SI(Système International d'Unités)

Excerpt from JIS Z 8203(1985)

1. International units SI and the method of use

1—1. Sphere 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 made be used.

1—2. Terminology and definitions Terminology used in this specification and definitions thereof are as follows

(1) **International System of Units (SI)** 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 Systeme International d'Unites (International System of Units).

(2) **SI unit** Generic term used to describe base units, supplementary units or derived units of the International System of Units (SI).

(3) **Base unit** Those units given in Table 1.

(4) **Supplementary unit** Those units given in Table 2.

Table 1. Base unit

Volume	Unit	Sign	Definition
Length	Meter	m	The meter is the distance light travels in $\frac{1}{299,792,458}$ of a second in a vacuum.
Mass	Kilogram	kg	The kilogram is a unit of mass (not weight nor force), equal to the mass of an international prototype stored in Sevres, France.
Time	Second	s	The second is a fundamental unit of time, equal to 9,192,631,770 periods of radiation corresponding to the transition between two superfine levels of the ground state of an atom of cesium-133.
Electric current	Ampere	A	The ampere is a unit of electric current, defined as a 2×10^{-7} newton force of attraction exerted at 1 meter intervals between two parallel current-carrying linear conductors that are infinitely small in circular cross-sectional area and infinitely long in length.
Thermodynamic temperature	Kelvin	K	The kelvin is a unit of absolute temperature equal to $\frac{1}{273.16}$ of the absolute temperature of the triple point of water.
Amount of substance	Mole	mol	The mole is the amount of substance of a system (with a specific composition) which contains as many elementary units (1) as there are atoms of carbon in 0.012 kilogram of pure nuclide carbon 12. The mole is used to specify both the elementary unit and system.
Luminous intensity	Candela	cd	The candela is a unit of luminous intensity, defined as the luminous intensity of a steradian light source which emits a monochrome radiation at a frequency of 540×10^{12}, in a specified direction and at a force equal to $\frac{1}{683}$ watts.

Note(1) The elementary unit must be specified and must be an atom, molecule, ion, electron, photon or a specified group of such units.

Table 2. Supplementary unit

Volume	Unit	Sign	Definition
Plane angle	Radian	rad	The radian is a unit of plane angle, defined as the central angle of a circle determined by two radii and an arc joining them, all of the same length.
Solid angle	Steradian	sr	The steradian is the unit of measurement for solid angles, equal to the solid angle subtended center of a sphere by a portion of the surface of the sphere whose area equals the square of the sphere's radius.

(5) **Derived units** The units of derived quantity in International units. Those are expressed algebraically in terms of the base units and supplementary units. Besides, the derived units that have proper names are shown in Table 3.

Example of the units derived from the base units

Volume	Derived units	
	Name	Symbol
Area	Square	m^2
Volume	Cubic	m^3
Velocity	Meter/second	m/s
Acceleration	Meter/second^2	m/s^2
Wave numbers	Every meter	m^{-1}
Density	Kilogram every cubic meter	kg/m^3
Electric 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. The derived units having proper names

Volume	Derived units		Expressing method by derived unit or supplementary unit/others
	Name	Symbol	
Frequency	Herz	Hz	1 Hz$=1s^{-1}$
Force	Newton	N	1 N$=1kg\cdot m/s^2$
Pressure, stress	Pascal	Pa	1 Pa$=1N/m^2$
Energy, work, heat	Joule	J	1 J$=1N\cdot m$
Work rate, process rate, power, electric power	Watt	W	1 W=1J/s
Electric charge, quantity of electricity	Coulomb	C	1 C$=1A\cdot s$
Potential, potential difference, voltage, electromotive force	Bolt	V	1 V=1J/C
Electrostatic capacity, capacitance	Farad	F	1 F=1C/V
Electric resistance	Ohm	Ω	1 Ω=1V/A
Conductance	Siemens	S	1 S$=1\Omega^{-1}$
Magnetic flux	Weber	Wb	1 Wb$=1V\cdot s$
Magnetic flux density, magnetic induction	Tesla	T	1 T$=1Wb/m^2$
Inductance	Henry	H	1 H=1Wb/A
Celsius temperature	Celsius degree or Degree	℃	1 t=(t+273.15)K
Light flux	Lumen	lm	1 lm$=1cd\cdot sr$
Illumination	Lux	lx	1 lx$=1lm/m^2$
Radioactivity	Becquerel	Bq	1 Bq$=1s^{-1}$
Quantity of absorption radio	Gray	Gy	1 Gy=1J/kg
Radio equivalent	Sievert	Sv	1 Sv=1J/kg

1—3. Integral multiplication in SI units

(1) **Prefixes** The multiple for composing the integral multiplication of 10 in SI units, names of prefixed and their symbols are shown in Table 4.

Table 4. Prefixes

Multiple to be combined with unit	Prefixes		Multiple to be combined with unit	Prefixes		Multiple to be combined with unit	Prefixes	
	Name	Symbol		Name	Symbol		Name	Symbol
10^{18}	Exsa	E	10^2	Hect	h	10^{-9}	Nano	n
10^{15}	Peta	P	10	Deca	da	10^{-12}	Pico	p
10^{12}	Tera	T	10^{-1}	Deci	d	10^{-15}	Femt	f
10^9	Giga	G	10^{-2}	Centi	c	10^{-18}	Ato	a
10^6	Mega	M	10^{-3}	Milli	m			
10^3	Kilo	k	10^{-6}	Micro	μ			

2. Table of conversion rate of JIS units attendant upon switchover to SI units

(The units contained in bold lines are SI units.)

