Civil Aviation Requirements
For
Units of Measurement
To be used in Air and Ground Operations

CAR - 5


Civil Aviation Authority of Nepal
Amendments

Amendments and Corrigenda to these Civil Aviation Requirements for "Units of Measurement" Nepal are issued by Director General of CAA, Nepal. The space below is provided to keep a record of such amendments.

Record of amendments and corrigenda

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<th>CORRIGENDA</th>
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</thead>
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<td>No.</td>
<td>DATE APPLICABLE</td>
</tr>
<tr>
<td>No.</td>
<td>DATE APPLICABLE</td>
</tr>
</tbody>
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FOREWORD

Article 28 (Air navigation facilities and standard system) of the Convention on International Civil Aviation requires each contracting State to provide, in its territory, airports radio services, meteorological services and other air navigation facilities to facilitate international air navigation, in accordance with the standards and recommended practices or established from time to time, pursuant to the Convention.

ICAO Annex 5 provides the Standards and Recommended Practices pertaining to the units and measurements to be used in Air and Ground Operations which are required to be adopted by the Contracting State.

This CAR Units of Measurements is enacted by Civil Aviation Authority of Nepal pursuant to Clause 5 Sub-Clause "Pha" and Clause 35 of Civil Aviation Authority of Nepal Act, 2053 (1996).

This CAR specifies the national standard for Units of Measurements to be used in air and ground operations.

All other legislations still stand valid as a part of Civil Aviation requirements for practical purposes.

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(Director General)
Civil Aviation Authority of Nepal
Chapter 1. DEFINITIONS

When the following terms are used in the CAR, 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 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 (°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 (°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 (W). 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 2. APPLICABILITY

2.1 The units as given in Table 2.1 shall be used for all aspects of air and ground operations.

<table>
<thead>
<tr>
<th>Ref. No.</th>
<th>Quantity</th>
<th>Unit to be used (symbol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>altitude</td>
<td>ft</td>
</tr>
<tr>
<td>1.2</td>
<td>area</td>
<td>M²</td>
</tr>
<tr>
<td>1.3</td>
<td>distance (long)</td>
<td>NM</td>
</tr>
<tr>
<td>1.4</td>
<td>distance (short)</td>
<td>M</td>
</tr>
<tr>
<td>1.5</td>
<td>elevation</td>
<td>ft</td>
</tr>
<tr>
<td>1.6</td>
<td>endurance</td>
<td>h and min</td>
</tr>
<tr>
<td>1.7</td>
<td>height</td>
<td>ft</td>
</tr>
<tr>
<td>1.8</td>
<td>latitude</td>
<td>° ' &quot;</td>
</tr>
<tr>
<td>1.9</td>
<td>length</td>
<td>m</td>
</tr>
<tr>
<td>1.10</td>
<td>longitude</td>
<td>° ' &quot;</td>
</tr>
<tr>
<td>1.11</td>
<td>plane angle (when required, decimal subdivisions of the degree shall be used)</td>
<td>°</td>
</tr>
<tr>
<td>1.12</td>
<td>runway length</td>
<td>m</td>
</tr>
<tr>
<td>1.13</td>
<td>runway visual range</td>
<td>m</td>
</tr>
<tr>
<td>1.14</td>
<td>tank capacities (aircraft) b)</td>
<td>L</td>
</tr>
<tr>
<td>1.15</td>
<td>time</td>
<td>s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>min</td>
</tr>
<tr>
<td></td>
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<td>h</td>
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<td>d</td>
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<td></td>
<td></td>
<td>week</td>
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<tr>
<td></td>
<td></td>
<td>month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>year</td>
</tr>
<tr>
<td>1.16</td>
<td>Visibility c)</td>
<td>km</td>
</tr>
<tr>
<td>1.17</td>
<td>volume</td>
<td>m³</td>
</tr>
<tr>
<td>1.18</td>
<td>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)</td>
<td>°</td>
</tr>
</tbody>
</table>

