


<b>Irish Aviation Authority</b> The Times Building 11-12 D'Olier Street Dublin 2, Ireland <a href="http://www.iaa.ie">www.iaa.ie</a>  <b>Safety Regulation Division</b>	<b>Udarás Eitlíochta na hÉireann</b> Foirgneamh na hAmanna 11-12 Sráid D'Olier Baile Átha Cliath 2, Éire  <b>Rannán na Rialachán Sábháilteachta</b>	No.            GAM 01 Revision:    00 Date:         03.10.17	
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## TITLE: International System of Units (SI)

### 1. PURPOSE OF DOCUMENT

The purpose of this memorandum is to specify the International System of Units (SI) as they apply to aviation in Ireland. This is contained in Table 1 below. This GAM replaces GAM 05/09 dated December 2009.

### 2. INTRODUCTION

Ireland uses the International System of Units (SI) as defined by the Bureau International des Poids et Mesures (BIPM) operating under the supervision of the International Committee of Weights and Measures (CIPM) and the General Conference of Weights and Measures.

The International System of Units (SI) is based on 7 base units i.e. the metre, kilogram, second, ampere, Kelvin, mole and candela. All other units used are derivatives of the base units. Ireland has given legal effect to the use of the International System of Units through SI No. 255 / 1992 – European Communities (Units of Measurement) Regulations, 1992 as amended.

The International Civil Aviation Organisation (ICAO) requires contracting states, through Annex 5 to the Chicago convention, to implement the International System of Units (SI). This requirement is met in Ireland through the above referenced legislation, SI 255 of 1992, as amended. In addition AIP Ireland specifies that units of measurement are in accordance with ICAO Annex 5.

### 3. DEFINITIONS

**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 meter apart in vacuum, would produce between these conductors a force equal to  $2 \times 10^{-7}$  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 ( $t^{\circ}C$ ).** The Celsius temperature is equal to the difference  $t^{\circ}C = T - T_0$  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 ( $^{\circ}C$ ).** The special name for the unit Kelvin for use in stating values of Celsius temperature.

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**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 equals 1 coulomb.

**Foot (ft).** The length equal to 0.304 8 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 of 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.

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*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 ( $\Omega$ ).** 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.


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**TABLE 1: STANDARD APPLICATION OF SPECIFIC UNITS OF MEASUREMENT**


<i>Ref. No.</i>	<i>Quantity</i>	<i>Primary unit (symbol)</i>	<i>Non SI alternative unit</i>
<b>1</b>	<b>Direction /Space/Time</b>		
1.1	altitude	m	ft
1.2	area distance	m <sup>2</sup>	
1.3	(long) <sup>a)</sup>	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) <sup>b)</sup>	L	
1.15	time	s min h d week month year	
1.16	visibility <sup>c)</sup>	km	
1.17	volume	m <sup>3</sup>	
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)	°	

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<i>Ref. No.</i>	<i>Quantity</i>	<i>Primary unit (symbol)</i>	<i>Non SI alternative unit</i>
<b>2.</b>	<b>Mass-related</b>		
2.1	air density	kg/m <sup>3</sup>	
2.2	area density	kg/m <sup>2</sup>	
2.3	cargo capacity	kg	
2.4	cargo density	kg/m <sup>3</sup>	
2.5	density (mass density)	kg/m <sup>3</sup>	
2.6	fuel capacity (gravimetric)	kg	
2.7	gas density	kg/m <sup>3</sup>	
2.8	gross mass or payload	kg	
		t	
2.9	hoisting provisions	kg	
2.10	linear density	kg/m	
2.11	liquid density	kg/m <sup>3</sup>	
2.12	mass	kg	
2.13	moment of inertia	kg · m <sup>2</sup>	
2.14	moment of momentum	kg · m <sup>2</sup> /s	
2.15	momentum	kg · m/s	
<b>3</b>	<b>Force-related</b>		
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	

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<i>Ref. No.</i>	<i>Quantity</i>	<i>Primary unit (symbol)</i>	<i>Non SI alternative unit</i>
<b>4</b>	<b>Mechanics</b>		
4.1	airspeed <sup>d)</sup>	km/h	kt
4.2	angular acceleration	rad/s <sup>2</sup>	
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 <sup>2</sup>	
4.9	kinetic energy absorbed by brakes	MJ	
4.10	linear acceleration	m/s <sup>2</sup>	
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	km/h	kt

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<b>5</b>	<b>Flow</b>		
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 piston engines (specific)	kg/h g/( kW · h)	
5.11	oil flow	g/s	
5.12	pump capacity	L/min	
5.13	ventilation airflow	m <sup>3</sup> /min	
5.14	viscosity (dynamic)	Pa · s	
5.15	viscosity (kinematic)	m <sup>2</sup> /s	
<b>6</b>	<b>Thermodynamics</b>		
6.1	coefficient of heat transfer	W/(m <sup>2</sup> · K)	
6.2	heat flow per unit area	J/m <sup>2</sup>	
6.3	heat flow rate	W	
6.4	humidity (absolute)	g/kg	
6.5	coefficient of linear expansion	°C <sup>-1</sup>	
6.6	quantity of heat	J	
6.7	temperature	°C	

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## **7                    Electricity and magnetism**

7.1	capacitance	F	
7.2	conductance	S	
7.3	conductivity	S/m	
7.4	current density	A/m <sup>2</sup>	
7.5	electric current	A	
7.6	electric field strength	C/m <sup>2</sup>	
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 <sup>2</sup>	
8.3	luminous exitance	lm/m <sup>2</sup>	
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	



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## **9                   Acoustics**

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

- a) As used in navigation, generally in excess of 4000m.  
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) The decibel (dB) is a ratio which may be used as a unit expressing sound pressure level and sound power level. When used, the reference level must be specified.