Force

N	dyn	kgf
1	1×10^5	$1.019\ 72\times10^{-1}$
1×10^{-5}	1	$1.019\ 72\times10^{-6}$
9.806 65	$9.806\ 65\times10^5$	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) 1 P $=1$ dyn·s/cm^2 $=1$ g/cm·s
1 Pa·s $=1$ N·S/m^2, 1 cP=1mPa·s

Stress

Pa or N/m^2	**MPa or N/mm^2**	kgf/mm^2	kgf/cm^2
1	1×10^{-6}	$1.019\ 72\times10^{-7}$	$1.019\ 72\times10^{-5}$
1×10^6	1	$1.019\ 72\times10^{-1}$	$1.019\ 72\times10$
$9.806\ 65\times10^6$	9.806 65	1	1×10^2
$9.806\ 65\times10^4$	$9.806\ 65\times10^{-2}$	1×10^{-2}	1

Note) 1 Pa=1 N/m^2, 1Mpa N/mm^2

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) 1 St=1cm^2/s, 1 cSt=1mm /S^2

Pressure

Pa	**kPa**	**MPa**	bar	kgf/cm^2	atm	mmH$_2$0	mmHg or Torr
1	1×10^{-3}	1×10^{-6}	1×10^{-5}	$1.019\ 72\times10^{-5}$	$9.869\ 23\times10^{-6}$	$1.019\ 72\times10^{-1}$	$7.500\ 62\times10^{-3}$
1×10^3	1	1×10^{-3}	1×10^{-2}	$1.019\ 72\times10^{-2}$	$9.869\ 23\times10^{-3}$	$1.019\ 72\times10^2$	7.500 62
1×10^6	1×10^3	1	1×10	$1.019\ 72\times10$	9.869 23	$1.019\ 72\times10^5$	$7.500\ 62\times10^3$
1×10^5	1×10^2	1×10^{-1}	1	1.019 72	$9.869\ 23\times10^{-1}$	$1.019\ 72\times10^4$	$7.500\ 62\times10^2$
$9.806\ 65\times10^4$	$9.806\ 65\times10$	$9.806\ 65\times10^{-2}$	$9.806\ 65\times10^{-1}$	1	$9.678\ 41\times10^{-1}$	1×10^4	$7.355\ 59\times10^2$
$1.013\ 25\times10^5$	$1.013\ 25\times10^2$	$1.013\ 25\times10^{-1}$	1.013 25	1.033 23	1	$1.033\ 23\times10^4$	$7.600\ 00\times10^2$
9.806 65	$9.806\ 65\times10^{-3}$	$9.806\ 65\times10^{-6}$	$9.806\ 65\times10^{-5}$	1×10^{-4}	$9.678\ 41\times10^{-5}$	1	$7.355\ 59\times10^{-2}$
$1.333\ 22\times10^2$	$1.333\ 22\times10^{-1}$	$1.333\ 22\times10^{-4}$	$1.333\ 22\times10^{-3}$	$1.359\ 51\times10^{-3}$	$1.315\ 79\times10^{-3}$	$1.359\ 51\times10$	1

Note) 1 Pa=1 N/m^2

Work, energy, quantity of heat

J	kW·h	kgf·m	kcal
1	$2.777\ 78\times10^{-7}$	$1.019\ 72\times10^{-1}$	$2.388\ 89\times10^{-4}$
$3.600\ \ \times10^6$	1	$3.670\ 98\times10^5$	$8.600\ \ 0\times10^2$
9.806 65	$2.724\ 07\times10^{-6}$	1	$2.342\ 70\times10^{-3}$
$4.186\ 05\times10^3$	$1.162\ 79\times10^{-3}$	$4.268\ 58\times10^2$	1

Note) 1 J=1 W·s, 1 J=1N·m

Power, heat flow rate

W	kgf·m/s	PS	kcal/h
1	$1.019\ 72\times10^{-1}$	$1.359\ 62\times10^{-3}$	$8.600\ 0\times10^{-1}$
9.806 61	1	$1.333\ 33\times10^{-2}$	8.433 71
$7.355\ \ \times10^2$	$7.5\ \ \times10$	1	$6.325\ 29\times10^2$
1.162 79	$1.185\ 72\times10^{-1}$	$1.580\ 95\times10^{-3}$	1

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

Thermal conductivity

W/(m·K)	kcal/(h·m·℃)
1	$8.600\ 0\times10^{-1}$
1.162 79	1

Coefficient of heat transfer

W/(m^2·K)	kcal/(h·m^2·℃)
1	$8.600\ 0\times10^{-1}$
1.162 79	1

Specific heat

J/(kg·K)	kcal/(kg·℃) cal/(g·℃)
1	$2.388\ 89\times10^{-4}$
$4.186\ 05\times10^{-3}$	1