

JIS

JAPANESE INDUSTRIAL STANDARD

**SI Units and the Use of their
Multiples and of
Certain other Units**

JIS Z 8203—1985

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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J I S

SI Units and the Use of their Multiples and
of Certain other Units

Z 8203-1985

1. Scope

This Japanese Industrial Standard specifies the International System of Units (SI), the uses of units according to SI, the units that are to be used together with SI, and the units that may be used together with SI.

- Remarks 1. The SI units that are in general use, the units that are to be used therewith, the units that may be used therewith, and those that are mainly used as their multiples in integer powers of base 10, hereinafter, are collectively given in Attached Tables of Appendix.
2. Of the SI units, the units that are to be used therewith, and the units that may be used therewith, those that are for quantities not shown in Attached Tables of Appendix, reference should be made to JIS Z 8202.

2. Terms and Their Definitions

The major terms and their definitions used in this standard shall be as follows:

- (1) International System of Units (SI) A coherent system of units that has been adopted by the General Conference of Weights and Measures. It is composed of the base units, the supplementary units, the derived units that are built up out of these two unit groups, and their multiples in integer powers of base 10. SI is the international abbreviation for International System of Units.
- (2) SI Units The general term for the base, the supplementary, and the derived units in SI.

Remark: For units included in SI, refer to the columns (3) of Attached Tables of Appendix.

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3. SI Units

3.1 Base Units The base units shall be those given in Table 1.

Table 1. Base Units

Quantity	Name of unit	Symbol	Definition
Length	metre	m	The metre is the length equal to the distance where light travels in vacuum in the fraction $1/299\,792\,458$ of 1 sec.
Mass	kilogram	kg	The kilogram is the unit of mass (being neither that of weight nor of force); it is equal to the mass of the international prototype of the kilogram.
Time	second	s	The sec is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom.
Electric current	ampere	A	The ampere is that constant electric current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.
Thermodynamic temperature ⁽¹⁾	kelvin	K	The kelvin is the fraction $1/273.16$ of the thermodynamic temperature of the triple point of water.
Amount of substance	mole	mol	The mole is the amount of substance of a system or a group of elementary entities ⁽²⁾ that contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12 (for the group the composition has to be specified), and to be used by specifying the elementary entities or the group thereof.
Luminous intensity	candela	cd	The candela is the luminous intensity in a given direction of a source which emits monochromatic radiation of frequency 540×10^{12} hertz and of which the radiant intensity in that direction is $1/683$ watt per steradian.

Notes ⁽¹⁾ See "Celsius temperature" in Table 3.

⁽²⁾ The elementary entities referred to are atoms, molecules, ions, electrons, or other particles.

3.2 Supplementary Units Those given in Table 2 shall be the supplementary units.

Table 2. Supplementary Units

Quantity	Name of unit	Symbol	Definition
Plane angle	radian	rad	The radian is the plane angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius.
Solid angle	steradian	sr	The steradian is the solid angle which, having its vertex in the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square sides of length equal to the radius of the sphere.

3.3 Derived Units The derived units are those which are expressed algebraically (namely, using mathematical symbols for multiplication or division) in terms of the base units and the supplementary units.

Examples of the Units Derived from the Base Units:

Quantity	Name of unit	Symbol
Area	square metre	m ²
Volume	cubic metre	m ³
Velocity	metre per second	m/s
Acceleration	metre per second per second	m/s ²
Wave number	per metre	m ⁻¹
Density	kilogram per cubic metre	kg/m ³
Electric current density	ampere per square metre	A/m ²
Magnetic field strength	ampere per metre	A/m
Concentration of substance	mole per cubic metre	mol/m ³
Specific volume	cubic metre per kilogram	m ³ /kg
Luminance	candela per square metre	cd/m ²

The derived units with proper names shall be as given in Tables 3 and 4.

Table 3. Derived Units with Proper Names

Quantity	Name of unit	Symbol	Derivation from basic units or supplementary units, or derivation from other units
Frequency	hertz	Hz	$1 \text{ Hz} = 1 \text{ s}^{-1}$
Force	newton	N	$1 \text{ N} = 1 \text{ kg} \cdot \text{m} / \text{s}^2$
Pressure, stress	pascal	Pa	$1 \text{ Pa} = 1 \text{ N} / \text{m}^2$
Energy, work, heat	joule	J	$1 \text{ J} = 1 \text{ N} \cdot \text{m}$
Power, electric power	watt	W	$1 \text{ W} = 1 \text{ J} / \text{s}$
Electric charge, quantity of electricity	coulomb	C	$1 \text{ C} = 1 \text{ A} \cdot \text{s}$
Electric potential, potential difference, voltage, electromotive force	volt	V	$1 \text{ V} = 1 \text{ J} / \text{C}$
Electrostatic capacity, capacitance	farad	F	$1 \text{ F} = 1 \text{ C} / \text{V}$
Electric resistance	ohm	Ω	$1 \Omega = 1 \text{ V} / \text{A}$
Electric conductance	siemens	S	$1 \text{ S} = 1 \Omega^{-1}$
Magnetic flux	weber	Wb	$1 \text{ Wb} = 1 \text{ V} \cdot \text{s}$
Magnetic flux density, magnetic induction	tesla	T	$1 \text{ T} = 1 \text{ Wb} / \text{m}^2$
Inductance	henry	H	$1 \text{ H} = 1 \text{ Wb} / \text{A}$
Celsius temperature	degree celsius or degree	$^{\circ}\text{C}$	(See 4-2.1 in the Attached Table 4 of Appendix)
Luminous flux	lumen	lm	$1 \text{ lm} = 1 \text{ cd} \cdot \text{sr}$
Illuminance	lux	lx	$1 \text{ lx} = 1 \text{ lm} / \text{m}^2$

