt-chart**

Heat Transfer Units Conversion Chart

Thermal conductivity, U-value, R-value and RSI, heat transfer coefficient, heat flux and specific heat

For: Building services, HVAC and mechanical engineers, energy assessors and students

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EXACT DEFINITION	FORMULA	REVERSE	WORKED EXAMPLE
1 BTU = 1055.055 852 62 J (IT), 1 ft = 0.3048 m, 1 °F interval = 5/9 K	RSI = R × 0.1761102; U (W/m²·K) = U (IP) × 5.678263	R = RSI × 5.678263; U-value = 1 ÷ total R-value	R-19 insulation = 19 × 0.17611 = 3.35 m²·K/W (RSI 3.35), U = 0.299 W/m²·K

Factors to 7 significant figures; tables to 5. All factors follow from the exact definitions above.

Multiply-by factors

Quantity	From	To	Multiply by
Thermal conductivity k	BTU/(h·ft·°F)	W/(m·K)	1.730735
Thermal conductivity k	W/(m·K)	BTU/(h·ft·°F)	0.5777893
Thermal conductivity k	BTU·in/(h·ft²·°F)	W/(m·K)	0.1442279
Thermal conductivity k	W/(m·K)	BTU·in/(h·ft²·°F)	6.933472
Thermal conductivity k	kcal/(h·m·°C)	W/(m·K)	1.163
U-value, heat transfer coefficient	BTU/(h·ft²·°F)	W/(m²·K)	5.678263
U-value, heat transfer coefficient	W/(m²·K)	BTU/(h·ft²·°F)	0.1761102
U-value, heat transfer coefficient	kcal/(h·m²·°C)	W/(m²·K)	1.163
Thermal resistance R	h·ft²·°F/BTU (R-value)	m²·K/W (RSI)	0.1761102
Thermal resistance R	m²·K/W (RSI)	h·ft²·°F/BTU (R-value)	5.678263
Heat flux	BTU/(h·ft²)	W/m²	3.154591
Heat flux	W/m²	BTU/(h·ft²)	0.3169983
Specific heat capacity	BTU/(lb·°F)	kJ/(kg·K)	4.1868
Specific heat capacity	kcal/(kg·°C)	kJ/(kg·K)	4.1868
Specific heat capacity	kJ/(kg·K)	BTU/(lb·°F)	0.2388459

Insulation R-value to RSI and U-value

R-value (h·ft²·°F/BTU)	RSI (m²·K/W)	U (W/m²·K)	U (BTU/h·ft²·°F)
1	0.18	5.678	1.0000
2	0.35	2.839	0.5000
3	0.53	1.893	0.3333
4	0.70	1.420	0.2500
5	0.88	1.136	0.2000
6	1.06	0.946	0.1667
8	1.41	0.710	0.1250
10	1.76	0.568	0.1000
11	1.94	0.516	0.0909
13	2.29	0.437	0.0769

R-value (h·ft²·°F/BTU)	RSI (m²·K/W)	U (W/m²·K)	U (BTU/h·ft²·°F)
15	2.64	0.379	0.0667
19	3.35	0.299	0.0526
21	3.70	0.270	0.0476
25	4.40	0.227	0.0400
30	5.28	0.189	0.0333
38	6.69	0.149	0.0263
40	7.04	0.142	0.0250
49	8.63	0.116	0.0204
50	8.81	0.114	0.0200
60	10.57	0.095	0.0167

U-value (W/m²·K) to imperial U and R-value

U (W/m²·K)	U (BTU/h·ft²·°F)	R-value (IP)	RSI (m²·K/W)
0.1	0.0176	56.8	10.00

U (W/m²·K)	U (BTU/h·ft²·°F)	R-value (IP)	RSI (m²·K/W)
0.45	0.0792	12.6	2.22

U (W/m²·K)	U (BTU/h·ft²·°F)	R-value (IP)	RSI (m²·K/W)
0.11	0.0194	51.6	9.09
0.13	0.0229	43.7	7.69
0.15	0.0264	37.9	6.67
0.16	0.0282	35.5	6.25
0.18	0.0317	31.5	5.56
0.2	0.0352	28.4	5.00
0.25	0.0440	22.7	4.00
0.28	0.0493	20.3	3.57
0.3	0.0528	18.9	3.33
0.35	0.0616	16.2	2.86

