

Conversion of units of temperature

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This is a compendium of temperature **conversion** formulas and comparisons among eight different temperature scales, several of which have long been obsolete.

Contents

- 1 Celsius (centigrade)
- 2 Fahrenheit
- 3 Kelvin
- 4 Rankine
- 5 Delisle
- 6 Newton
- 7 Réaumur
- 8 Römer
- 9 Comparison
- 10 Comparison of temperature scales
 - 10.1 Graphical representation
- 11 Conversion table between different temperature units
- 12 See also
- 13 Notes and references
- 14 External links

Celsius (centigrade)

	from Celsius	to Celsius
Fahrenheit	$[\text{°F}] = [\text{°C}] \times \frac{9}{5} + 32$	$[\text{°C}] = ([\text{°F}] - 32) \times \frac{5}{9}$
Kelvin	$[\text{K}] = [\text{°C}] + 273.15$	$[\text{°C}] = [\text{K}] - 273.15$
Rankine	$[\text{°R}] = ([\text{°C}] + 273.15) \times \frac{9}{5}$	$[\text{°C}] = ([\text{°R}] - 491.67) \times \frac{5}{9}$
Delisle	$[\text{°De}] = (100 - [\text{°C}]) \times \frac{3}{2}$	$[\text{°C}] = 100 - [\text{°De}] \times \frac{2}{3}$
Newton	$[\text{°N}] = [\text{°C}] \times \frac{33}{100}$	$[\text{°C}] = [\text{°N}] \times \frac{100}{33}$
Réaumur	$[\text{°Ré}] = [\text{°C}] \times \frac{4}{5}$	$[\text{°C}] = [\text{°Ré}] \times \frac{5}{4}$
Römer	$[\text{°Rø}] = [\text{°C}] \times \frac{21}{40} + 7.5$	$[\text{°C}] = ([\text{°Rø}] - 7.5) \times \frac{40}{21}$

Fahrenheit

	from Fahrenheit	to Fahrenheit
Celsius	$[\text{°C}] = ([\text{°F}] - 32) \times \frac{5}{9}$	$[\text{°F}] = [\text{°C}] \times \frac{9}{5} + 32$
Kelvin	$[\text{K}] = ([\text{°F}] + 459.67) \times \frac{5}{9}$	$[\text{°F}] = [\text{K}] \times \frac{9}{5} - 459.67$
Rankine	$[\text{°R}] = [\text{°F}] + 459.67$	$[\text{°F}] = [\text{°R}] - 459.67$
Delisle	$[\text{°De}] = (212 - [\text{°F}]) \times \frac{5}{6}$	$[\text{°F}] = 212 - [\text{°De}] \times \frac{6}{5}$
Newton	$[\text{°N}] = ([\text{°F}] - 32) \times \frac{11}{60}$	$[\text{°F}] = [\text{°N}] \times \frac{60}{11} + 32$
Réaumur	$[\text{°Ré}] = ([\text{°F}] - 32) \times \frac{4}{9}$	$[\text{°F}] = [\text{°Ré}] \times \frac{9}{4} + 32$
Römer	$[\text{°Rø}] = ([\text{°F}] - 32) \times \frac{7}{24} + 7.5$	$[\text{°F}] = ([\text{°Rø}] - 7.5) \times \frac{24}{7} + 32$

