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LEGISLATIVE COUNCIL BRIEF

Metrication Ordinance (Chapter 214)

METRICATION ORDINANCE (AMENDMENT OF SCHEDULES) ORDER 2019

INTRODUCTION

At the meeting of the Executive Council on 12 November 2019, the Council **ADVISED** and the Chief Executive **ORDERED** that the Metrication Ordinance (Amendment of Schedules) Order 2019 ("the Order") at **Annex A** should be made pursuant to section 4 of the Metrication Ordinance and tabled before the Legislative Council.

A

JUSTIFICATIONS

Revision of the International System of Units (SI)

2. The SI is a metric system of units of measurement launched by the 11th General Conference on Weights and Measures ("CGPM") in 1960. The SI consists of a set of base units, derived units and prefixes[1]. There are seven SI base units, namely - the metre, the kilogram, the second, the ampere, the kelvin, the mole and the candela[2]. In 1976, the Metrication Ordinance ("the Ordinance") was enacted to make the SI the preferred units of measurement in Hong Kong. The SI has also been adopted by nearly all countries in the world.

3. On 16 November 2018, the 26th CGPM passed a resolution to revise four of the seven SI base units, namely the kilogram, the ampere, the

[1] The SI derived units are formed by products of powers of the SI base units. For example, the newton (symbol N), the SI derived unit of force, is defined as kg m s^{-2}. The SI prefixes are used to form decimal multiples and submultiples of the SI units. For example, the SI prefix kilo (symbol k), when attached to the SI unit metre (symbol m), will form the SI unit kilometre (symbol km).

[2] The metre, the kilogram, the second, the ampere, the kelvin, the mole and the candela are respectively the SI unit of length, mass, time, electric current, temperature, amount of substance and luminous intensity.

kelvin and the mole. The objective of the revision is to guarantee the stability and universality of the SI base units. It replaces the conventional use of physical artifacts to define measurement units, by linking all SI base units to fundamental physical constants[3]. The revision is not intended to change the values of the SI units and aims at keeping their consequential changes to a minimum to preserve continuity with earlier definitions.

Impacts on the General Public

4. The impact of the revision of the SI on the general public is minimal and is summarised as follows -

SI Unit	Impact on the General Public
The kilogram (SI unit of mass)	The value of the mass standards (in everyday life many people refer "mass" as "weight") will **remain unchanged** after the re-definition of the kilogram. Its re-definition would not have impact on the general public.
The ampere (SI unit of electric current)	The re-definition of the ampere will lead to one-time small changes of electric current unit (0.000008%, or 80 parts per billion, change in electric current values). This infinitesimal change would have minimal impact on the general public.
The kelvin (SI unit of temperature)	The value of the temperature standards, irrespective of whether the readings are in kelvin or degree Celsius, will **remain unchanged** after the re-definition of the kelvin. There would be no impact on the general public.
The mole (SI unit of amount of substance)	The mole is usually used in chemical measurements and the measurement results will **not** be affected by its re-definition. The re-definition would have no impact on the general public.

Proposed Legislative Amendments

5. In the Ordinance, the definitions of SI base units are specified in the First Schedule to the Ordinance. They will become obsolete if the First Schedule is not amended to give effect to the re-definition. In

[3] Fundamental physical constants refer to constants of nature such as speed of light or technical constant such as the luminous efficacy K_{cd} used in the definition of the candela.

accordance with section 4 of the Ordinance, the Chief Executive may by order published in the Gazette amend the First, Second or Third Schedule. To implement the revised SI, we propose to amend the First Schedule by replacing the existing definitions for the kilogram, the ampere, the kelvin and the mole with the new definitions recommended by CGPM.

6. Although the substantive definitions for the remaining three SI base units, namely the second, the metre and the candela, remain unchanged, the texts of their definitions have been amended by CGPM to align with the presentation of the other four base units. We propose to replace the texts accordingly in the First Schedule to the Ordinance.