U (W/m²·K)	U (BTU/h·ft²·°F)	R-value (IP)	RSI (m²·K/W)
0.5	0.0881	11.4	2.00
0.7	0.1233	8.1	1.43
1	0.1761	5.7	1.00
1.4	0.2466	4.1	0.71
1.6	0.2818	3.5	0.63
2	0.3522	2.8	0.50
2.8	0.4931	2.0	0.36
4.8	0.8453	1.2	0.21
5.7	1.0038	1.0	0.18

Thermal conductivity

k (W/m·K)	BTU/(h·ft·°F)	BTU·in/(h·ft²·°F)	kcal/(h·m·°C)
0.02	0.011556	0.13867	0.017197
0.025	0.014445	0.17334	0.021496
0.03	0.017334	0.208	0.025795
0.035	0.020223	0.24267	0.030095
0.04	0.023112	0.27734	0.034394
0.05	0.028889	0.34667	0.042992
0.1	0.057779	0.69335	0.085985
0.15	0.086668	1.04	0.12898
0.2	0.11556	1.3867	0.17197
0.5	0.28889	3.4667	0.42992

k (W/m·K)	BTU/(h·ft·°F)	BTU·in/(h·ft²·°F)	kcal/(h·m·°C)
1	0.57779	6.9335	0.85985
2	1.1556	13.867	1.7197
5	2.8889	34.667	4.2992
10	5.7779	69.335	8.5985
16	9.2446	110.94	13.758
50	28.889	346.67	42.992
100	57.779	693.35	85.985
200	115.56	1,386.7	171.97
237	136.94	1,643.2	203.78
401	231.69	2,780.3	344.8

Heat transfer coefficient h

h (W/m²·K)	BTU/(h·ft²·°F)	kcal/(h·m²·°C)
2	0.35222	1.7197
5	0.88055	4.2992
10	1.7611	8.5985
25	4.4028	21.496
50	8.8055	42.992
100	17.611	85.985
250	44.028	214.96

h (W/m²·K)	BTU/(h·ft²·°F)	kcal/(h·m²·°C)
500	88.055	429.92
1,000	176.11	859.85
2,500	440.28	2,149.6
5,000	880.55	4,299.2
10,000	1,761.1	8,598.5
20,000	3,522.2	17,197
100,000	17,611	85,985

Typical convection heat transfer coefficients

Process	h (W/m²·K)	h (BTU/h·ft²·°F)
Free convection, gases	2–25	0.35–4.4
Free convection, liquids	50–1,000	8.8–176
Forced convection, gases	25–250	4.4–44
Forced convection, liquids	100–20,000	17.6–3,522
Boiling or condensation	2,500–100,000	440–17,611

Heat flux

W/m²	BTU/(h·ft²)	kW/m²
1	0.317	0.001

W/m²	BTU/(h·ft²)	kW/m²
1,000	317	1

W/m²	BTU/(h·ft²)	kW/m²
10	3.17	0.01
50	15.85	0.05
100	31.7	0.1
500	158.5	0.5

W/m²	BTU/(h·ft²)	kW/m²
1,361	431.43	1.361
5,000	1,585	5
10,000	3,170	10
100,000	31,700	100

Specific heat of liquid water at 1 atm (IAPWS-IF97)

T (°C)	T (°F)	cp (kJ/kg·K)	cp (BTU/lb·°F)
0.01	32.02	4.2194	1.0078
10	50	4.1954	1.0021
20	68	4.1848	0.9995
25	77	4.1819	0.9988
30	86	4.1800	0.9984
40	104	4.1786	0.9980

T (°C)	T (°F)	cp (kJ/kg·K)	cp (BTU/lb·°F)
50	122	4.1796	0.9983
60	140	4.1828	0.9990
70	158	4.1881	1.0003
80	176	4.1955	1.0021
90	194	4.2050	1.0043
99	210.2	4.2154	1.0068

Heat transfer formulas

Formula	Meaning	Worked example
Q = m × c × ΔT	Heat to change the temperature of a mass	Heating 10 kg of water by 50 K: 10 × 4.18 × 50 = 2,090 kJ (0.58 kWh)
q = k × A × ΔT ÷ L	Conduction through a slab	k 0.04, 10 m², 20 K, 0.1 m: q = 80 W
q = U × A × ΔT	Heat loss through a wall or window	U 0.3, 50 m², 20 K: q = 300 W
U = 1 ÷ ΣR	U-value from the layer resistances (including surfaces)	R total 3.33 m²·K/W: U = 0.30 W/m²·K
R = L ÷ k	Resistance of one layer	100 mm at k 0.035: R = 2.86 m²·K/W