Kelvin

	from Kelvin	to Kelvin
Celsius	$[^{\circ}\text{C}] = [\text{K}] - 273.15$	$[\text{K}] = [^{\circ}\text{C}] + 273.15$
Fahrenheit	$[^{\circ}\text{F}] = [\text{K}] \times \frac{9}{5} - 459.67$	$[\text{K}] = ([^{\circ}\text{F}] + 459.67) \times \frac{5}{9}$
Rankine	$[^{\circ}\text{R}] = [\text{K}] \times \frac{9}{5}$	$[\text{K}] = [^{\circ}\text{R}] \times \frac{5}{9}$
Delisle	$[^{\circ}\text{De}] = (373.15 - [\text{K}]) \times \frac{3}{2}$	$[\text{K}] = 373.15 - [^{\circ}\text{De}] \times \frac{2}{3}$
Newton	$[^{\circ}\text{N}] = ([\text{K}] - 273.15) \times \frac{33}{100}$	$[\text{K}] = [^{\circ}\text{N}] \times \frac{100}{33} + 273.15$
Réaumur	$[^{\circ}\text{Ré}] = ([\text{K}] - 273.15) \times \frac{4}{5}$	$[\text{K}] = [^{\circ}\text{Ré}] \times \frac{5}{4} + 273.15$
Rømer	$[^{\circ}\text{Rø}] = ([\text{K}] - 273.15) \times \frac{21}{40} + 7.5$	$[\text{K}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{40}{21} + 273.15$

Rankine

	from Rankine	to Rankine
Celsius	$[^{\circ}\text{C}] = ([^{\circ}\text{R}] - 491.67) \times \frac{5}{9}$	$[^{\circ}\text{R}] = ([^{\circ}\text{C}] + 273.15) \times \frac{9}{5}$
Fahrenheit	$[^{\circ}\text{F}] = [^{\circ}\text{R}] - 459.67$	$[^{\circ}\text{R}] = [^{\circ}\text{F}] + 459.67$
Kelvin	$[\text{K}] = [^{\circ}\text{R}] \times \frac{5}{9}$	$[^{\circ}\text{R}] = [\text{K}] \times \frac{9}{5}$
Delisle	$[^{\circ}\text{De}] = (671.67 - [^{\circ}\text{R}]) \times \frac{5}{6}$	$[^{\circ}\text{R}] = 671.67 - [^{\circ}\text{De}] \times \frac{6}{5}$
Newton	$[^{\circ}\text{N}] = ([^{\circ}\text{R}] - 491.67) \times \frac{11}{60}$	$[^{\circ}\text{R}] = [^{\circ}\text{N}] \times \frac{60}{11} + 491.67$
Réaumur	$[^{\circ}\text{Ré}] = ([^{\circ}\text{R}] - 491.67) \times \frac{4}{9}$	$[^{\circ}\text{R}] = [^{\circ}\text{Ré}] \times \frac{9}{4} + 491.67$
Rømer	$[^{\circ}\text{Rø}] = ([^{\circ}\text{R}] - 491.67) \times \frac{7}{24} + 7.5$	$[^{\circ}\text{R}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{24}{7} + 491.67$

Delisle

	from Delisle	to Delisle
Celsius	$[^{\circ}\text{C}] = 100 - [^{\circ}\text{De}] \times \frac{2}{3}$	$[^{\circ}\text{De}] = (100 - [^{\circ}\text{C}]) \times \frac{3}{2}$
Fahrenheit	$[^{\circ}\text{F}] = 212 - [^{\circ}\text{De}] \times \frac{6}{5}$	$[^{\circ}\text{De}] = (212 - [^{\circ}\text{F}]) \times \frac{5}{6}$
Kelvin	$[\text{K}] = 373.15 - [^{\circ}\text{De}] \times \frac{2}{3}$	$[^{\circ}\text{De}] = (373.15 - [\text{K}]) \times \frac{3}{2}$
Rankine	$[^{\circ}\text{R}] = 671.67 - [^{\circ}\text{De}] \times \frac{6}{5}$	$[^{\circ}\text{De}] = (671.67 - [^{\circ}\text{R}]) \times \frac{5}{6}$
Newton	$[^{\circ}\text{N}] = 33 - [^{\circ}\text{De}] \times \frac{11}{50}$	$[^{\circ}\text{De}] = (33 - [^{\circ}\text{N}]) \times \frac{50}{11}$
Réaumur	$[^{\circ}\text{Ré}] = 80 - [^{\circ}\text{De}] \times \frac{8}{15}$	$[^{\circ}\text{De}] = (80 - [^{\circ}\text{Ré}]) \times \frac{15}{8}$
Rømer	$[^{\circ}\text{Rø}] = 60 - [^{\circ}\text{De}] \times \frac{7}{20}$	$[^{\circ}\text{De}] = (60 - [^{\circ}\text{Rø}]) \times \frac{20}{7}$