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

2.9 hoisting provisions                              kg
2.10 linear density \( \text{kg/m} \)  
2.11 liquid density \( \text{kg/m}^3 \)  
2.12 mass \( \text{kg} \)  
2.13 moment of inertia \( \text{kg} \cdot \text{m}^2 \)  
2.14 moment of momentum \( \text{kg} \cdot \text{m}^2/\text{s} \)  
2.15 momentum \( \text{kg} \cdot \text{m/s} \)  

### 3. Force-related

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

### 4. Mechanics

4.1 airspeed \( \text{kt} \)  
4.2 angular acceleration \( \text{rad/s}^2 \)  
4.3 angular velocity \( \text{rad/s} \)  
4.4 energy or work \( \text{J} \)  
4.5 equivalent shaft power \( \text{kW} \)  
4.6 frequency \( \text{Hz} \)  
4.7 ground speed \( \text{kt} \)  
4.8 impact \( \text{J/m}^2 \)  
4.9 kinetic energy absorbed by brakes \( \text{MJ} \)  
4.10 linear acceleration \( \text{m/s}^2 \)  
4.11 power \( \text{kW} \)  
4.12 rate of trim \( \text{°/s} \)  
4.13 shaft power \( \text{kW} \)  
4.14 velocity \( \text{m/s} \)  
4.15 vertical speed \( \text{ft/min} \)  
4.16 wind speed \( \text{kt} \)  

### 5. Flow

5.1 engine airflow \( \text{kg/s} \)  
5.2 engine waterflow \( \text{kg/h} \)  
5.3 fuel consumption (specific)  
   - piston engines \( \text{kg}/(\text{kW.h}) \)  
   - turbo-shaft engines \( \text{kg}/(\text{kW.h}) \)  
   - jet engines \( \text{kg}/(\text{kN.h}) \)  
5.4 fuel flow \( \text{kg/h} \)  
5.5 fuel tank filling rate (gravimetric) \( \text{kg/min} \)
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

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 V/m
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
9.2 mass density
9.3 noise level
9.4 period, periodic time
9.5 sound intensity
9.6 sound power
9.7 sound pressure
9.8 sound level
9.9 static pressure (instantaneous)
9.10 velocity of sound
9.11 volume velocity (instantaneous)
9.12 wavelength

10. Nuclear physics and ionizing radiation

10.1 absorbed dose
10.2 absorbed dose rate
10.3 activity of radionuclides
10.4 dose equivalent
10.5 radiation exposure
10.6 exposure rate

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 for expressing sound pressure level and sound power level. When used, the reference level must be specified.

Table 2-2. Unit prefixes

<table>
<thead>
<tr>
<th>Multiplication factor</th>
<th>Prefix</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10^{18})</td>
<td>exa</td>
<td>E</td>
</tr>
<tr>
<td>(10^{15})</td>
<td>peta</td>
<td>P</td>
</tr>
<tr>
<td>(10^{12})</td>
<td>tera</td>
<td>T</td>
</tr>
<tr>
<td>(10^9)</td>
<td>giga</td>
<td>G</td>
</tr>
<tr>
<td>(10^6)</td>
<td>mega</td>
<td>M</td>
</tr>
<tr>
<td>(10^3)</td>
<td>kilo</td>
<td>K</td>
</tr>
<tr>
<td>(10^2)</td>
<td>hecto</td>
<td>H</td>
</tr>
<tr>
<td>(10^1)</td>
<td>deca</td>
<td>da</td>
</tr>
<tr>
<td>0.1</td>
<td>deci</td>
<td>d</td>
</tr>
<tr>
<td>0.01</td>
<td>centi</td>
<td>c</td>
</tr>
<tr>
<td>0.001</td>
<td>Milli</td>
<td>m</td>
</tr>
<tr>
<td>0.000 001</td>
<td>Micro</td>
<td>g</td>
</tr>
<tr>
<td>0.000 000 001</td>
<td>Nano</td>
<td>n</td>
</tr>
<tr>
<td>Value</td>
<td>Prefix</td>
<td>Symbol</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>0.000 000 000 001</td>
<td>Pico</td>
<td>p</td>
</tr>
<tr>
<td>0.000 000 000 000 001</td>
<td>femto</td>
<td>f</td>
</tr>
<tr>
<td>0.000 000 000 000 000 001</td>
<td>atto</td>
<td>a</td>
</tr>
</tbody>
</table>
Table 2.3. Additional units for use with the above units