Table 4. Derived Units with Proper Names for Safeguarding of Human Health

Quantity	Name of unit	Symbol	Derivation from basic units or supplementary units
Radioactivity	becquerel	Bq	$1 \text{ Bq} = 1 \text{ s}^{-1}$
Mass energy imparted, absorbed dose	gray	Gy	$1 \text{ Gy} = 1 \text{ J} / \text{kg}$
Dose equivalent	sievert	Sv	$1 \text{ Sv} = 1 \text{ J} / \text{kg}$

4. Decimal Multiples and Submultiples in SI Units

4.1 Prefixes The decimal multiples and submultiples, names of prefixes, and their symbols for the construction of SI units shall be as given in Table 5.

Table 5. Prefixes

Multiple to be combined with unit	Prefix	
	Name	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hecto	h
10	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

4.2 Construction of Decimal Multiples and Submultiples in SI Units The construction of decimal multiples and submultiples of SI units shall be as follows:

- (1) The symbol of a prefix shall be considered to be an integral part of the unit symbol that immediately succeeds it. Furthermore, they may be used as a new unit symbol by placing a plus or a minus sign, or be constructed into a new derived unit symbol by combining with other unit symbol.

Example 1: $1 \text{ cm}^3 = (10^{-2} \text{ m})^3 = 10^{-6} \text{ m}^3$

Example 2: $1 \mu \text{s}^{-1} = (10^{-6} \text{ s})^{-1} = 10^6 \text{ s}^{-1}$

Example 3: $1 \text{ mm}^2/\text{s} = (10^{-3} \text{ m})^2/\text{s} = 10^{-6} \text{ m}^2/\text{s}$

Remark: Since the name of the base unit for mass, kilogram, contains the name of a prefix "kilo", the names of multiples for units of mass shall be constructed by combining "gram" and an appropriate prefix. For example, not μkg but mg (milligram) shall be used.

- (2) No compounded prefixes shall be used. For example, not μm but nm (nanometre) shall be used.

5. Uses of SI Units and Their Multiples

The uses of SI units and their decimal multiples and submultiples shall be as follows:

- (1) For the integer exponent of a multiple, one that is convenient in the size shall be chosen, and for a particular application, the multiple shall be so chosen that the numerical value will fall within a practical range.
- (2) The multiple shall as a general rule be so chosen that the numerical value will be between 0.1 and 1 000. However, in a table of values for the same quantity or in a discussion of such values within a given context, it will generally be better to use the same multiple for all items, even when some of the numerical values will be outside the range 0.1 to 1 000.

Also, for certain quantities in particular applications, the same multiple is customarily used. For example, the millimetre is used for dimensions in most mechanical engineering drawings.

Example 1: Write 12 kN for 1.2×10^4 N.

Example 2: Write 3.94 mm for 0.003 94 m.

Example 3: Write 1.401 kPa for 1 401 Pa.

Example 4: Write 31 ns for 3.1×10^{-8} s.

Exception: The kinematic viscosity $0.01 \text{ m}^2/\text{s} = 10^{-2} \times 10^6 \text{ mm}^2/\text{s} = 10^4 \text{ mm}^2/\text{s}$ cannot be written so that the numerical value will be between 0.1 and 1 000.

- (3) When a compound unit is formed by combining two or more SI units and by multiplying with a multiple, only one prefix shall be used. However, as a special exception, when the basic unit kg is in the denominator, the prefix "k" shall not be in the prefix.

Example 1: Write $\text{klm} \cdot \text{s}$, not $\text{Mlm} \cdot \text{ms}$

Example 2: Write MJ/kg , not kJ/g .

- (4) Rules for Writing Unit Symbols The unit symbols shall be written as follows:

- (a) For printing, the upright (roman) type shall be used for the unit symbols irrespective of the type used in the rest of the text, and neither the plural form nor the period (full stop) shall be used. Also, following all the numerals that represent the quantity, one half the space of a type shall be left in between the numerical value and the unit symbol.

When the name of the unit is the one that is derived from a proper noun, only the first letter shall be in the upper case type (the capital letter), the rest being all in the lower case (the small letters).