Newton

	from Newton	to Newton
Celsius	$[^{\circ}\text{C}] = [^{\circ}\text{N}] \times \frac{100}{33}$	$[^{\circ}\text{N}] = [^{\circ}\text{C}] \times \frac{33}{100}$
Fahrenheit	$[^{\circ}\text{F}] = [^{\circ}\text{N}] \times \frac{60}{11} + 32$	$[^{\circ}\text{N}] = ([^{\circ}\text{F}] - 32) \times \frac{11}{60}$
Kelvin	$[\text{K}] = [^{\circ}\text{N}] \times \frac{100}{33} + 273.15$	$[^{\circ}\text{N}] = ([\text{K}] - 273.15) \times \frac{33}{100}$
Rankine	$[^{\circ}\text{R}] = [^{\circ}\text{N}] \times \frac{60}{11} + 491.67$	$[^{\circ}\text{N}] = ([^{\circ}\text{R}] - 491.67) \times \frac{11}{60}$
Delisle	$[^{\circ}\text{De}] = (33 - [^{\circ}\text{N}]) \times \frac{50}{11}$	$[^{\circ}\text{N}] = 33 - [^{\circ}\text{De}] \times \frac{11}{50}$
Réaumur	$[^{\circ}\text{Ré}] = [^{\circ}\text{N}] \times \frac{80}{33}$	$[^{\circ}\text{N}] = [^{\circ}\text{Ré}] \times \frac{33}{80}$
Rømer	$[^{\circ}\text{Rø}] = [^{\circ}\text{N}] \times \frac{35}{22} + 7.5$	$[^{\circ}\text{N}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{22}{35}$

Réaumur

	from Réaumur	to Réaumur
Celsius	$[^{\circ}\text{C}] = [^{\circ}\text{Ré}] \times \frac{5}{4}$	$[^{\circ}\text{Ré}] = [^{\circ}\text{C}] \times \frac{4}{5}$
Fahrenheit	$[^{\circ}\text{F}] = [^{\circ}\text{Ré}] \times \frac{9}{4} + 32$	$[^{\circ}\text{Ré}] = ([^{\circ}\text{F}] - 32) \times \frac{4}{9}$
Kelvin	$[\text{K}] = [^{\circ}\text{Ré}] \times \frac{5}{4} + 273.15$	$[^{\circ}\text{Ré}] = ([\text{K}] - 273.15) \times \frac{4}{5}$
Rankine	$[^{\circ}\text{R}] = [^{\circ}\text{Ré}] \times \frac{9}{4} + 491.67$	$[^{\circ}\text{Ré}] = ([^{\circ}\text{R}] - 491.67) \times \frac{4}{9}$
Delisle	$[^{\circ}\text{De}] = (80 - [^{\circ}\text{Ré}]) \times \frac{15}{8}$	$[^{\circ}\text{Ré}] = 80 - [^{\circ}\text{De}] \times \frac{8}{15}$
Newton	$[^{\circ}\text{N}] = [^{\circ}\text{Ré}] \times \frac{33}{80}$	$[^{\circ}\text{Ré}] = [^{\circ}\text{N}] \times \frac{80}{33}$
Rømer	$[^{\circ}\text{Rø}] = [^{\circ}\text{Ré}] \times \frac{21}{32} + 7.5$	$[^{\circ}\text{Ré}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{32}{21}$