Sources and method

- **NIST Special Publication 811** — Conversion factors; BTU is the International Table BTU (1055.055 852 62 J) (www.nist.gov/pml/special-publication-811)
- **IAPWS-IF97 (IAPWS R7-97, 2012 revision)** — Industrial formulation for the thermodynamic properties of water and steam; reference state u = s = 0 for saturated liquid at the triple point (iapws.org/relguide/IF97-Rev.html)
- **Incropera et al., Fundamentals of Heat and Mass Transfer** — Table 1.1, typical convection heat transfer coefficients

Every factor is calculated from the exact definitions of the BTU, foot, pound and degree Fahrenheit; specific heat of water is calculated with IAPWS-IF97. Interactive version, corrections and more charts: **allunitconversions.com/heat-transfer-conversion-chart**

Power Conversion Chart

Watts, kilowatts, horsepower, BTU/h and tons of refrigeration

For: Engineers, HVAC technicians, electricians and mechanics

allunitconversions.com/power-conversion-chart
By Miguel Coelho · Edition 2.0
9 November 2026

EXACT DEFINITION	FORMULA	REVERSE	WORKED EXAMPLE
1 hp = 745.699 872 W; 1 BTU/h = 0.293 071 W; 1 RT = 12,000 BTU/h	kW = hp × 0.7457; W = BTU/h × 0.293 071	hp = kW ÷ 0.7457; BTU/h = W × 3.412 14	A 12,000 BTU/h air conditioner = 3.517 kW = 1 RT

Matrix values use 6 significant figures; tables are rounded as shown.

Factor matrix — 1 unit in every other unit

1 unit =	W	kW	MW	hp	PS	BTU/h	RT
1 W	1	0.001	1×10^{-6}	0.00134102	0.00135962	3.41214	2.84345×10^{-4}
1 kW	1,000	1	0.001	1.34102	1.35962	3,412.14	0.284345
1 MW	1×10^{6}	1,000	1	1,341.02	1,359.62	3.41214×10^{6}	284.345
1 hp	745.7	0.7457	7.457×10^{-4}	1	1.01387	2,544.43	0.212036
1 PS	735.499	0.735499	7.35499×10^{-4}	0.98632	1	2,509.63	0.209135
1 BTU/h	0.293071	2.93071×10^{-4}	2.93071×10^{-7}	3.93015×10^{-4}	3.98466×10^{-4}	1	8.33333×10^{-5}
1 RT	3,516.85	3.51685	0.00351685	4.71618	4.78159	12,000	1

Horsepower to kilowatts

Horsepower (mech.) (hp)	Kilowatts (kW)	Horsepower (mech.) (hp)	Kilowatts (kW)	Horsepower (mech.) (hp)	Kilowatts (kW)	Horsepower (mech.) (hp)	Kilowatts (kW)
1	0.75	**12**	8.95	**35**	26.10	**90**	67.11
2	1.49	**13**	9.69	**40**	29.83	**95**	70.84
3	2.24	**14**	10.44	**45**	33.56	**100**	74.57
4	2.98	**15**	11.19	**50**	37.28	**150**	111.85
5	3.73	**16**	11.93	**55**	41.01	**200**	149.14
6	4.47	**17**	12.68	**60**	44.74	**250**	186.42
7	5.22	**18**	13.42	**65**	48.47	**300**	223.71
8	5.97	**19**	14.17	**70**	52.20	**350**	260.99
9	6.71	**20**	14.91	**75**	55.93	**400**	298.28
10	7.46	**25**	18.64	**80**	59.66	**450**	335.56
11	8.20	**30**	22.37	**85**	63.38	**500**	372.85

BTU per hour to watts and tons of refrigeration

BTU per hour (BTU/h)	Watts (W)	Tons of refrigeration (RT)	BTU per hour (BTU/h)	Watts (W)	Tons of refrigeration (RT)
1,000	293	0.08	**18,000**	5,275	1.50
2,000	586	0.17	**24,000**	7,034	2.00
5,000	1,465	0.42	**30,000**	8,792	2.50
6,000	1,758	0.50	**36,000**	10,551	3.00
8,000	2,345	0.67	**42,000**	12,309	3.50
9,000	2,638	0.75	**48,000**	14,067	4.00
10,000	2,931	0.83	**60,000**	17,584	5.00
12,000	3,517	1.00	**100,000**	29,307	8.33
15,000	4,396	1.25			