7. In addition, we also propose to –

(a) update the First and Second Schedules to the Ordinance to reflect some minor changes in SI supplementary units, SI derived units, SI prefixes and non-SI units in general international use over the past decades; and

(b) make minor amendments to the format and style of the Third Schedule.

These minor changes will have no impact on the general public.

THE METRICATION ORDINANCE (AMENDMENT OF SCHEDULES) ORDER 2019

8. The main purpose of the Order is to amend the Schedules to the Ordinance to align with the revised international measurement system.

LEGISLATIVE TIMETABLE

9. The legislative timetable will be as follows:

Publication in the Gazette	22 November 2019
Tabling before the Legislative Council (for negative vetting)	27 November 2019
Commencement	1 April 2020

IMPLICATIONS OF THE PROPOSAL

10. The revision of the SI is purely technical in nature. The proposal has minimal economic implications as set out in **Annex B**. Apart from the economic implications, there are no other sustainability implications. The proposal is in conformity with the Basic Law, including the provisions concerning human rights. It has no financial, civil service, productivity, environmental, gender or family implications. The proposal will not affect the current binding effect of the Ordinance and its subsidiary legislation.

B

PUBLIC CONSULTATION

11. The Innovation and Technology Commission conducted briefings on the revision of the SI for relevant stakeholders in the industrial sector, the academia and the testing and certification industry on 27 October 2017 and 11 January 2019 respectively. No adverse feedback was received.

PUBLICITY

12. We will issue a press release upon gazettal of the Order. A spokesperson will be available to handle enquiries.

ENQUIRIES

13. Enquiries on this Brief can be addressed to Mr C.M. TSUI, Head of Laboratory at 2829 4880.

Innovation and Technology Bureau
Innovation and Technology Commission
20 November 2019

Metrication Ordinance (Amendment of Schedules) Order 2019

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Metrication Ordinance (Amendment of Schedules) Order 2019

(Made by the Chief Executive under section 4 of the Metrication Ordinance (Cap. 214) after consultation with the Executive Council)

1. Commencement

This Order comes into operation on 1 April 2020.

2. Metrication Ordinance amended

The Metrication Ordinance (Cap. 214) is amended as set out in sections 3, 4 and 5.

3. First Schedule substituted

First Schedule—

Repeal the Schedule

Substitute

"First Schedule

[ss. 2 & 4]

International System of Units

Part I

SI Base Units

First Column	Second Column	Third Column	Fourth Column
Quantity	Name	Symbol	Definition
1. time	second	s	It is defined by taking the fixed numerical value of the caesium frequency $\Delta\nu_{Cs}$, the unperturbed ground-state hyperfine transition frequency of the caesium 133 atom, to be 9 192 631 770 when expressed in the unit Hz, which is equal to s^{-1}.
2. length	metre	m	It is defined by taking the fixed numerical value of the speed of light in vacuum c to be 299 792 458 when expressed in the unit m s^{-1}, where the second is defined in terms of the caesium frequency $\Delta\nu_{Cs}$.
3. mass	kilogram	kg	It is defined by taking the fixed numerical value of the Planck constant h to be $6.626\ 070\ 15 \times 10^{-34}$ when expressed in the unit J s, which is equal to kg m^2 s^{-1}, where the metre and the second are defined in terms of c and $\Delta\nu_{Cs}$.
4. electric current	ampere	A	It is defined by taking the fixed numerical value of the elementary charge e to be $1.602\ 176\ 634 \times 10^{-19}$ when expressed in the unit C, which is equal to A s, where the second is defined in terms of $\Delta\nu_{Cs}$.
5. thermodynamic temperature	kelvin	K	It is defined by taking the fixed numerical value of the Boltzmann constant k to be $1.380\ 649 \times 10^{-23}$ when expressed in the unit J K^{-1}, which is equal to kg m^2 s^{-2} K^{-1}, where the kilogram, metre and second are defined in terms of h, c and $\Delta\nu_{Cs}$.
6. amount of substance	mole	mol	One mole contains exactly $6.022\ 140\ 76 \times 10^{23}$ elementary entities. This number is the fixed numerical value of the Avogadro constant N_A, when expressed in the unit mol^{-1} and is called the Avogadro number. The amount of substance, symbol n, of a system is a measure of the number of specified elementary