Rømer

	from Rømer	to Rømer
Celsius	$[^{\circ}\text{C}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{40}{21}$	$[^{\circ}\text{Rø}] = [^{\circ}\text{C}] \times \frac{21}{40} + 7.5$
Fahrenheit	$[^{\circ}\text{F}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{24}{7} + 32$	$[^{\circ}\text{Rø}] = ([^{\circ}\text{F}] - 32) \times \frac{7}{24} + 7.5$
Kelvin	$[\text{K}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{40}{21} + 273.15$	$[^{\circ}\text{Rø}] = ([\text{K}] - 273.15) \times \frac{21}{40} + 7.5$
Rankine	$[^{\circ}\text{R}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{24}{7} + 491.67$	$[^{\circ}\text{Rø}] = ([^{\circ}\text{R}] - 491.67) \times \frac{7}{24} + 7.5$
Delisle	$[^{\circ}\text{De}] = (60 - [^{\circ}\text{Rø}]) \times \frac{20}{7}$	$[^{\circ}\text{Rø}] = 60 - [^{\circ}\text{De}] \times \frac{7}{20}$
Newton	$[^{\circ}\text{N}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{22}{35}$	$[^{\circ}\text{Rø}] = [^{\circ}\text{N}] \times \frac{35}{22} + 7.5$
Réaumur	$[^{\circ}\text{Ré}] = ([^{\circ}\text{Rø}] - 7.5) \times \frac{32}{21}$	$[^{\circ}\text{Rø}] = [^{\circ}\text{Ré}] \times \frac{21}{32} + 7.5$

Comparison

Celsius	Fahrenheit	Kelvin	Rankine	Delisle	Newton	Réaumur	Rømer
500.00	932.00	773.15	1391.67	−600.00	165.00	400.00	270.00
490.00	914.00	763.15	1373.67	−585.00	161.70	392.00	264.75
480.00	896.00	753.15	1355.67	−570.00	158.40	384.00	259.50
470.00	878.00	743.15	1337.67	−555.00	155.10	376.00	254.25
460.00	860.00	733.15	1319.67	−540.00	151.80	368.00	249.00
450.00	842.00	723.15	1301.67	−525.00	148.50	360.00	243.75
440.00	824.00	713.15	1283.67	−510.00	145.20	352.00	238.50
430.00	806.00	703.15	1265.67	−495.00	141.90	344.00	233.25
420.00	788.00	693.15	1247.67	−480.00	138.60	336.00	228.00
410.00	770.00	683.15	1229.67	−465.00	135.30	328.00	222.75
400.00	752.00	673.15	1211.67	−450.00	132.00	320.00	217.50
390.00	734.00	663.15	1193.67	−435.00	128.70	312.00	212.25
380.00	716.00	653.15	1175.67	−420.00	125.40	304.00	207.00
370.00	698.00	643.15	1157.67	−405.00	122.10	296.00	201.75
360.00	680.00	633.15	1139.67	−390.00	118.80	288.00	196.50
350.00	662.00	623.15	1121.67	−375.00	115.50	280.00	191.25
340.00	644.00	613.15	1103.67	−360.00	112.20	272.00	186.00
330.00	626.00	603.15	1085.67	−345.00	108.90	264.00	180.75
320.00	608.00	593.15	1067.67	−330.00	105.60	256.00	175.50
310.00	590.00	583.15	1049.67	−315.00	102.30	248.00	170.25
300.00	572.00	573.15	1031.67	−300.00	99.00	240.00	165.00
290.00	554.00	563.15	1013.67	−285.00	95.70	232.00	159.75
280.00	536.00	553.15	995.67	−270.00	92.40	224.00	154.50
270.00	518.00	543.15	977.67	−255.00	89.10	216.00	149.25
260.00	500.00	533.15	959.67	−240.00	85.80	208.00	144.00
250.00	482.00	523.15	941.67	−225.00	82.50	200.00	138.75
240.00	464.00	513.15	923.67	−210.00	79.20	192.00	133.50
230.00	446.00	503.15	905.67	−195.00	75.90	184.00	128.25
220.00	428.00	493.15	887.67	−180.00	72.60	176.00	123.00
210.00	410.00	483.15	869.67	−165.00	69.30	168.00	117.75
200.00	392.00	473.15	851.67	−150.00	66.00	160.00	112.50
190.00	374.00	463.15	833.67	−135.00	62.70	152.00	107.25
180.00	356.00	453.15	815.67	−120.00	59.40	144.00	102.00
170.00	338.00	443.15	797.67	−105.00	56.10	136.00	96.75
160.00	320.00	433.15	779.67	−90.00	52.80	128.00	91.50
150.00	302.00	423.15	761.67	−75.00	49.50	120.00	86.25
140.00	284.00	413.15	743.67	−60.00	46.20	112.00	81.00
130.00	266.00	403.15	725.67	−45.00	42.90	104.00	75.75
120.00	248.00	393.15	707.67	−30.00	39.60	96.00	70.50
110.00	230.00	383.15	689.67	−15.00	36.30	88.00	65.25
100.00	212.00	373.15	671.67	0.00	33.00	80.00	60.00
90.00	194.00	363.15	653.67	15.00	29.70	72.00	54.75
80.00	176.00	353.15	635.67	30.00	26.40	64.00	49.50
70.00	158.00	343.15	617.67	45.00	23.10	56.00	44.25
60.00	140.00	333.15	599.67	60.00	19.80	48.00	39.00
50.00	122.00	323.15	581.67	75.00	16.50	40.00	33.75
40.00	104.00	313.15	563.67	90.00	13.20	32.00	28.50
30.00	86.00	303.15	545.67	105.00	9.90	24.00	23.25

