

1. International System of Units and Usage

- 1-1. Scope of Application** This standard specifies how to use the International System of Units (SI) and other international unitary systems, as well as units used in correlation with units from international systems, and other units which may be used.
- 1-2. Terms and Definitions** Terminology used in this specification and definitions thereof are as follows :
- (1) **International System of Units** Coherent system of units adopted and recommended by the International Committee on Weights and Measures. It contains base units and supplementary units, units derived from them and their integral exponents to the 10th power. SI is the abbreviation of *Système International d'Unités* (International System of Units).
 - (2) **SI Units** Generic term used to describe base units, supplementary units or derived units of the International System of Units (SI).
 - (3) **Base Units** Those units given in **Table 1**.
 - (4) **Supplementary Units** Those units given in **Table 2**.

Table 1. Base Units

Base Quantity	Unit	Symbol	Definition
Length	Meter	m	A meter is the length of the path traveled by light in a vacuum during a time interval of $\frac{1}{299\,792\,458}$ of a second.
Mass	Kilogram	kg	A kilogram is a unit of mass (not weight nor force); it is equal to the mass of the international prototype of the kilogram.
Time	Second	s	A second is the duration of 9 192 631 770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom.
Current	Ampere	A	An ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 meter apart in a vacuum, would produce between these conductors a force equal to 2×10^{-7} Newton per meter of length.
Thermodynamic Temperature	Kelvin	K	Kelvin, a unit of thermodynamic temperature, is the fraction $\frac{1}{273.16}$ of the thermodynamic temperature of the triple point of water.
Amount of Substance	Mole	mol	A mole is the amount of substance of a system that contains as many elementary particles ⁽¹⁾ or aggregation of elementary particles as there are atoms in 0.012 kilogram of carbon 12 and when the mole is used, the elementary particles must be specified.
Luminous Intensity	Candela	cd	A candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of $\frac{1}{683}$ watt per steradian.

Note (1): The elementary particles here must be atoms, molecules, ions, electrons or other particles.

Table 2. Supplementary Unit

Base Quantity	Unit	Symbol	Definition
Plane Angle	Radian	rad	A radian is the plane angle between two radii of a circle that cuts off an arc on the circumference equal in length to the radius.
Solid Angle	Steradian	sr	A steradian is the solid angle which, having its vertex in the center of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides equal in length to the radius of the sphere.

(5) **Derived Units** The units algebraically expressed using mathematical symbols such as plus, minus, etc. The SI derived units with special names and symbols are given in **Table 3**.

Examples of SI Derived Units Expressed in Terms of Base Units

Base Quantity	Derived Units	
	Unit	Symbol
Area	Square	m ²
Volume	Cubic	m ³
Velocity	Meter/Second	m/s
Acceleration	Meter/Second ²	m/s ²
Wave Number	Every Meter	m ⁻¹
Density	Kilogram Every Cubic Meter	kg/m ³
Current Density	Ampere Every Square Meter	A/m ²
Magnetic Field Strength	Ampere Every Meter	A/m
Concentration of Substance	Mole Every Cubic Meter	mol/m ³
Specific Volume	Cubic Meter Every Kilogram	m ³ /kg
Luminance	Candela Every Square Meter	cd/m ²

Table 3: SI Derived Units with Special Names and Symbols

Base Quantity	SI Derived Units		Expression in Terms of Base Units or Supplementary Units, Supplementary Units or other SI Units
	Unit	Symbol	
Frequency	Hertz	Hz	1 Hz = 1 s ⁻¹
Force	Newton	N	1 N = 1 kg · m/s ²
Pressure, Stress	Pascal	Pa	1 Pa = 1 N/m ²
Energy, Work, Heat Quantity	Joule	J	1 J = 1 N · m
Work Rate, Process Rate, Power, Electric Power	Watt	W	1 W = 1 J/s
Electric Charge, Quantity of Electricity	Coulomb	C	1 C = 1 A · s
Electric Potential, Potential Difference, Voltage, Electromotive Force	Volts	V	1 V = 1 J/C
Electrostatic Capacity, Capacitance	Farad	F	1 F = 1 C/V
Electric Resistance	Ohm	Ω	1 Ω = 1 V/A
Conductance	Siemens	S	1 S = 1 Ω ⁻¹
Magnetic Flux	Weber	Wb	1 Wb = 1 V · s
Magnetic Flux Density	Tesla	T	1 T = 1 Wb/m ²
Inductance	Henry	H	1 H = 1 Wb/A
Celsius Temperature	Degree Celsius or Degree	°C	1 °C = (t+273.15)K
Luminous Flux	Lumen	lm	1 lm = 1 cd · sr
Illuminance	Lux	lx	1 lx = 1 lm/m ²
Radioactivity	Becquerel	Bq	1 Bq = 1 s ⁻¹
Absorbed Dose	Gray	Gy	1 Gy = 1 J/kg
Dose Equivalent	Sievert	Sv	1 Sv = 1 J/kg

1-3 Multiples of 10 of SI Units

Prefixes : The multiples and the names and symbols of prefixes to express integer multiples of 10 in SI Units are shown in **Table 4**.

Table 4. Prefixes

Multiples of Unit	Prefix		Multiples of Unit	Prefix		Multiples of Unit	Prefix	
	Name	Symbol		Name	symbol		Name	symbol
10 ¹⁸	Exsa	E	10 ²	Hecto	h	10 ⁻⁹	Nano	n
10 ¹⁵	Peta	P	10 ¹	Deca	da	10 ⁻¹²	Pico	p
10 ¹²	Tera	T	10 ⁻¹	Deci	d	10 ⁻¹⁵	Femto	f
10 ⁹	Giga	G	10 ⁻²	Centi	c	10 ⁻¹⁸	Atto	a
10 ⁶	Mega	M	10 ⁻³	Milli	m			
10 ³	Kilo	k	10 ⁻⁶	Micro	μ			

2. Conversion Tables for SI and Conventional Units

(The units enclosed by thick lines are the SI units.)