Metrication Ordinance (Amendment of Schedules) Order 2019

First Column	Second Column	Third Column	Fourth Column
Quantity	Name	Symbol	Definition
			entities. An elementary entity may be an atom, a molecule, an ion, an electron, any other particle or specified group of particles.
7. luminous intensity	candela	cd	It is defined by taking the fixed numerical value of the luminous efficacy of monochromatic radiation of frequency 540×10^{12} Hz, K_{cd}, to be 683 when expressed in the unit lm W^{-1}, which is equal to cd sr W^{-1}, or cd sr kg^{-1} m^{-2} s^3, where the kilogram, metre and second are defined in terms of h, c and Δv_{Cs}.

Notes—

1. The SI derived units are defined as products of powers of the SI base units.
2. The 7 SI base units in this Part and the 22 SI derived units with special names and symbols in Part III may be used in combination to express the units of other derived quantities. All other SI units are combinations of some of these 29 units.

Part II

SI Supplementary Units

Part III

SI Derived Units Having Special Names and Symbols

First Column	Second Column	Third Column
Quantity	Special Name	Symbol (unit expressed in terms of base units)
1. plane angle	radian	rad (= m/m)
2. solid angle	steradian	sr (= m^2/m^2)
3. frequency	hertz	Hz (= s^{-1})
4. force	newton	N (= kg m s^{-2})
5. pressure, stress	pascal	Pa (= kg m^{-1} s^{-2})
6. energy, work, amount of heat	joule	J (= kg m^2 s^{-2})
7. power, radiant flux	watt	W (= kg m^2 s^{-3})
8. electric charge	coulomb	C (= A s)
9. electric potential difference	volt	V (= kg m^2 s^{-3} A^{-1})
10. capacitance	farad	F (= kg^{-1} m^{-2} s^4 A^2)
11. electric resistance	ohm	Ω (= kg m^2 s^{-3} A^{-2})
12. electric conductance	siemens	S (= kg^{-1} m^{-2} s^3 A^2)

First Column	Second Column	Third Column	
Quantity	Special Name	Symbol (unit expressed in terms of base units)	
13. magnetic flux	weber	Wb	(= kg m^2 s^{-2} A^{-1})
14. magnetic flux density	tesla	T	(= kg s^{-2} A^{-1})
15. inductance	henry	H	(= kg m^2 s^{-2} A^{-2})
16. Celsius temperature	degree Celsius	°C	(= K)
17. luminous flux	lumen	lm	(= cd sr)
18. illuminance	lux	lx	(= cd sr m^{-2})
19. activity referred to a radionuclide	becquerel	Bq	(= s^{-1})
20. absorbed dose, kerma	gray	Gy	(= m^2 s^{-2})
21. dose equivalent	sievert	Sv	(= m^2 s^{-2})
22. catalytic activity	katal	kat	(= mol s^{-1})

Notes—

1. The SI derived units are defined as products of powers of the SI base units.

2. The 7 SI base units in Part I and the 22 SI derived units with special names and symbols in this Part may be used in combination to express the units of other derived quantities. All other SI units are combinations of some of these 29 units.

Part IV

SI Prefixes

First Column	Second Column	Third Column
Factor by which the unit is multiplied	Name	Symbol
10^{24}	yotta	Y
10^{21}	zetta	Z
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^{1}	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n

First Column	Second Column	Third Column
Factor by which the unit is multiplied	Name	Symbol
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y

Note—

The SI prefixes are used to form names and symbols of decimal multiples and sub-multiples of the SI units.".

