2019/91

Measurement Standards Regulations 2019

Patsy Reddy, Governor-General

Order in Council

At Wellington this 13th day of May 2019

Present:
Her Excellency the Governor-General in Council

These regulations are made under section 5 of the Measurement Standards Act 1992 on the advice and with the consent of the Executive Council.

Contents

Regulations

1 Title

These regulations are the Measurement Standards Regulations 2019.

2 Commencement

These regulations come into force on 20 May 2019.

3 Interpretation

In these regulations, unless the context otherwise requires,—

CIPM MRA means the International Committee for Weights and Measures' arrangement for mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes, agreed at Paris on 14 October 1999 and as amended from time to time

government agency means any of the following:

(a) a department under section 27A of the State Sector Act 1988:

(b) a statutory entity that is a Crown entity under section 7(1)(a) of the Crown Entities Act 2004:

(c) a Crown Research Institute established under section 11 of the Crown Research Institutes Act 1992

Measurement Standards Laboratory of New Zealand means the laboratory of Callaghan Innovation (established under section 7 of the Callaghan Innovation Act 2012) that maintains the principal standard measures for New Zealand

New Zealand unit of measurement, for a physical quantity, means the unit of measurement for use throughout New Zealand in relation to that quantity

participating institute means a national metrology institute or other organisation recognised as a participating institute under the CIPM MRA

Table means a table in Schedule 2.

4 Transitional, savings, and related provisions

The transitional, savings, and related provisions (if any) set out in Schedule 1 have effect according to their terms.

5 Basis for standards of measurement

(1) A standard of measurement, in relation to a physical quantity, may—

(a) be based on fundamental constants of physics or nature; or

(b) be based on the bulk properties of a pure material or the atomic properties of a single isotope; or

(c) be associated with a particular material object; or

(d) result from measurements made using instruments of stable and proven characteristics; or

(e) result from measurements made using a recognised overseas measurement standard.

(2) A standard of measurement is a **recognised overseas measurement standard** if a participating institute has issued a calibration and measurement certificate for the standard of measurement and the validity of the certificate has been recognised in accordance with the procedures in place under the CIPM MRA.

6 New Zealand units of measurement and standards of measurement

(1) For a physical quantity listed in Table 2,—

(a) the New Zealand unit of measurement is the unit set out in Table 2 for that quantity; and

(b) the New Zealand standard of measurement is the definition of that unit set out in Table 2.

(2) For a physical quantity listed in Table 3 (each of which is derived from 1 or more of the quantities listed in Table 2),—

(a) the New Zealand unit of measurement is the unit set out in Table 3 for that quantity; and

(b) the New Zealand standard of measurement is to be derived from the standards of measurements for the base units from which the quantity's New Zealand unit of measurement is derived (as set out in the fourth column of Table 3).

(3) Table 1 sets out fundamental constants for the purposes of Table 2.

(4) The prefixes set out in Table 4 may be used to form the names and symbols of the decimal multiples and submultiples of the units of measurement.

7 Appointment of verifying authorities

(1) The Minister may, in writing, appoint an eligible office holder to be a verifying authority in relation to the verification and reverification of a standard of measurement (including the comparison of principal standard measures with corresponding standard measures outside New Zealand).

(2) An **eligible office holder** is—

(a) the person for the time being holding, or performing the duties of, any of the following offices:

(i) the Chief Metrologist at the Measurement Standards Laboratory of New Zealand:

(ii) a specified office in a government agency that has responsibility for a standard of measurement or a class of standards of measurement; or

(b) a named person who currently holds or is performing the duties of an office referred to in paragraph (a)(ii).

(3) An appointment may be made in relation to—

(a) standards of measurement generally; or

(b) a specified standard of measurement; or

(c) a specified class of standards of measurement.

8 Powers of verifying authority

(1) The verifying authority in relation to a standard of measurement may—

(a) determine the value of the standard of measurement in terms of New Zealand units of measurement of physical quantities for that standard of measurement:

(b) determine the accuracy (in the New Zealand units of measurement) with which the standard of measurement has been verified or reverified:

(c) determine whether and how the standard of measurement should be marked or identified as having been verified or reverified, and mark or identify it, or require it to be marked or identified, accordingly:

(d) issue certificates or other documents in relation to the verification and reverification of the standard.

(2) A verifying authority may, in writing, delegate any of the authority’s powers under subclause (1),—

(a) if the verifying authority is the Chief Metrologist, to a person working in the Measurement Standards Laboratory of New Zealand; or

(b) otherwise, to a person working in the verifying authority’s government agency.

9 Regulations revoked

The National Standards Regulations 1976 (SR 1976/239) are revoked.

Schedule 1
Transitional, savings, and related provisions

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Part 1
Provisions relating to these regulations as made

There are no transitional, savings, or related provisions relating to these regulations as made.