Force	N	dyn	kgf
	1	1 × 10 ⁵	1.019 72 × 10 ⁻¹
	1 × 10 ⁻⁵	1	1.019 72 × 10 ⁻⁶
	9.806 65	9.806 65 × 10 ⁵	1

Viscosity	Pa · s	cP	P
	1	1 × 10 ³	1 × 10
	1 × 10 ⁻³	1	1 × 10 ⁻²
	1 × 10 ⁻¹	1 × 10 ²	1

Note) 1P = 1 dyn · s/cm² = 1g/cm · s
1Pa · s = 1N · s/m², 1cP = 1mPa · s

Stress	Pa or N/m ²	MPa or N/mm ²	kgf/mm ²	kgf/cm ²
	1	1 × 10 ⁻⁶	1.019 72 × 10 ⁻⁷	1.019 72 × 10 ⁻⁵
	1 × 10 ⁶	1	1.019 72 × 10 ⁻¹	1.019 72 × 10
	9.806 65 × 10 ⁶	9.806 65	1	1 × 10 ²
	9.806 65 × 10 ⁴	9.806 65 × 10 ⁻²	1 × 10 ⁻²	1

Kinematic Viscosity	m ² /s	cSt	St
	1	1 × 10 ⁶	1 × 10 ⁴
	1 × 10 ⁻⁶	1	1 × 10 ⁻²
	1 × 10 ⁻⁴	1 × 10 ²	1

Note) 1St = 1cm²/s, 1cSt = 1mm²/s

Note) 1Pa = 1N/m², 1MPa = 1N/mm²

Pressure	Pa	kPa	MPa	bar	kgf/cm ²	atm	mmHg ₀	mmHg ₀ or Torr
	1	1 × 10 ⁻³	1 × 10 ⁻⁶	1 × 10 ⁻⁵	1.019 72 × 10 ⁻⁵	9.869 23 × 10 ⁻⁶	1.019 72 × 10 ⁻¹	7.500 62 × 10 ⁻³
	1 × 10 ³	1	1 × 10 ⁻³	1 × 10 ⁻²	1.019 72 × 10 ⁻²	9.869 23 × 10 ⁻³	1.019 72 × 10 ²	7.500 62
	1 × 10 ⁶	1 × 10 ³	1	1 × 10	1.019 72 × 10	9.869 23	1.019 72 × 10 ⁵	7.500 62 × 10 ³
	1 × 10 ⁵	1 × 10 ²	1 × 10 ⁻¹	1	1.019 72	9.869 23 × 10 ⁻¹	1.019 72 × 10 ⁴	7.500 62 × 10 ²
	9.806 65 × 10 ⁴	9.806 65 × 10	9.806 65 × 10 ⁻²	9.806 65 × 10 ⁻¹	1	9.678 41 × 10 ⁻¹	1 × 10 ⁴	7.355 59 × 10 ²
	1.013 25 × 10 ⁵	1.013 25 × 10 ²	1.013 25 × 10 ⁻¹	1.013 25	1.033 23	1	1.033 23 × 10 ⁴	7.600 00 × 10 ²
	9.806 65	9.806 65 × 10 ⁻³	9.806 65 × 10 ⁻⁶	9.806 65 × 10 ⁻⁵	1 × 10 ⁻⁴	9.678 41 × 10 ⁻⁵	1	7.355 59 × 10 ⁻²
1.333 22 × 10 ²	1.333 22 × 10 ⁻¹	1.333 22 × 10 ⁻⁴	1.333 22 × 10 ⁻³	1.359 51 × 10 ⁻³	1.315 79 × 10 ⁻³	1.359 51 × 10	1	

Note) 1Pa = 1N/m²

Work, Energy, Heat Quantity	J	kW · h	kgf · m	kcal
	1	2.777 78 × 10 ⁻⁷	1.019 72 × 10 ⁻¹	2.388 89 × 10 ⁻⁴
	3.600 × 10 ⁶	1	3.670 98 × 10 ⁵	8.600 0 × 10 ²
	9.806 65	2.724 07 × 10 ⁻⁶	1	2.342 70 × 10 ⁻³
	4.186 05 × 10 ³	1.162 79 × 10 ⁻³	4.268 58 × 10 ²	1

Note) 1J = 1W · s, 1J = 1N · m

Power, Heat Flow	W	kgf · m/s	PS	kcal/h
	1	1.019 72 × 10 ⁻¹	1.359 62 × 10 ⁻³	8.600 0 × 10 ⁻¹
	9.806 65	1	1.333 33 × 10 ⁻²	8.433 71
	7.355 × 10 ²	7.5 × 10	1	6.325 29 × 10 ²
	1.162 79	1.185 72 × 10 ⁻¹	1.580 95 × 10 ⁻³	1

Note) 1W = 1J/s, PS : French Horsepower

Thermal Conductivity	W/(m · K)	kcal/(h · m · °C)
	1	8.600 0 × 10 ⁻¹
	1.162 79	1

Coefficient of Heat Transfer	W/(m ² · K)	kcal/(h · m ² · °C)
	1	8.600 0 × 10 ⁻¹
	1.162 79	1

Specific Heat	J/(kg · K)	kcal/(kg · °C)
	1	2.388 89 × 10 ⁻⁴
	4.186 05 × 10 ³	1