20.00	68.00	293.15	527.67	120.00	6.60	16.00	18.00
10.00	50.00	283.15	509.67	135.00	3.30	8.00	12.75
0.00	32.00	273.15	491.67	150.00	0.00	0.00	7.50
−10.00	14.00	263.15	473.67	165.00	−3.30	−8.00	2.25
−20.00	−4.00	253.15	455.67	180.00	−6.60	−16.00	−3.00
−30.00	−22.00	243.15	437.67	195.00	−9.90	−24.00	−8.25
−40.00	−40.00	233.15	419.67	210.00	−13.20	−32.00	−13.50
−50.00	−58.00	223.15	401.67	225.00	−16.50	−40.00	−18.75
−60.00	−76.00	213.15	383.67	240.00	−19.80	−48.00	−24.00
−70.00	−94.00	203.15	365.67	255.00	−23.10	−56.00	−29.25
−80.00	−112.00	193.15	347.67	270.00	−26.40	−64.00	−34.50
−90.00	−130.00	183.15	329.67	285.00	−29.70	−72.00	−39.75
−100.00	−148.00	173.15	311.67	300.00	−33.00	−80.00	−45.00
−110.00	−166.00	163.15	293.67	315.00	−36.30	−88.00	−50.25
−120.00	−184.00	153.15	275.67	330.00	−39.60	−96.00	−55.50
−130.00	−202.00	143.15	257.67	345.00	−42.90	−104.00	−60.75
−140.00	−220.00	133.15	239.67	360.00	−46.20	−112.00	−66.00
−150.00	−238.00	123.15	221.67	375.00	−49.50	−120.00	−71.25
−160.00	−256.00	113.15	203.67	390.00	−52.80	−128.00	−76.50
−170.00	−274.00	103.15	185.67	405.00	−56.10	−136.00	−81.75
−180.00	−292.00	93.15	167.67	420.00	−59.40	−144.00	−87.00
−190.00	−310.00	83.15	149.67	435.00	−62.70	−152.00	−92.25
−200.00	−328.00	73.15	131.67	450.00	−66.00	−160.00	−97.50
−210.00	−346.00	63.15	113.67	465.00	−69.30	−168.00	−102.75
−220.00	−364.00	53.15	95.67	480.00	−72.60	−176.00	−108.00
−230.00	−382.00	43.15	77.67	495.00	−75.90	−184.00	−113.25
−240.00	−400.00	33.15	59.67	510.00	−79.20	−192.00	−118.50
−250.00	−418.00	23.15	41.67	525.00	−82.50	−200.00	−123.75
−260.00	−436.00	13.15	23.67	540.00	−85.80	−208.00	−129.00
−270.00	−454.00	3.15	5.67	555.00	−89.10	−216.00	−134.25
−273.15	−459.67	0.00	0.00	559.725	−90.1395	−218.52	−135.90375
Celsius	Fahrenheit	Kelvin	Rankine	Delisle	Newton	Réaumur	Rømer

