Gibraltar Director of Civil Aviation

Units of Measurements

Direction 01

Contents

Revision History

Version	Item	Date
1	Initial Issue	22 May 2009
2	Complete Review	22 November 2022
3	Review to align wording with Annex 5 wording	21 May 2025

Rationale

Annex 5 to the Chicago Convention contains specifications for the use of a standardized system of units of measurement in international civil aviation air and ground operations. This standardized system of units of measurement is based on the International System of Units (SI) and certain non-SI units considered necessary to meet the specialized requirements of international civil aviation.

The units of measurement to be used in Gibraltar when exercising the privileges of any licence, approval or certificate issued, validated or recognised by the Gibraltar Director of Civil Aviation (DCA), or when conducting any operation which is subject to the Gibraltar Civil Aviation Act 2009, are defined and detailed in this Direction.

1. Direction

As Director of Civil Aviation, in the exercise of my powers under section 17(1) of the Civil Aviation Act 2009, I direct that all persons:

- exercising the privileges of any licence, approval or certificate issued or validated by the Gibraltar DCA;
- conducting any air or ground operation that is subject to the Gibraltar Civil Aviation Act 2009;

are to use the Units of Measurement set out in this Direction.

2. Applicability

This Direction shall be applicable to all aspects of international civil aviation air and ground operations.

Note: These regulations contain specifications for the use of a standardized system of units of measurement in international civil aviation air and ground operations. This standardized system of units of measurement is based on the International System of Units (SI) and certain non-SI units considered necessary to meet the specialized requirements of international civil aviation.

3. Standard Application of Units of Measurement

3.1 SI units

3.1.1 The International System of Units developed and maintained by the General Conference of Weights and Measures (CGPM) shall, subject to the provisions of 3.2 and 3.3, be used as the standard system of units of measurement for all aspects of international civil aviation air and ground operations.

3.1.2 Prefixes

The prefixes and symbols listed in Table 3 shall be used to form names and symbols of the decimal multiples and sub- multiples of SI units.

Note: As used herein the term SI unit is meant to include base units and derived units as

well as their multiples and sub-multiples.

3.2 Non-SI Units

3.2.1 The non-SI units listed in Table 6 shall be used either in lieu of, or in addition to, SI units as primary units of measurement but only as specified in Table 2.

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

Note: It is intended that the use of the non-SI alternative units listed in Table 4 and applied as indicated in Table 2 will eventually be discontinued in accordance with individual unit termination dates established by ICAO.

3.3 Application of Specific Units

3.3.1 The application of units of measurement for certain quantities used in international civil aviation air and ground operations shall be in accordance with Table 2.

Note: Table 2 is intended to provide standardization of units (including prefixes) for those quantities commonly used in air and ground operations. Basic Annex provisions apply for units to be used for quantities not listed.

3.3.2 Means and provisions for design, procedures and training should 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.

Note. Guidance material on human performance can be found in the Human Factors Training Manual (Doc 9683).

4. Termination of use of Non-SI Units

Note.— The non-SI units listed in Table 4 have been retained temporarily for use as alternative units because of their widespread use and to avoid potential safety problems which could result from the lack of international coordination concerning the termination of their use. As termination dates are established by the Council, they will be reflected as Standards contained in this Chapter. It is expected that the establishment of such dates will be well in advance of actual termination. Any special procedures associated with specific unit termination will be circulated to all States separately from this Annex.

4.1 The use in international civil aviation operations of the alternative non-SI units listed in Table 4 shall be terminated on dates to be established by ICAO.

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Director of Civil Aviation
21 May 2025

Table 1. Definitions

When the following terms are used concerning the units of measurement to be used in all aspects of international civil aviation air and ground operations, they have the following meanings.

Unit	Symbol	Definition
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 x 10 -7 Newton per metre of length
Becquerel	Bq	The activity of a radionuclide having one spontaneous nuclear transition per second
Candela	cd	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	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	The quantity of electricity transported in 1 second by a current of 1 ampere
Degree Celsius	°C	The special name for the unit Kelvin for use in stating values of Celsius temperature
Farad	F	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	The length equal to 0.3048 metre exactly
Gray	Gy	The energy imparted by ionizing radiation to a mass of matter corresponding to 1 joule per kilogram
Henry	H	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	The frequency of a periodic phenomenon of which the period is 1 second
Human performance		Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations
Joule	J	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	A unit of thermodynamic temperature which is the fraction 1/273.16 of the thermodynamic temperature of the triple point of