Schedule 2
New Zealand units of measurement of physical quantities and standards of measurement

r 6

Table 1
Fundamental constants

Fundamental constant	**Symbol**	**Numerical value**	**Unit**
hyperfine transition frequency of caesium	$\Delta\nu_{Cs}$	9 192 631 770	Hz
speed of light in vacuum	c	299 792 458	m s^{-1}
Planck constant	h	$6.626\ 070\ 15 \times 10^{-34}$	J s
elementary charge	e	$1.602\ 176\ 634 \times 10^{-19}$	C
Boltzmann constant	k	$1.380\ 649 \times 10^{-23}$	J K^{-1}
Avogadro constant	N_A	$6.022\ 140\ 76 \times 10^{23}$	mol^{-1}
luminous efficacy	K_{cd}	683	lm W^{-1}

Table 2
Base units for physical quantities

Physical quantity	**New Zealand unit of measurement**		
	Unit	**Symbol**	**Definition of unit**
time	second	s	The second 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}.
length	metre	m	The metre 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 $\Delta\nu_{Cs}$.
mass	kilogram	kg	The kilogram 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 $\Delta\nu_{Cs}$.
electric current	ampere	A	The ampere 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 $\Delta\nu_{Cs}$.
thermodynamic temperature	kelvin	K	The kelvin 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 $\Delta\nu_{Cs}$.
amount of substance	mole	mol	1 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,

Physical quantity	**New Zealand unit of measurement**		
	Unit	**Symbol**	**Definition of unit**
			symbol *n*, of a system is a measure of the number of specified elementary entities. An elementary entity may be an atom, a molecule, an ion, an electron, or any other particle or specified group of particles.
luminous intensity	candela	cd	The candela is the unit of luminous intensity in a given direction. 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 $\Delta\nu_{Cs}$.

Table 3
Derived physical quantities

Derived physical quantity	New Zealand unit of measurement				
	Unit	Symbol	Expressed in base units	Expressed in derived units	Definition of unit
plane angle	radian	rad	rad = m/m		1 radian is the angle subtended at the centre of a circle by an arc that is equal in length to the radius.
solid angle	steradian	sr	sr = m^2/m^2		1 steradian is the solid angle subtended at the centre of a sphere by an area of the surface that is equal to the squared radius.
frequency	hertz	Hz	Hz = s^{-1}		1 hertz is the frequency of a periodic phenomenon of which the period is 1 second.
force	newton	N	N = kg m s^{-2}		1 newton is the force that, when applied to a body having a mass of 1 kilogram, causes an acceleration of 1 metre per second per second in the direction of the application of the force.
pressure, stress	pascal	Pa	Pa = kg m^{-1} s^{-2}		1 pascal is the pressure, or compressive or tensile stress, that arises when a force of 1 newton is applied normal to, and uniformly over, an area of 1 square metre. The pascal is also the shear stress that arises when a force of 1 newton is applied in the plane of, and uniformly over, an area of 1 square metre.
energy, work, amount of heat	joule	J	J = kg m^2 s^{-2}	J = N m	1 joule is the work done or the energy expended when a force of 1 newton moves the point of application a distance of 1 metre in the direction of that force.
power, radiant flux	watt	W	W = kg m^2 s^{-3}	W = J/s	1 watt is the power used when work is done or energy is expended at the rate of 1 joule per second.
electric charge	coulomb	C	C = A s		1 coulomb is the quantity of electric charge that is transferred each second by an electric current of 1 ampere.
electric potential difference	volt	V	V = kg m^2 s^{-3} A^{-1}	V = W/A	1 volt is the potential difference that exists between 2 points on a conductor carrying an unvarying electric current of 1 ampere when the power dissipated between the points is equal to 1 watt.