Comparison of temperature scales

Comparison of temperature scales

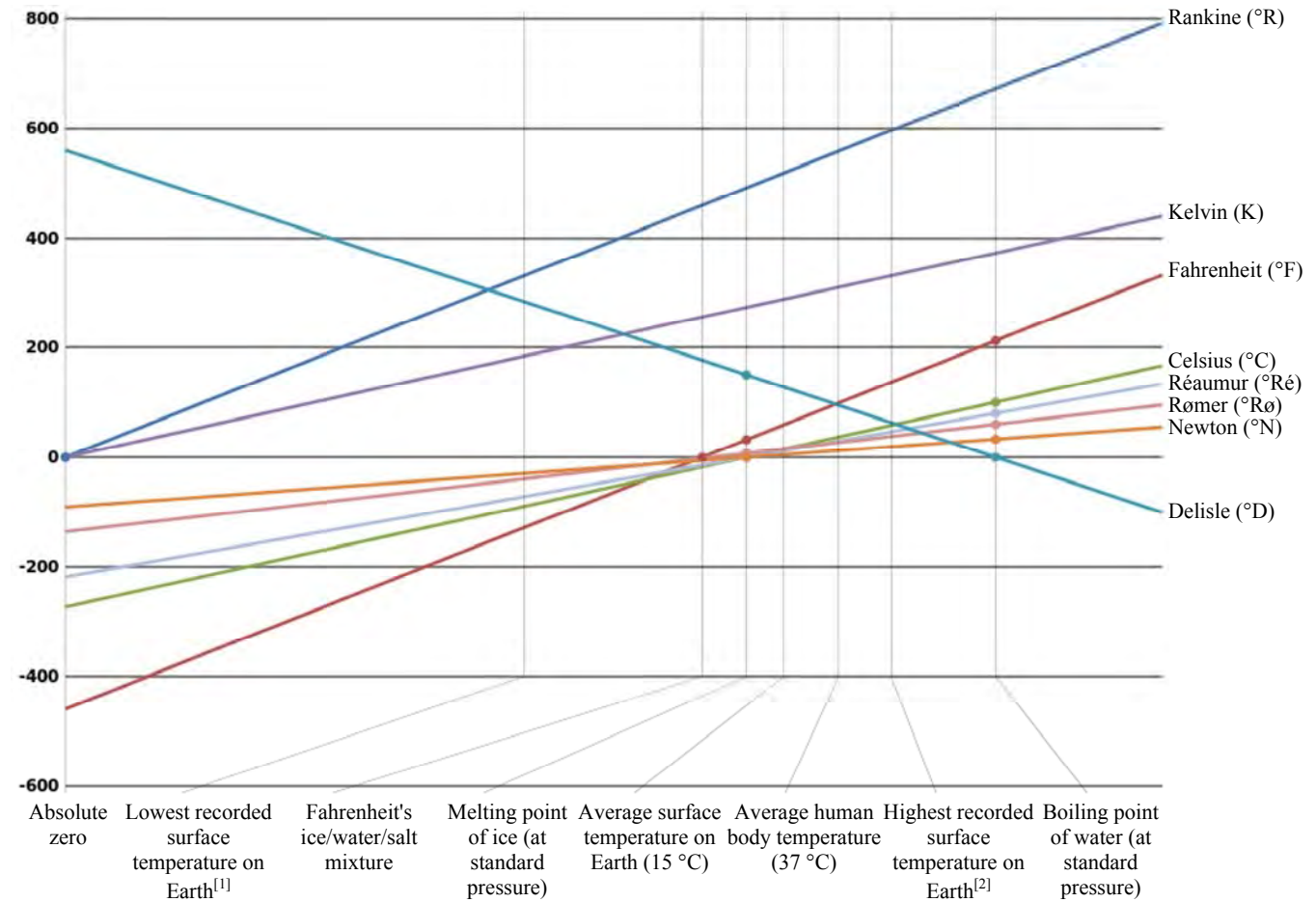
Comment	Kelvin	Celsius	Fahrenheit	Rankine	Delisle	Newton	Réaumur	Rømer
Absolute zero	0.00	−273.15	−459.67	0.00	559.73	−90.14	−218.52	−135.90
Lowest recorded surface temperature on Earth ^[1]	184	−89.2 ^[1]	−128.6 ^[1]	331	284	−29	−71	−39
Fahrenheit's ice/salt mixture	255.37	−17.78	0.00	459.67	176.67	−5.87	−14.22	−1.83
Ice melts (at standard pressure)	273.15	0.00	32.00	491.67	150.00	0.00	0.00	7.50
Triple point of water	273.16	0.01	32.018	491.688	149.985	0.0033	0.008	7.50525
Average surface temperature on Earth	288	15	59	519	128	5	12	15
Average human body temperature*	310	37	98	558	95	12	29	27
Highest recorded surface temperature on Earth ^[2]	331	58 ^[2]	136.4 ^[2]	596	63	19	46	38
Water boils (at standard pressure)	373.1339 ^[3]	99.9839 ^[3]	211.97102 ^[4]	671.64102 ^[4]	0.00	33.00	80.00	60.00
Titanium melts	1941	1668	3034	3494	−2352	550	1334	883
The surface of the Sun	5800	5500	9900	10400	−8100	1800	4400	2900