<table>
<thead>
<tr>
<th>Specific quantities in Table 3-4 related to</th>
<th>Unit</th>
<th>Symbol</th>
<th>Definition (in terms of SI units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mass</td>
<td>tonne</td>
<td>t'</td>
<td>1 t = 10³ kg</td>
</tr>
<tr>
<td>plane angle</td>
<td>degree</td>
<td>º</td>
<td>1º = (π/180) rad</td>
</tr>
<tr>
<td></td>
<td>minute</td>
<td>'</td>
<td>1' = (1/60)º = (π/10 800) rad</td>
</tr>
<tr>
<td></td>
<td>second</td>
<td>&quot;</td>
<td>1&quot; = (1/60)&quot; = (π/648 000) rad</td>
</tr>
<tr>
<td>temperature</td>
<td>degree Celsius</td>
<td>ºC</td>
<td>1 unit ºC = 1 unit K</td>
</tr>
<tr>
<td>time</td>
<td>minute</td>
<td>min</td>
<td>1 min = 60 s</td>
</tr>
<tr>
<td></td>
<td>hour</td>
<td>h</td>
<td>1 h = 60 min = 3600 s</td>
</tr>
<tr>
<td></td>
<td>day</td>
<td>d</td>
<td>1 d = 24 h = 86 400 s</td>
</tr>
<tr>
<td></td>
<td>week, month, year</td>
<td>_____</td>
<td></td>
</tr>
<tr>
<td>volume</td>
<td>litre</td>
<td>L</td>
<td>1 L = 1 dm³ = 10⁻³m³</td>
</tr>
</tbody>
</table>

a) See Table below for conversion

Temperature conversion formulae

<table>
<thead>
<tr>
<th>To convert from</th>
<th>to</th>
<th>Use formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Celsius temperature (t°C)</td>
<td>Kelvin temperature (t K)</td>
<td>t K = t °C + 273.15</td>
</tr>
<tr>
<td>Fahrenheit temperature (t°F)</td>
<td>Celsius temperature (t°C)</td>
<td>t °C = (t°F – 32)/1.8</td>
</tr>
<tr>
<td>Fahrenheit temperature (t°F)</td>
<td>Kelvin temperature (t K)</td>
<td>t K = (t°F + 459.67)/1.8</td>
</tr>
<tr>
<td>Kelvin temperature (t K)</td>
<td>Celsius temperature (t°C)</td>
<td>t °C = t K – 273.15</td>
</tr>
<tr>
<td>Rankine temperature (t°R)</td>
<td>Kelvin temperature (t K)</td>
<td>t K = t°R /1.8</td>
</tr>
</tbody>
</table>

Distance/speed conversion formulae

(alititude, elevation, height, vertical speed)

<table>
<thead>
<tr>
<th>To convert from</th>
<th>To</th>
<th>Use formulae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nautical Mile (NM)</td>
<td>Meter (m)</td>
<td>1 NM = 1852 m</td>
</tr>
<tr>
<td>Foot (ft)</td>
<td>Meter (m)</td>
<td>1 ft = 0.3048 m</td>
</tr>
<tr>
<td>Knot (kt)</td>
<td>Meter/second (m/s)</td>
<td>1 kt = 0.514 444 m/s</td>
</tr>
</tbody>
</table>

** END **