Statutory Instrument No. 58 of 2022

CIVIL AVIATION ACT
(Cap. 71:01)

**CIVIL AVIATION (UNITS OF MEASUREMENT TO BE USED IN AIR AND
GROUND OPERATIONS) REGULATIONS, 2022**
(Published on 6th June, 2022)

ARRANGEMENT OF REGULATIONS

REGULATION

IN EXERCISE of the powers conferred on the Minister of Transport and Public Works by section 89 (1) of the Civil Aviation Act, and on the recommendation of the Civil Aviation Authority, the following Regulations are hereby made —

PART I — *Preliminary*

1. These Regulations may be cited as the Civil Aviation (Units of Measurement to be used in Air and Ground Operations) Regulations, 2022.   Citation

2. In these Regulations, unless the context otherwise requires –   Interpretation
"Ampere (A)" means a 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 a vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length;

"Becquerel (Bq)" means the activity of a radionuclide having one spontaneous nuclear transition per second;

"Candela (cd)" means the luminous intensity, in the perpendicular direction, of a surface of 1/600 000 square metre of black body at the temperature of freezing platinum under a pressure of 101 325 newtons per square metre;

"Celsius temperature (t°C)" means the Celsius temperature is equal to the difference $t°C = T-T_0$ between two thermodynamic temperatures T and T_0 where T_0 equals 273.15 Kelvin;

"Coulomb (C)" means the quantity of electricity transported in 1 second by a current of 1 ampere;

"Degree Celsius (°C)" means the special name for the unit Kelvin for use in stating values of Celsius temperature;

"Farad (F)" means the capacitance of a capacitor between the plates of which there appears a difference of potential of 1 volt when it is charged by a quantity of electricity equal to 1 coulomb;

"Foot (ft)" means the length equal to 0.3048 metre exactly;

"Gray (Gy)" means the energy imparted by ionizing radiation to a mass of matter corresponding to 1 joule per kilogram;

"Henry (H)" means the inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 ampere per second;

"Hertz (Hz)" means the frequency of a periodic phenomenon of which the period is 1 second;

"Human performance" means human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations;

"Joule (J)" means the work done when the point of application of a force of 1 Newton is displaced a distance of 1 metre in the direction of the force;

"Kelvin (K)" means a unit of thermodynamic temperature which is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water;

"Kilogram (kg)" means the unit of mass equal to the mass of the international prototype of the kilogram;

"Knot (kt)" means the speed equal to 1 nautical mile per hour;

"International System of Units (SI)" means a complete, coherent system which includes three classes of units base units, supplementary units; and derived units;

"Litre (L)" means a unit of volume restricted to the measurement of liquids and gases which is equal to 1 cubic decimeter;

"Lumen (lm)" means the luminous flux emitted in a solid angle of 1 steradian by a point source having a uniform intensity of 1 candela;

"Lux (lx)" means the illuminance produced by a luminous flux of 1 lumen uniformly distributed over a surface of 1 square metre;

"Metre (m)" means the distance travelled by light in a vacuum during 1/299 792 458 of a second;

"Mole (mol)" means the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12;

"Nautical mile (NM)" means the length equal to 1,852 metres exactly;

"Newton (N)" means the force which when applied to a body having a mass of 1 kilogram gives it an acceleration of 1 metre per second squared;

"Ohm (Ω)" means the electric resistance between two points of a conductor when a constant difference of potential of 1 volt, applied between these two points, produces in this conductor a current of 1 ampere, this conductor not being the source of any electromotive force;

"Pascal (Pa)" means the pressure or stress of 1 newton per square metre;

"Radian (rad)" means the plane angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius;

"Second (s)" means 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;

"Siemens (S)" means the electric conductance of a conductor in which a current of 1 ampere is produced by an electric potential difference of 1 volt;

"Sievert (Sv)" means the unit of radiation dose equivalent corresponding to 1 joule per kilogram;

"Steradian (sr)" means 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 with sides of length equal to the radius of the sphere;

"Tesla (T)" means the magnetic flux density given by a magnetic flux of 1 weber per square metre;

"Tonne (t)" means the mass equal to 1 000 kilograms;

"Volt (V)" means the unit of electric potential difference and electromotive force which is the difference of electric potential between two points of a conductor carrying a constant current of 1 ampere, when the power dissipated between these points is equal to 1 watt;

"Watt (W)" means the power which gives rise to the production of energy at the rate of 1 joule per second; and

"Weber (Wb)" means the magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of 1 volt as it is reduced to zero at a uniform rate in 1 second.