		water
Kilogram	kg	The unit of mass equal to the mass of the international prototype of the kilogram
Knot	kt	The speed equal to 1 nautical mile per hour
Litre	L	A unit of volume restricted to the measurement of liquids and gases which is equal to 1 cubic decimetre
Lumen	lm	The luminous flux emitted in a solid angle of 1 Steradian by a point source having a uniform intensity of 1 candela
Lux	lx	The illuminance produced by a luminous flux of 1 lumen uniformly distributed over a surface of 1 square metre
Metre	m	The distance travelled by light in a vacuum during 1/299,792,458 of a second
Mole	mol	The amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12 Note-- When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles or specified groups of such particles
Nautical mile	NM	The length equal to 1,852 metres exactly
Newton	N	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	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	The pressure or stress of 1 Newton per square metre
Radian	rad	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	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	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	The unit of radiation dose equivalent corresponding to 1 joule per kilogram
Steradian	sr	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	The magnetic flux density given by a magnetic flux of 1 Weber

		per square metre
Tonne	t	The mass equal to 1,000 kilograms
Volt	V	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	The power which gives rise to the production of energy at the rate of 1 joule per second
Weber	Wb	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

Table 2. 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 – (see Note A)	M	**ft**
	1.2	area	m^2	
	1.3	distance (long) - (see Note B)	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 – (see note C)	º ' "	
	1.9	length	M	
	1.10	longitude - (see note C)	º ' "	
	1.11	plane angle (when required, decimal subdivisions of the degree shall be used)	º	
	1.12	runway length	m	
	1.13	runway visual range	m	
	1.14	tank capacities (aircraft) - (see Note D)	L	
	1.15	time – (Note E)	s	
			min	
			h	
			d	
			week	
			month	
			year	
	1.16	Visibility - (see Note F)	km	
	1.17	volume	m^3	
	1.18	Wind direction (wind directions other than for a landing and take-off expressed in degrees true; for landing and take-off wind directions expressed in degrees magnetic)	º	
2. Mass-related – (see Note G)				

	2.1	air density	kg/m^3	
	2.2	area density	kg/m^2	
	2.3	cargo capacity	kg	
	2.4	cargo density	kg/m^3	
	2.5	density (mass density)	kg/m^3	
	2.6	fuel capacity (gravimetric)	kg	
	2.7	gas density	kg/m^3	
	2.8	gross mass or payload	kg	
	2.9	hoisting provisions	Kg	
	2.10	linear density	kg/m	
	2.11	liquid density	kg/m^3	
	2.12	mass	Kg	
	2.13	moment of inertia	$kg \cdot m^2$	
	2.14	moment of momentum	$kg \cdot m^2/s$	
	2.15	momentum	$kg \cdot m/s$	
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 - (see Note H)	km/h	**kt**
	4.2	angular acceleration	rad/s^2	
	4.3	angular velocity	rad/s	
	4.4	energy or work	J	
	4.5	equivalent shaft power	kW	
	4.6	frequency	Hz	
	4.7	ground speed	Km/h	**kt**
	4.8	impact	J/m^2	
	4.9	kinetic energy absorbed by brakes	MJ	
	4.10	linear acceleration	m/s^2	
	4.11	power	kW	
	4.12	rate of trim	º/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 air flow	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.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.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 (see Note I)	
	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 (see Note J)	
	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. Nuclear physics and ionizing radiation				
	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	
Notes				
	A)	Mean sea level (MSL) datum, which gives the relationship of gravity-related height (elevation) to a surface known as the geoid, shall be used as the vertical reference system for air navigation.		

	B)	As used in navigation, generally in excess of 4,000m
	C)	Based on the World Geodetic System (WGS84)
	D)	Such as aircraft fuel, hydraulic fluids, water, oil and high pressure oxygen vessels
	E)	The Gregorian calendar and Coordinated Universal Time (UTC) shall be used as the temporal reference system for air navigation.
	F)	Visibility of less than 5 km may be given in m
	G)	The Earth Gravitational Model — 1996 (EGM-96) shall be used as the global gravity model for air navigation.
	H)	Airspeed is sometimes reported in flight operations in terms of the ratio MACH number.
	I)	A conversion of 1kt=0.5m/s is used in ICAO Annexes for the representation of wind speed
	J)	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 3. 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 4. Non-SI alternative units permitted for temporary use with SI

Specific quantities in Table 2 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 = 0.3048 m
speed	Knot	kt	1 kt = 0.514 444
a) altitude, elevation, height, vertical speed			

Table 5. Date/ time format

Date	**In alphanumeric form**	**day month year**
	In numeric form	Year (4 digits) month (2 digits) day (2 digits)
Time		hh:mm:ss
Co-ordinated Universal Time used with the day commencing at midnight		
Decimal seconds where required		

Table 6 – 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	$1t = 10^3 kg$
plane angle	degree	°	$1° = (\pi/180)$ rad
	minute	‘	
	second	“	
temperature	Degree Celsius	°C	I unit °C = I unit K
time	minute	min	1 min =60 s
	hour	h	1h = 60min =3,600s
	day	d	1d = 24h = 86400s
	week, month, year	-	
volume	litre	L	$1L=1dm^3 =10^{-3}m^3$