Sources and method

- **NIST Special Publication 811** — Guide for the Use of the International System of Units (www.nist.gov/pml/special-publication-811)

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Pressure Conversion Chart

psi, kPa, bar, atm, Pa, MPa, mbar and Torr

For: Engineers, HVAC technicians, mechanics and cyclists

allunitconversions.com/pressure-conversion-chart
By Miguel Coelho · Edition 2.0
9 November 2026

EXACT DEFINITION	FORMULA	REVERSE	WORKED EXAMPLE
1 bar = 100 kPa; 1 atm = 101.325 kPa; 1 psi = 6.894 757 kPa	kPa = psi × 6.894 757	psi = kPa ÷ 6.894 757; psi = bar × 14.503 77	32 psi × 6.894757 = 220.6 kPa = 2.206 bar

Matrix values use 6 significant figures; tables are rounded as shown.

Factor matrix — 1 unit in every other unit

1 unit =	Pa	kPa	MPa	bar	mbar	atm	psi	Torr
1 Pa	1	0.001	1×10^{-6}	1×10^{-5}	0.01	9.86923×10^{-6}	1.45038×10^{-4}	0.00750062
1 kPa	1,000	1	0.001	0.01	10	0.00986923	0.145038	7.50062
1 MPa	1×10^{6}	1,000	1	10	10,000	9.86923	145.038	7,500.62
1 bar	100,000	100	0.1	1	1,000	0.986923	14.5038	750.062
1 mbar	100	0.1	1×10^{-4}	0.001	1	9.86923×10^{-4}	0.0145038	0.750062
1 atm	101,325	101.325	0.101325	1.01325	1,013.25	1	14.6959	760
1 psi	6,894.76	6.89476	0.00689476	0.0689476	68.9476	0.068046	1	51.7149
1 Torr	133.322	0.133322	1.33322×10^{-4}	0.00133322	1.33322	0.00131579	0.0193368	1

psi to kPa and bar (tyres, HVAC, hydraulics)

psi (psi)	Kilopascals (kPa)	Bar (bar)	psi (psi)	Kilopascals (kPa)	Bar (bar)	psi (psi)	Kilopascals (kPa)	Bar (bar)
1	6.9	0.069	**19**	131.0	1.310	**65**	448.2	4.482
2	13.8	0.138	**20**	137.9	1.379	**70**	482.6	4.826
3	20.7	0.207	**21**	144.8	1.448	**75**	517.1	5.171
4	27.6	0.276	**22**	151.7	1.517	**80**	551.6	5.516
5	34.5	0.345	**23**	158.6	1.586	**85**	586.1	5.861
6	41.4	0.414	**24**	165.5	1.655	**90**	620.5	6.205
7	48.3	0.483	**25**	172.4	1.724	**95**	655.0	6.550
8	55.2	0.552	**26**	179.3	1.793	**100**	689.5	6.895
9	62.1	0.621	**27**	186.2	1.862	**105**	723.9	7.239
10	68.9	0.689	**28**	193.1	1.931	**110**	758.4	7.584
11	75.8	0.758	**29**	199.9	1.999	**115**	792.9	7.929
12	82.7	0.827	**30**	206.8	2.068	**120**	827.4	8.274
13	89.6	0.896	**35**	241.3	2.413	**125**	861.8	8.618
14	96.5	0.965	**40**	275.8	2.758	**130**	896.3	8.963
15	103.4	1.034	**45**	310.3	3.103	**135**	930.8	9.308
16	110.3	1.103	**50**	344.7	3.447	**140**	965.3	9.653
17	117.2	1.172	**55**	379.2	3.792	**145**	999.7	9.997
18	124.1	1.241	**60**	413.7	4.137	**150**	1,034.2	10.342

bar to psi and kPa

Bar (bar)	psi (psi)	Kilopascals (kPa)	Bar (bar)	psi (psi)	Kilopascals (kPa)
0.5	7.25	50	**10.5**	152.29	1,050
1.0	14.50	100	**11.0**	159.54	1,100

