



Report on entire Annex

Annex Reference	UNITS OF MEASUREMENT TO BE USED IN AIR AND GROUND OPERATIONS Standard or Recommended Practice	State Legislation, Regulation or Document Reference	Level of implementation of SARP's	Text of the difference to be notified to ICAO	Comments including the reason for the difference
Chapter 1 Reference Definition	<p style="text-align: center;">INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES</p> <p style="text-align: center;">CHAPTER 1. DEFINITIONS</p> <p>When the following terms are used in the Standards and Recommended Practices concerning the units of measurement to be used in all aspects of international civil aviation air and ground operations, they have the following meanings:</p> <p>Lumen (lm). The luminous flux emitted in a solid angle of 1 steradian by a point source having a uniform intensity of 1 candela.</p>	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	<p>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 2×10^{-7} newton per metre of length.</p>	Civil Aviation Rule (CAR) 19.3 - Annex 5 is incorporated by reference in this rule.	No Difference		Civil Aviation Rules are available on the CAANZ website, http://www.caa.govt.nz/rules/rules/ .
Chapter 1 Reference Definition	<p>Becquerel (Bq). The activity of a radionuclide having one spontaneous nuclear transition per second.</p>	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Celsius temperature (t°C). The Celsius temperature is equal to the difference $t^{\circ}\text{C} = T - T_0$ between two thermodynamic temperatures T and T ₀ where T ₀ equals 273.15 kelvin.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Coulomb (C). The quantity of electricity transported in 1 second by a current of 1 ampere.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Degree Celsius (°C). The special name for the unit kelvin for use in stating values of Celsius temperature.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	Foot (ft). The length equal to 0.304 8 metre exactly.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Gray (Gy). The energy imparted by ionizing radiation to a mass of matter corresponding to 1 joule per kilogram.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Hertz (Hz). The frequency of a periodic phenomenon of which the period is 1 second.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Kelvin (K). A unit of thermodynamic temperature which is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Kilogram (kg). The unit of mass equal to the mass of the international prototype of the kilogram.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Knot (kt). The speed equal to 1 nautical mile per hour.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Litre (L). A unit of volume restricted to the measurement of liquids and gases which is equal to 1 cubic decimetre.	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	Lux (lx). The illuminance produced by a luminous flux of 1 lumen uniformly distributed over a surface of 1 square metre.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Metre (m). The distance travelled by light in a vacuum during 1/299 792 458 of a second.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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. <i>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.</i>	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Nautical mile (NM). The length equal to 1 852 metres exactly.	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Pascal (Pa). The pressure or stress of 1 newton per square metre.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Sievert (Sv). The unit of radiation dose equivalent corresponding to 1 joule per kilogram.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Tesla (T). The magnetic flux density given by a magnetic flux of 1 weber per square metre.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Tonne (t). The mass equal to 1 000 kilograms.	CAR 19.3.	No Difference		



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Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	Watt (W). The power which gives rise to the production of energy at the rate of 1 joule per second.	CAR 19.3.	No Difference		
Chapter 1 Reference Definition	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.	CAR 19.3.	No Difference		



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Chapter 2 Reference 2.1 Standard	<p align="center">CHAPTER 2. APPLICABILITY</p> <p><i>Introductory Note.— This Annex 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. See Attachment A for details concerning the development of the SI.</i></p> <p align="center">Applicability</p> <p>The Standards and Recommended Practices contained in this Annex shall be applicable to all aspects of international civil aviation air and ground operations.</p>	CAR 19.3.	No Difference		
Chapter 3 Reference 3.1.1 Standard	<p align="center">CHAPTER 3. STANDARD APPLICATION OF UNITS OF MEASUREMENT</p> <p align="center">3.1 SI Units</p> <p>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.</p>	CAR 19.3.	No Difference		