3. These Regulations shall apply to all aspects of civil aviation air and ground operations. *Application*

PART II — *Standard Application of Units of Measurement*

4. (1) The International System of Units developed and maintained by the General Conference of Weights and Measures (CGPM) shall, subject to regulations 5 and 6 be used as the standard system of units of measurement for all aspects of civil aviation air and ground operations. *SI units*

(2) The prefixes and symbols listed in Table 1 of the Schedule shall be used to form names and symbols of the decimal multiples and submultiples of SI units.

5. (1) The non-SI units listed in Table 2 of the Schedule, shall be used either in lieu of, or in addition to, the SI units as the unit of measure but only as specified in Table 4 of the Schedule. *Non-SI units*

(2) The non-SI units listed in Table 3 of the Schedule shall be permitted for temporary use as alternative units of measurement but only for those specific quantities listed in Table 4 of the Schedule.

6. (1) The application of units of measurement for certain quantities used in civil aviation air and ground operations shall be in accordance with Table 4 of the Schedule of these regulations. *Application of specific units*

(2) In instances where the mole is used, the elementary entities shall be specified and may be atoms, molecules, ions, electrons, other particles or specified groups of such particles.

Design,
procedures
and training

7. The means and provisions for design, procedures and training shall be established for operations in environments involving the use of standard and non-SI alternatives of specific units of measurement, or the transition between environments using different units, with due consideration to human performance.

PART III — *Termination of Use of Non-SI Alternative Units*

Use of
alternative
non-SI units

8. The use in civil aviation operations of the alternative non-SI units (Knot, Nautical Mile and foot) shall be terminated on the dates to be established by International Civil Aviation.

Base units,
supplementary
units and
derived units

9. The International System of Units is a complete, coherent system which includes three classes of units as depicted in Table 5; supplementary units as depicted in Table 6; and derived units as depicted in Table 7 of the Schedule.

Offence

10. Any person who contravenes any provision of these Regulations commits an offence and is liable to the penalties provided under section 88 of the Act.

SCHEDULE

REGULATIONS 4, 5 & 6

SI UNITS

Table 1. SI unit prefixes

Multiplication factor		Prefix	Symbol
1 000 000 000 000 000 000	$= 10^{18}$	exa	E
1 000 000 000 000 000	$= 10^{15}$	peta	P
1 000 000 000 000	$= 10^{12}$	tera	T
1 000 000 000	$= 10^{9}$	giga	G
1 000 000	$= 10^{6}$	mega	M
1 000	$= 10^{3}$	kilo	k
100	$= 10^{2}$	hecto	h
10	$= 10^{1}$	deca	da
0.1	$= 10^{-1}$	deci	d
0.01	$= 10^{-2}$	centi	c
0.001	$= 10^{-3}$	milli	m
0.000 001	$= 10^{-6}$	micro	µ
0.000 000 001	$= 10^{-9}$	nano	n
0.000 000 000 001	$= 10^{-12}$	pico	p
0.000 000 000 000 001	$= 10^{-15}$	femto	f
0.000 000 000 000 000 001	$= 10^{-18}$	atto	a

Table 2. Non-SI units for use with the SI

Specific quantities in Table 3-4 related to	Unit	Symbol	Definition (in terms of SI units)
mass	tonne	t	$1\ t = 10^3\ kg$
plane angle	degree	°	$1° = (\pi/180)\ rad$
	minute	'	$1' = (1/60)° = (\pi/10\ 800)\ rad$
	second	"	$1'' = (1/60)' = (\pi/648\ 000)\ rad$
temperature	degree Celsius	°C	1 unit °C = 1 unit K[a]
time	minute	min	1 min = 60 s
	hour	h	1 h = 60 min = 3 600 s
	day	d	1 d = 24 h = 86 400 s
	week, month, year	—	
volume	litre	L	$1\ L = 1\ dm^3 = 10^{-3}\ m^3$