Bar (bar)	psi (psi)	Kilopascals (kPa)
1.5	21.76	150
2.0	29.01	200
2.5	36.26	250
3.0	43.51	300
3.5	50.76	350
4.0	58.02	400
4.5	65.27	450
5.0	72.52	500
5.5	79.77	550
6.0	87.02	600
6.5	94.27	650
7.0	101.53	700
7.5	108.78	750
8.0	116.03	800
8.5	123.28	850
9.0	130.53	900
9.5	137.79	950
10.0	145.04	1,000

Bar (bar)	psi (psi)	Kilopascals (kPa)
11.5	166.79	1,150
12.0	174.05	1,200
12.5	181.30	1,250
13.0	188.55	1,300
13.5	195.80	1,350
14.0	203.05	1,400
14.5	210.30	1,450
15.0	217.56	1,500
15.5	224.81	1,550
16.0	232.06	1,600
16.5	239.31	1,650
17.0	246.56	1,700
17.5	253.82	1,750
18.0	261.07	1,800
18.5	268.32	1,850
19.0	275.57	1,900
19.5	282.82	1,950
20.0	290.08	2,000

Sources and method

- **BIPM SI Brochure, 9th edition** — Definitions of the SI units, including the kelvin (www.bipm.org/en/publications/si-brochure)
- **NIST Special Publication 811** — Guide for the Use of the International System of Units (www.nist.gov/pml/special-publication-811)

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Temperature Conversion Chart

Celsius, Fahrenheit and Kelvin side by side

For: Students, scientists, engineers and cooks

allunitconversions.com/temperature-conversion-chart
By Miguel Coelho · Edition 2.0
9 November 2026

EXACT DEFINITION	FORMULA	REVERSE	WORKED EXAMPLE
K = °C + 273.15 and °F = °C × 9/5 + 32 (exact)	°F = (°C × 1.8) + 32; K = °C + 273.15	°C = (°F − 32) ÷ 1.8; °C = K − 273.15	25 °C = 77 °F = 298.15 K

Values are rounded to 2 decimal places.

−50 °C to 300 °C in 5-degree steps

Celsius (°C)	Fahrenheit (°F)	Kelvin (K)	Celsius (°C)	Fahrenheit (°F)	Kelvin (K)
−50	−58.0	223.15	**130**	266.0	403.15
−45	−49.0	228.15	**135**	275.0	408.15
−40	−40.0	233.15	**140**	284.0	413.15
−35	−31.0	238.15	**145**	293.0	418.15
−30	−22.0	243.15	**150**	302.0	423.15
−25	−13.0	248.15	**155**	311.0	428.15
−20	−4.0	253.15	**160**	320.0	433.15
−15	5.0	258.15	**165**	329.0	438.15
−10	14.0	263.15	**170**	338.0	443.15
−5	23.0	268.15	**175**	347.0	448.15
0	32.0	273.15	**180**	356.0	453.15
5	41.0	278.15	**185**	365.0	458.15
10	50.0	283.15	**190**	374.0	463.15
15	59.0	288.15	**195**	383.0	468.15
20	68.0	293.15	**200**	392.0	473.15
25	77.0	298.15	**205**	401.0	478.15
30	86.0	303.15	**210**	410.0	483.15
35	95.0	308.15	**215**	419.0	488.15
40	104.0	313.15	**220**	428.0	493.15
45	113.0	318.15	**225**	437.0	498.15
50	122.0	323.15	**230**	446.0	503.15
55	131.0	328.15	**235**	455.0	508.15
60	140.0	333.15	**240**	464.0	513.15
65	149.0	338.15	**245**	473.0	518.15
70	158.0	343.15	**250**	482.0	523.15
75	167.0	348.15	**255**	491.0	528.15
80	176.0	353.15	**260**	500.0	533.15
85	185.0	358.15	**265**	509.0	538.15
90	194.0	363.15	**270**	518.0	543.15
95	203.0	368.15	**275**	527.0	548.15
100	212.0	373.15	**280**	536.0	553.15
105	221.0	378.15	**285**	545.0	558.15
110	230.0	383.15	**290**	554.0	563.15

Celsius (°C)	Fahrenheit (°F)	Kelvin (K)
115	239.0	388.15
120	248.0	393.15
125	257.0	398.15