4. Second Schedule substituted

Second Schedule—

Repeal the Schedule

Substitute

"Second Schedule

[ss. 2 & 4]

Non-SI Units in General International Use

First Column	Second Column	Third Column	Fourth Column
Quantity	Name	Symbol	Value in SI units
1. time	minute	min	60 s

First Column	Second Column	Third Column	Fourth Column
Quantity	Name	Symbol	Value in SI units
2. time	hour	h	3 600 s
3. time	day	d	86 400 s
4. plane and phase angle	degree	°	(π/180) rad
5. plane and phase angle	minute	'	(π/10 800) rad
6. plane and phase angle	second	"	(π/648 000) rad
7. area	hectare	ha	10^4 m^2
8. volume	litre	l, L	10^{-3} m^3
9. mass	tonne	t	10^3 kg
10. mass per unit length (Note 1)	tex	tex	10^{-6} kg/m
11. length (Note 2)	nautical mile (international)		1 852 m
12. speed velocity (Note 2)	knot (international)		(1 852/3 600) m/s

Notes—

1. This unit is used in the textile industry for the measurement of the linear density of yarn.
2. Related to nautical and aeronautical navigation and meteorology. One knot is equal to one nautical mile per hour.".

5. Third Schedule substituted

Third Schedule—

Repeal the Schedule

Substitute

"Third Schedule

[ss. 3 & 4]

Values of Non-metric Basic Units Expressed in terms of SI Base Units

First Column	Second Column	Third Column
Quantity	Non-metric basic unit	Value in SI base unit
1. length	yard	0.914 4 m
2. mass	pound	0.453 592 37 kg
3. capacity	gallon	$4.546\ 09 \times 10^{-3}$ m^3 (Note 1)
4. temperature interval	degree Fahrenheit	5/9 K (Note 2)

Notes—

1. Correct to 6 significant figures.
2. A formal definition of the Fahrenheit scale of temperature is not thought to exist, but for most practical purposes Fahrenheit temperature may be defined by the equation $f = 1.8\ T - 459.67$ where f is the Fahrenheit temperature expressed in degrees Fahrenheit (symbol °F) and T is the thermodynamic temperature expressed in kelvins (symbol K).".

Carrie Lam

Chief Executive

14 November 2019

Explanatory Note

On 16 November 2018, the 26th General Conference on Weights and Measures (***CGPM***) reviewed the International System of Units (***SI***). The Member States of CGPM voted to adopt the Resolution that 4 of the 7 SI base units, namely kilogram, ampere, kelvin and mole, would be re-defined by fixing the values of the Planck constant (h), the elementary charge (e), the Boltzmann constant (k) and the Avogadro constant (N_A).

2. The definitions of the remaining 3 SI base units have been amended by CGPM to align with the presentation of the 4 SI base units mentioned in paragraph 1.

3. The Metrication Ordinance (Cap. 214) provides for metric units. This Order amends the First Schedule to the Ordinance to reflect the new international definitions.

4. This Order also—

   (a) updates the First and Second Schedules to the Ordinance to reflect some minor changes in SI supplementary units, SI derived units, SI prefixes and non-SI units in general international use over the past decades; and

   (b) makes minor amendments to the format and style of the Third Schedule to the Ordinance.

Annex B

Implication of the Proposal

The implications of the proposal are set out below-

Economic Implication

1. The proposal will have minimal economic implication since the re-definition of International System of Units ("SI") will only affect measurements at the highest accuracy level, like those performed by the Standards and Calibration Laboratory and other overseas national metrology institutes. Common users of instruments and the general public would unlikely be affected.

2. If the definitions of SI in the Metrication Ordinance are not updated, the measurement system of Hong Kong will not be aligned with the revised international measurement system, and hence Hong Kong will lag behind other developed economies in terms of the legal framework in metrology. This may reflect unfavourably on the image of Hong Kong as an innovation and technology hub in the region.