Table 3. Non-SI units for temporary use with the SI

Specific quantities in Table 3-4 related to	Unit	Symbol	Definition (in terms of SI units)
distance (long)	nautical mile	NM	1 NM = 1 852 m
distance (vertical)[a]	foot	ft	1 ft = 0.304 8 m
speed	knot	kt	1 kt = 0.514 444 m/s

a) altitude, elevation, height, vertical speed

Table 4. Standard application of specific units of measurement

Ref. No.	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
1. *Direction/Space/Time*			
1.1	altitude	m	ft
1.2	area	m²	
1.3	distance (long)[a]	km	NM
1.4	distance (short)	m	
1.5	elevation	m	ft
1.6	endurance	h and min	
1.7	height	m	ft
1.8	latitude	° ′ ″	
1.9	length	m	
1.10	longitude	° ′ ″	
1.11	plane angle (when required, decimal subdivisions of the degree shall be used)	°	
1.12	runway length	m	
1.13	runway visual range	m	
1.14	tank capacities (aircraft)[b]	L	
1.15	time	s	min h d week month year
1.16	visibility[c]		km
1.17	volume		m³
1.18	wind direction (wind directions other than for a landing and take-off shall be expressed in degrees true; for landing and take-off wind directions shall be expressed in degrees magnetic)		°

2. *Mass-related*

2.1	air density	kg/m³
2.2	area density	kg/m²
2.3	cargo capacity	kg
2.4	cargo density	kg/m³
2.5	density (mass density)	kg/m³
2.6	fuel capacity (gravimetric)	kg
2.7	gas density	kg/m³
2.8	gross mass or payload	kg
		t
2.9	hoisting provisions	kg
2.10	linear density	kg/m
2.11	liquid density	kg/m³
2.12	mass	kg
2.13	moment of inertia	kg · m²
2.14	moment of momentum	kg · m²/s
2.15	momentum	kg · m/s

3. *Force-related*

3.1	air pressure (general)	kPa
3.2	altimeter setting	hPa
3.3	atmospheric pressure	hPa
3.4	bending moment	kN · m
3.5	force	N
3.6	fuel supply pressure	kPa
3.7	hydraulic pressure	kPa
3.8	modulus of elasticity	MPa
3.9	pressure	kPa
3.10	stress	MPa
3.11	surface tension	mN/m
3.12	thrust	kN
3.13	torque	N · m
3.14	vacuum	Pa

4. *Mechanics*

4.1	airspeed[d]	km/h	kt
4.2	angular acceleration	rad/s²	
4.3	angular velocity	rad/s	
4.4	energy or work	J	

4	4.5	equivalent shaft power	kW	
M	4.6	frequency	Hz	
e				
c	4.7	groundspeed	km/h	kt
h				
a	4.8	impact	J/m^2	
n				
i	4.9	kinetic energy absorbed by brakes	MJ	
c				
s	4.10	linear acceleration	m/s^2	
	4.11	Power	kW	
	4.12	rate of trim	°/s	
	4.13	shaft power	kW	
	4.14	velocity	m/s	
	4.15	vertical speed	m/s	ft/min
	4.16	wind speed	m/s	kt

5. Flow

5.1	engine airflow	kg/s
5.2	engine waterflow	kg/h
5.3	fuel consumption (specific)	
	piston engines	kg/(kW · h)
	turbo-shaft engines	kg/(kW · h)
	jet engines	kg/(kN · h)
5.4	fuel flow	kg/h
5.5	fuel tank filling rate (gravimetric)	kg/min
5.6	gas flow	kg/s
5.7	liquid flow (gravimetric)	g/s
5.8	liquid flow (volumetric)	L/s
5.9	mass flow	kg/s
5.10	oil consumption	
	gas turbine	kg/h
	piston engines (specific)	g/(kW · h)
5.11	oil flow	g/s
5.12	pump capacity	L/min
5.13	ventilation airflow	m^3/min
5.14	viscosity (dynamic)	Pa · s
5.15	viscosity (kinematic)	m^2/s