Celsius (°C)	Fahrenheit (°F)	Kelvin (K)
295	563.0	568.15
300	572.0	573.15

Reference points

Reference	Celsius (°C)	Fahrenheit (°F)	Kelvin (K)
Absolute zero	−273.15	−459.67	0
Celsius equals Fahrenheit	−40	−40	233.15
Water freezes	0	32	273.15
Room temperature	20	68	293.15
Body temperature	37	98.6	310.15
Water boils (sea level)	100	212	373.15

Sources and method

- **BIPM SI Brochure, 9th edition** — Definitions of the SI units, including the kelvin (www.bipm.org/en/publications/si-brochure)
- **NIST Special Publication 811** — Guide for the Use of the International System of Units (www.nist.gov/pml/special-publication-811)

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Energy Conversion Chart

Joules, kWh, calories, BTU and therms

For: Engineers, students, energy auditors and nutrition

allunitconversions.com/energy-conversion-chart
By Miguel Coelho · Edition 2.0
9 November 2026

EXACT DEFINITION	FORMULA	REVERSE	WORKED EXAMPLE
1 kWh = 3.6 MJ; 1 kcal = 4.184 kJ; 1 BTU = 1,055.055 852 62 J	MJ = kWh × 3.6; kJ = kcal × 4.184	kWh = MJ ÷ 3.6; kcal = kJ ÷ 4.184	1 therm = 100,000 BTU = 29.307 kWh

Matrix values use 6 significant figures. Calories are thermochemical (4.184 J); food labels use kcal.

Factor matrix — 1 unit in every other unit

1 unit =	J	kJ	MJ	kcal	Wh	kWh	BTU	thm
1 J	1	0.001	1×10^{-6}	2.39006×10^{-4}	2.77778×10^{-4}	2.77778×10^{-7}	9.47817×10^{-4}	9.47817×10^{-9}
1 kJ	1,000	1	0.001	0.239006	0.277778	2.77778×10^{-4}	0.947817	9.47817×10^{-6}
1 MJ	1×10^{6}	1,000	1	239.006	277.778	0.277778	947.817	0.00947817
1 kcal	4,184	4.184	0.004184	1	1.16222	0.00116222	3.96567	3.96567×10^{-5}
1 Wh	3,600	3.6	0.0036	0.860421	1	0.001	3.41214	3.41214×10^{-5}
1 kWh	3.6×10^{6}	3,600	3.6	860.421	1,000	1	3,412.14	0.0341214
1 BTU	1,055.06	1.05506	0.00105506	0.252164	0.293071	2.93071×10^{-4}	1	1×10^{-5}
1 thm	1.05506×10^{8}	105,506	105.506	25,216.4	29,307.1	29.3071	100,000	1

Kilowatt-hours to megajoules, BTU and therms

Kilowatt-hours (kWh)	Megajoules (MJ)	British thermal units (BTU)	Therms (thm)
1	3.6	3,412	0.034
2	7.2	6,824	0.068
3	10.8	10,236	0.102
4	14.4	13,649	0.136
5	18.0	17,061	0.171
6	21.6	20,473	0.205
7	25.2	23,885	0.239
8	28.8	27,297	0.273
9	32.4	30,709	0.307
10	36.0	34,121	0.341
15	54.0	51,182	0.512
20	72.0	68,243	0.682
25	90.0	85,304	0.853
50	180.0	170,607	1.706
100	360.0	341,214	3.412
250	900.0	853,035	8.530
500	1,800.0	1,706,071	17.061
1,000	3,600.0	3,412,142	34.121

Food energy: kilocalories to kilojoules

Kilocalories (kcal)	Kilojoules (kJ)
50	209
100	418

Kilocalories (kcal)	Kilojoules (kJ)
350	1,464
400	1,674

Kilocalories (kcal)	Kilojoules (kJ)
1,000	4,184
1,500	6,276

Kilocalories (kcal)	Kilojoules (kJ)
150	628
200	837
250	1,046
300	1,255

Kilocalories (kcal)	Kilojoules (kJ)
450	1,883
500	2,092
600	2,510
750	3,138

Kilocalories (kcal)	Kilojoules (kJ)
2,000	8,368
2,500	10,460
3,000	12,552

Sources and method

- **NIST Special Publication 811** — Guide for the Use of the International System of Units (www.nist.gov/pml/special-publication-811)
- **BIPM SI Brochure, 9th edition** — Definitions of the SI units, including the kelvin (www.bipm.org/en/publications/si-brochure)

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