Civil Aviation Authority of Bangladesh

Gazette

Dhaka, ……….,1430/   March, 2024

No. CAAB 30.31.0000.111.37.006.23 – In exercise of the power conferred by Section 47, read with Section 14 of the Civil Aviation Act, 2017 (Act No. 18 of 2017), hereinafter referred as the "Act", the Chairman of the Civil Aviation Authority of Bangladesh is pleased to issue this Air Navigation Order (ANO) "ANO-5 Issue 01 on Units of Measurement to be used in Air and Ground Operations".

2. This ANO shall come into force on the date of its final publication in the Official Gazette.

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Chapter 1 GENERAL

1.1   Short Title and Commencement

This Air Navigation Order (ANO) may be called the ANO 5 – *"Units of Measurements to be used in Air and Ground Operations"*, issued in accordance with the *ICAO Annex 5 – "Units of Measurements to be used in Air and Ground Operations"* (5th Edition up to *the amendment 17*) to the Chicago Convention and referred herein as the "ANO 5" Issue 01. This ANO shall be effective immediately upon published in this Official Gazette.

1.2   Applicability

Note.— This ANO 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.

1.2.1   This Air Navigation Order— Units of Measurement to be used in Air and Ground Operations (hereafter referred to as the "ANO-5") shall be applicable to all aspects of international civil aviation air and ground operations in Bangladesh.

1.2.2   The provisions in this ANO are based on the Standards and Recommended Practices (SARPs) adopted by the International Civil Aviation Organization (ICAO) and incorporated in the Amendment No.17 to Annex 5 – "Units of Measurements to be used in Air and Ground Operations"

1.2.3   Where there is a difference between a provision in this ANO and that of the ICAO Annexes, differences, where they exist, between the provisions in this ANO and those contained in the relevant ICAO Annexes shall be published in section GEN 1.7 of the Bangladesh AIP and also notified to ICAO.

1.2.4   All operators and service providers involved in international civil aviation air and ground operations in Bangladesh shall comply with all provisions set out in this ANO at all times.

Chapter 2 DEFINITIONS

2.1 Definitions

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

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 a 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°C)
The Celsius temperature is equal to the difference $t°C = T – T0$ between two thermodynamic temperatures T and T0 where T0 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 0.304 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 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.

Chapter 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 in Bangladesh.

3.1.2   The prefixes and symbols listed in Table 3-1 shall be used to form names and symbols of the decimal multiples and submultiples of SI units.

Table 3-1:   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

3.2   Non-SI units

3.2.1   Non-SI units for permanent use with the SI

The non-SI units listed in Table 3-2 shall be used either in lieu of, or in addition to, SI units as primary units of measurement but only as specified in Table 3-4.

3.2.2   Non-SI alternative units permitted for temporary use with the SI

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

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 3-4.

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).*

Table 3-2:   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 minute second	° ' "	$1^0 = (\pi/180)$ rad $1' = (1/60)°$ $= (\pi/10{,}800)$rad $1" = (1/60)'$ $= (\pi/648{,}000)$ rad
temperature	degree Celsius	°C	1 unit ^0C = 1 unit $K^{a)}$
time	minute hour day week month year	min h d - - 	1 min = 60 s 1 h = 60 min = 3,600 s 1 d = 24 h = 86,400 s
volume	litre	L	$1\,L = 1\,dm^3 = 10^{-3}\,m^3$

a) See Table 3-5 for conversion.

Table 3-3:   Non-SI alternative units permitted 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 3-4:   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)	°	

Table 3-4: Standard application of specific units of measurement (Contd…)

Ref. No	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
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	$kg . m^2$	
2.14	moment of momentum	$kg . m^2/s$	
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	

Table 3-4:   Standard application of specific units of measurement (Contd…)

Ref. No	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
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	
4.5	equivalent shaft power	kW	
4.6	frequency	Hz	
4.7	ground speed	Km/h	kt
4.8	impact	J/m²	
4.9	kinetic energy absorbed by brakes	MJ	
4.10	linear acceleration	m/s²	
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 [e]	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	m³/min	
5.14	viscosity (dynamic)	Pa . s	
5.15	viscosity (kinematic)	m²/s	

Table 3-4:   Standard application of specific units of measurement (Contd…)

Ref. No	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
6.	**Thermodynamics**		
6.1	coefficient of heat transfer	W/(m².K)	
6.2	heat flow per unit area	J/ m²	
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/ m²	
7.5	electric current	A	
7.6	electric field strength	C/ m²	
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/ m²	
8.3	luminous exitance	lm/ m²	
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/m³	
9.3	noise level	dB [e)]	
9.4	period, periodic time	s	
9.5	sound intensity	W/ m²	

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)	m³/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 radio nuclides	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) A conversion of 1 kt = 0.5 m/s may be used 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 3-5: Temperature conversion formulae

To convert from	*to*	*Use formula*
Celsius temperature (t°_C)	Kelvin temperature (t_K)	$t_K = t^\circ_C + 273.15$
Fahrenheit temperature (t°_F)	Celsius temperature (t°_C)	$t^\circ_C = (t^\circ_F - 32)/1.8$
Fahrenheit temperature (t°_F)	Kelvin temperature (t_K)	$t_K = (t^\circ_F + 459.67)/1.8$
Kelvin temperature (t_K)	Celsius temperature (t°_C)	$t^\circ_C = t_K - 273.15$
Rankine temperature (t°_R)	Kelvin temperature (t_K)	$t_K = t^\circ_R/1.8$

Note.— See Attachment C of ICAO Annex 5 for the list of conversion factors provided to express the definitions of miscellaneous units of measure as numerical multiples of SI units.

Chapter 4 TERMINATION OF USE OF NON-SI ALTERNATIVE UNITS

4.1   The use in international civil aviation operations of the alternative non-SI units listed in Table 3-3 shall be terminated on the dates listed in Table 4-1.

Table 4-1.   Termination dates for non-SI alternative units

Non-SI alternative unit	Termination date
Knot Nautical mile	not established [a]
Foot	not established [b]

a) No termination date has yet been established for use of nautical mile and knot.
b) No termination date has yet been established for use of the foot.

Chapter 5 REPEAL AND SAVINGS

5.1   As soon as may be after the commencement of this ANO, the First Edition of ANO (Units of Measurement) A-1 issued on 10th May 2009 shall stand repealed.

5.2   Despite such repeal under sub-section (5.1),

   (a) any act done, measures taken, any order, ANO, circular, or notice issued, certificate, licence or permit given or any agreement entered into or document signed under the said ANO shall be deemed to have done, taken, entered, issued, given, made or signed under this ANO;

   (b) any proceeding, going on or pending, shall, in so far as possible, be disposed of under this ANO; and

   (c) any suit and other legal proceedings instituted before any court shall, if pending, be disposed of in such way as if the said ANO had not been repealed.

— END —