6. Thermodynamics

6.1	coefficient of heat transfer	$W/(m^2 \cdot K)$
6.2	heat flow per unit area	J/m^2
6.3	heat flow rate	W
6.4	humidity (absolute)	g/kg
6.5	coefficient of linear expansion	$°C^{-1}$
6.6	quantity of heat	J
6.7	temperature	°C

7. Electricity and magnetism

7.1	capacitance	F
7.2	conductance	S
7.3	conductivity	S/m
7.4	current density	A/m^2
7.5	electric current	A
7.6	electric field strength	C/m^2
7.7	electric potential	V
7.8	electromotive force	V
7.9	magnetic field strength	A/m
7.10	magnetic flux	Wb
7.11	magnetic flux density	T
7.12	power	W
7.13	quantity of electricity	C
7.14	resistance	Ω

8. Light and related electromagnetic radiations

8.1	illuminance	lx
8.2	luminance	cd/m^2
8.3	luminous exitance	lm/m^2
8.4	luminous flux	lm
8.5	luminous intensity	cd
8.6	quantity of light	$lm \cdot s$
8.7	radiant energy	J
8.8	wavelength	m

9. Acoustics

9.1	frequency	Hz
9.2	mass density	kg/m^3
9.3	noise level	dB[e]
9.4	period, periodic time	s
9.5	sound intensity	W/m^2
9.6	sound power	W
9.7	sound pressure	Pa
9.8	sound level	dB[f]
9.9	static pressure (instantaneous)	Pa
9.10	velocity of sound	m/s
9.11	volume velocity (instantaneous)	m^3/s
9.12	wavelength	m

10.1	absorbed dose	Gy
10.2	absorbed dose rate	Gy/s
10.3	activity of radionuclides	Bq
10.4	dose equivalent	Sv
10.5	radiation exposure	C/kg
10.6	exposure rate	C/kg · s

a) As used in navigation, generally in excess of 4 000 m.
b) Such as aircraft fuel, hydraulic fluids, water, oil and high pressure oxygen vessels.
c) Visibility of less than 5 km may be given in m.
d) Airspeed is sometimes reported in flight operations in terms of the ratio MACH number.
e) A conversion of 1 kt = 0.5 m s is used in ICAO Annexes for the representation of wind speed.
f) The decibel (dB) is a ratio which may be used as a unit for expressing sound pressure level and sound power level. When used, the reference level must be specified.

Table 5. SI Base Units

Quantity	Unit	Symbol
amount of substance	mole	mol
electric current	ampere	A
length	metre	m
luminous intensity	candela	cd
mass	kilogram	kg
thermodynamic	kelvin	K
time	second	s

Table 6. SI Supplementary units

Quantity	Unit	Symbol
plane angle	radian	rad
solid angle	steradian	sr

Table 7. SI Derived units with special names

Quantity	Unit	Symbol	Derivation
Absorbed dose (radiation)	gray	Gy	J/kg
activity and radionuclides	becquerel	Bq	1/s
capacitance	farad	F	C/V
conductance	siemens	S	A/V
dose equivalent radiation	sievert	Sv	J/kg
electric potential, potential difference, electromotive force	volt	V	W/A
electric resistance	ohm	Ω	V/A
energy, work, quantity of heat	joule	J	N · m
force	newton	N	kg ·m/s2
frequency (of a	hertz	Hz	1/s

periodic phenomenon)			
illuminance	lux	lx	lm/m2
Inductance	henry	H	Wb/A
luminous flux	lumen	lm	cd · sr
magnetic flux density	tesla	T	Wb/m2
power, radiant flux	watt	W	J/s
pressure, stress	pascal	Pa	N/m2
quantity of electricity, electric charge	coulomb	C	A ·s

MADE this 27th day of May, 2022.

ERIC MOTHIBI MOLALE,
Minister of Transport and Public Works.