* Normal human body temperature is 36.8 °C ±0.7 °C, or 98.2 °F ±1.3 °F. The commonly given value 98.6 °F is simply the exact conversion of the nineteenth-

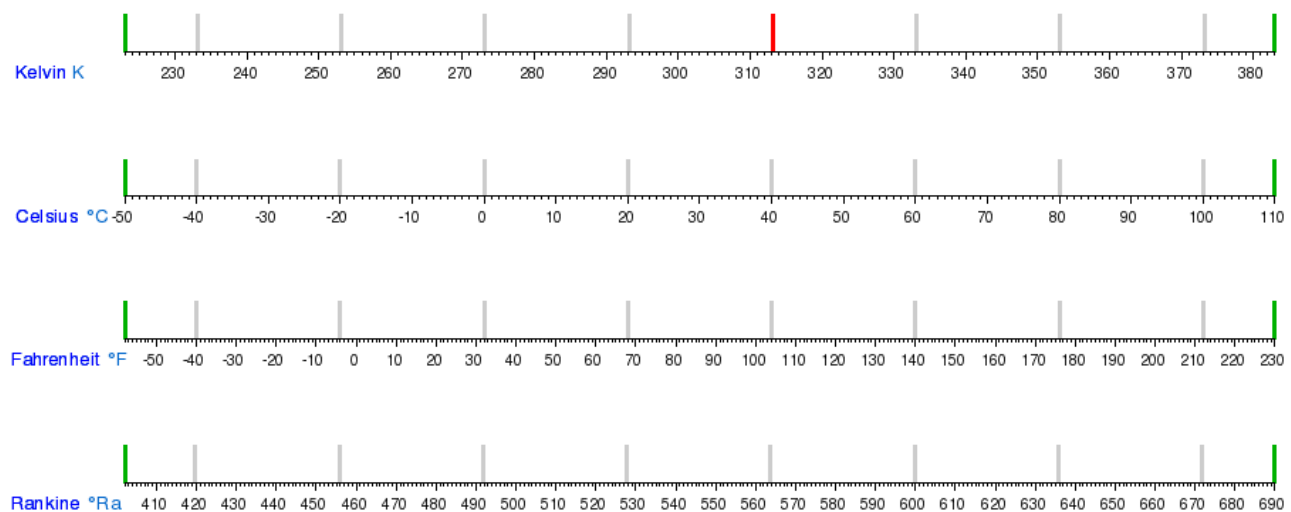
century German standard of 37 °C. Since it does not list an acceptable range, it could therefore be said to have excess (invalid) precision.^[5]