Derived physical quantity	New Zealand unit of measurement				
	Unit	Symbol	Expressed in base units	Expressed in derived units	Definition of unit
capacitance	farad	F	$F = kg^{-1}\ m^{-2}\ s^{4}\ A^{2}$	F = C/V	1 farad is the electric capacitance that exists between 2 conductors when the transfer of an electric charge of 1 coulomb from one to the other changes the potential difference between them by 1 volt.
electric resistance	ohm	Ω	$\Omega = kg\ m^{2}\ s^{-3}\ A^{-2}$	Ω = V/A	1 ohm is the electric resistance between 2 points on a conductor, which does not contain any source of electromotive force between those 2 points, when a constant potential difference of 1 volt maintained between those points results in a current of 1 ampere in the conductor.
electric conductance	siemens	S	$S = kg^{-1}\ m^{-2}\ s^{3}\ A^{2}$	S = A/V	1 siemens is the electric conductance of a conductor that has an electrical resistance of 1 ohm.
magnetic flux	weber	Wb	$Wb = kg\ m^{2}\ s^{-2}\ A^{-1}$	Wb = V s	1 weber is the flux that, linking a circuit of 1 turn, produces in it an electromotive force of 1 volt as the flux is reduced to zero at a uniform rate in 1 second.
magnetic flux density	tesla	T	$T = kg\ s^{-2}\ A^{-1}$	$T = Wb/m^{2}$	1 tesla is the density of 1 weber of magnetic flux per square metre.
inductance	henry	H	$H = kg\ m^{2}\ s^{-2}\ A^{-2}$	H = Wb/A	1 henry is the electric inductance of a closed circuit in which an electromotive force of 1 volt is produced when an electric current that traverses the circuit varies uniformly at the rate of 1 ampere per second.
Celsius temperature	degree Celsius	°C	°C = K		1 degree Celsius is equal in magnitude to the unit kelvin. The quantity Celsius temperature t is related to thermodynamic temperature T by the equation $t/°C = T/K - 273.15$.
luminous flux	lumen	lm	$lm = cd\ m^{2}/m^{2}$	lm = cd sr	1 lumen is the luminous flux emitted into unit solid angle by an isotropic point source having a luminous intensity of 1 candela.
illuminance	lux	lx	$lx = cd\ m^{-2}$	$lx = lm/m^{2}$	1 lux is an illuminance of 1 lumen per square metre.
activity referred to a radionuclide	becquerel	Bq	$Bq = s^{-1}$		1 becquerel is the activity of a quantity of radioactive material in which 1 nucleus decays per second.
absorbed dose, kerma	gray	Gy	$Gy = m^{2}\ s^{-2}$	Gy = J/kg	1 gray is the absorption of 1 joule of radiation energy per kilogram of matter.
dose equivalent	sievert	Sv	$Sv = m^{2}\ s^{-2}$	Sv = J/kg	1 sievert represents the equivalent biological effect of the deposit of 1 joule of radiation energy in 1 kilogram of human tissue.

Derived physical quantity	New Zealand unit of measurement				
	Unit	Symbol	Expressed in base units	Expressed in derived units	Definition of unit
catalytic activity	katal	kat	kat = mol s^{-1}		1 katal is the catalytic activity that catalyses a reaction rate of 1 mole per second in an assay system.

Table 4
Prefixes

Factor	Name	Symbol	Factor	Name	Symbol
10^{1}	deca	da	10^{-1}	deci	d
10^{2}	hecto	h	10^{-2}	centi	c
10^{3}	kilo	k	10^{-3}	milli	m
10^{6}	mega	M	10^{-6}	micro	µ
10^{9}	giga	G	10^{-9}	nano	n
10^{12}	tera	T	10^{-12}	pico	p
10^{15}	peta	P	10^{-15}	femto	f
10^{18}	exa	E	10^{-18}	atto	a
10^{21}	zetta	Z	10^{-21}	zepto	z
10^{24}	yotta	Y	10^{-24}	yocto	y

The prefix name is combined with the unit name and written as 1 word, except in relation to units of mass.

For units of mass, because the base unit kilogram contains the prefix kilo, the names of the decimal multiples and submultiples of the unit of mass are formed by adding the appropriate prefixes to the word gram. For example, milligram (mg) is used instead of microkilogram (µkg).

Michael Webster,
Clerk of the Executive Council.

Explanatory note

This note is not part of the regulations, but is intended to indicate their general effect.

These regulations are made under the Measurement Standards Act 1992 and replace the National Standards Regulations 1976 (the **revoked regulations**).

The regulations prescribe the units of measurement to be used in New Zealand for each of the physical quantities listed in *Tables 2 and 3 of Schedule 2* and the standards of measurements to be used for those units of measurements.

Like the revoked regulations, these regulations provide for the use in New Zealand of the International System of Units (known as SI) that is recognised through the international Convention of the Metre 1875.

However, the revoked regulations needed to be replaced because in November 2018 the parties to the convention (including New Zealand) agreed to major changes in the way that the basic units of measurement will be defined. Rather than relying on physical artefacts (such as the kilogram prototype in Paris), they will be determined using fundamental constants of physics or nature (such as the speed of light).

These changes to the SI will take effect on 20 May 2019 and are reflected in *Schedule 2* of these regulations. The fundamental constants used in the SI are set out in *Table 1*.

The 7 base units of the SI, the physical quantities that they measure, and their new definitions are set out in *Table 2*.

Table 3 sets out the New Zealand units of measurement for physical quantities that are not themselves part of the SI but can be derived from 1 or more of the base units of the SI. *Table 4* sets out prefixes that may be used with units of measurement.

The regulations continue the provisions for the appointment and powers of verifying authorities from the revoked regulations. The only substantive change is to expand the class of eligible office holders to include office holders at certain Crown entities or Crown Research Institutes as well as departments. This is to ensure that New Zealand can appropriately fulfil its obligations under the International Committee for Weights and Measures' mutual recognition arrangement.

These regulations will come into force on 20 May 2019 to coincide with the changes to the SI.

Issued under the authority of the Legislation Act 2012.
Date of notification in *Gazette*: 16 May 2019.
These regulations are administered by the Ministry of Business, Innovation, and Employment.

Wellington, New Zealand:
Published under the authority of the New Zealand Government—2019