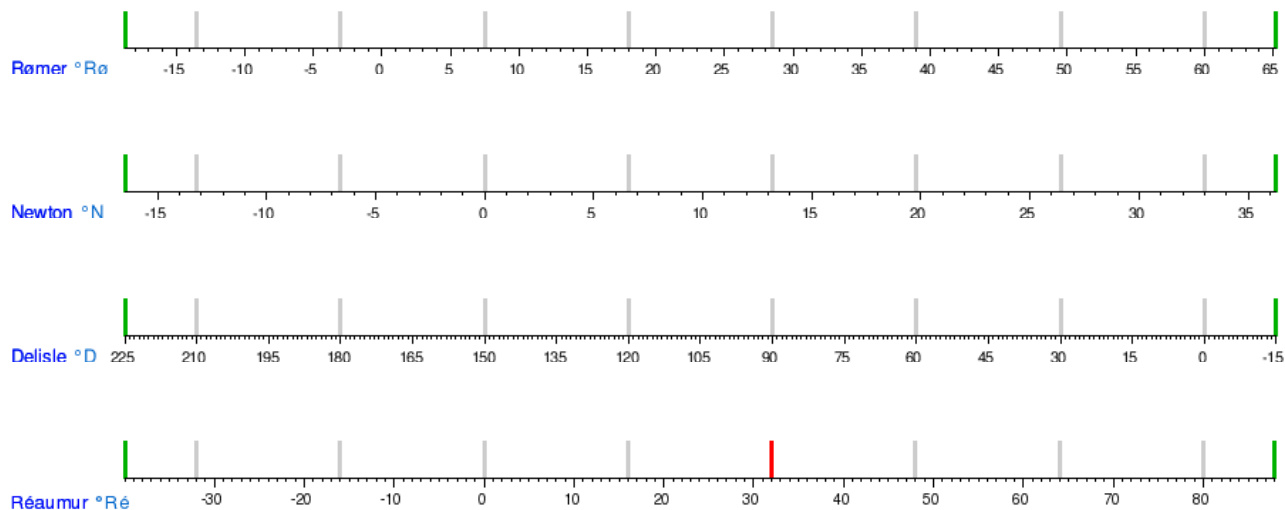
Some numbers in this table have been rounded.

Graphical representation



Conversion table between different temperature units





313.15 K = 40 °C = 104 °F = 563.67 °Ra = 28.5 °Rø = 13.2 °N = 90 °D = 32 °Ré

See also

- Degrees of frost
- Conversion of units
- Gas Mark

Notes and references

1. The Coldest Inhabited Places on Earth (<https://www.expertsure.com/2008/12/14/the-coldest-inhabited-places-on-earth/>); researches of the Vostok Station recorded the coldest known temperature on Earth on July 21st 1983: −89.2 °C (−128.6 °F).
2. World: Highest Temperature (<http://wmo.asu.edu/world-highest-temperature>) Archived (<https://web.archive.org/web/20130104143844/http://wmo.asu.edu/world-highest-temperature>) January 4, 2013, at the Wayback Machine.; an Italian weather station in al 'Aziziyah (Libya) measured a temperature of 58 °C (136.4 °F) on September 13th 1922. *"Although this record has gained general acceptance as the world's highest temperature recorded under standard conditions, the validity of the extreme has been questioned."*
3. <http://chemistry.uah.edu/Faculty/shriver/supplements/Temperature%20scales.pdf> The University of Alabama in Huntsville - Temperature scales – Celsius, centigrade, and kelvin
4. <http://www.tampile.com/scales.php> Tampile - Temperature Conversion Scales
5. "Temperature of a Healthy Human (Body Temperature)". Hypertextbook.com. Retrieved 2010-09-16.

External links

- Online temperature conversions for 70 different scales (<http://www.curiousnotions.com/temperature-conversion/>)

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Categories: Units of temperature | Conversion of units of measurement

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