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Chapter 3 Reference 3.1.2 Standard	<p style="text-align: center;">Prefixes</p> <p>The prefixes and symbols listed in Table 3-1 shall be used to form names and symbols of the decimal multiples and sub-multiples of SI units.</p> <p><i>N1.As used herein the term SI unit is meant to include base units and derived units as well as their multiples and sub-multiples.</i></p> <p><i>N2.See Attachment B for guidance on the general application of prefixes.</i></p> <p style="text-align: center;">Table 3-1. SI unit prefixes</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><i>Multiplication factor</i></th> <th style="text-align: center;"><i>Symbol</i></th> <th style="text-align: right;"><i>Prefix</i></th> </tr> </thead> <tbody> <tr> <td>1 000 000 000 000 000 000</td> <td style="text-align: center;">=</td> <td>10¹⁸ exa</td> </tr> <tr> <td></td> <td style="text-align: center;">E</td> <td></td> </tr> <tr> <td>1 000 000 000 000 000</td> <td style="text-align: center;">=</td> <td>10¹⁵</td> </tr> <tr> <td></td> <td style="text-align: center;">peta</td> <td>P</td> </tr> <tr> <td>1 000 000 000 000</td> <td style="text-align: center;">=</td> <td>10¹² tera</td> </tr> <tr> <td></td> <td style="text-align: center;">T</td> <td></td> </tr> <tr> <td>1 000 000 000</td> <td style="text-align: center;">=</td> <td>10⁹</td> </tr> <tr> <td></td> <td style="text-align: center;">giga</td> <td>G</td> </tr> <tr> <td>1 000 000</td> <td style="text-align: center;">=</td> <td>10⁶</td> </tr> <tr> <td></td> <td style="text-align: center;">mega</td> <td>M</td> </tr> <tr> <td>1 000</td> <td style="text-align: center;">=</td> <td>10³ kilo</td> </tr> <tr> <td></td> <td style="text-align: center;">k</td> <td></td> </tr> <tr> <td>100</td> <td style="text-align: center;">=</td> <td>10²</td> </tr> <tr> <td></td> <td style="text-align: center;">hecto</td> <td>h</td> </tr> <tr> <td>10</td> <td style="text-align: center;">=</td> <td>10¹</td> </tr> <tr> <td></td> <td style="text-align: center;">deca</td> <td>da</td> </tr> <tr> <td>0.1</td> <td style="text-align: center;">=</td> <td>10⁻¹</td> </tr> <tr> <td></td> <td style="text-align: center;">deci</td> <td>d</td> </tr> <tr> <td>0.01</td> <td style="text-align: center;">=</td> <td>10⁻²</td> </tr> <tr> <td></td> <td style="text-align: center;">centi</td> <td>c</td> </tr> <tr> <td>0.001</td> <td style="text-align: center;">=</td> <td>10⁻³ milli</td> </tr> <tr> <td></td> <td style="text-align: center;">m</td> <td></td> </tr> </tbody> </table>	<i>Multiplication factor</i>	<i>Symbol</i>	<i>Prefix</i>	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		CAR 19.3.	No Difference		
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Chapter 3 Reference 3.2.1 Standard	<p style="text-align: center;">3.2 Non-SI Units</p> <p style="text-align: center;">Non-SI units for permanent use with the SI</p> <p>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.</p>	CAR 19.3.	No Difference																																



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Chapter 3 Reference 3.2.2 Standard	<p>Non-SI alternative units permitted for temporary use with the SI</p> <p>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.</p> <p><i>Note.— It is intended that the use of the non-SI alternative units listed in Table 3-3 and applied as indicated in Table 3-4 will eventually be discontinued in accordance with individual unit termination dates established by the Council. Termination dates, when established, will be given in Chapter 4.</i></p> <p style="text-align: center;">Table 3-2. Non-SI units for use with the SI</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><i>Specific quantities in Table 3-4 related to units)</i></th> <th style="text-align: center;"><i>Symbol</i></th> <th style="text-align: center;"><i>Definition (in terms of SI)</i></th> <th style="text-align: center;"><i>Unit</i></th> </tr> </thead> <tbody> <tr> <td>mass</td> <td style="text-align: center;">tonne</td> <td></td> <td style="text-align: center;">t 1 t</td> </tr> <tr> <td>= 103 kg</td> <td></td> <td></td> <td></td> </tr> <tr> <td>plane angle</td> <td style="text-align: center;">degree</td> <td></td> <td style="text-align: center;">° 1° =</td> </tr> <tr> <td>($\pi/180$) rad</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">minute</td> <td></td> <td style="text-align: center;">' 1' =</td> </tr> <tr> <td>(1/60)° = ($\pi/10\ 800$) rad</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">second</td> <td></td> <td style="text-align: center;">" 1"</td> </tr> <tr> <td>= (1/60)' = ($\pi/648\ 000$) rad</td> <td></td> <td></td> <td></td> </tr> <tr> <td>temperature</td> <td style="text-align: center;">degree Celcius</td> <td></td> <td style="text-align: center;">°C</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">1 unit °C = 1 unit K_a)</td> <td></td> </tr> <tr> <td>time</td> <td style="text-align: center;">minute</td> <td></td> <td style="text-align: center;">min</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">1 min = 60 s</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">hour</td> <td></td> <td style="text-align: center;">h 1 h</td> </tr> <tr> <td>= 60 min = 3 600 s</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">day</td> <td></td> <td style="text-align: center;">d 1 d</td> </tr> <tr> <td>= 24 h = 86 400 s</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">week, month, year</td> <td></td> <td style="text-align: center;">—</td> </tr> </tbody> </table>	<i>Specific quantities in Table 3-4 related to units)</i>	<i>Symbol</i>	<i>Definition (in terms of SI)</i>	<i>Unit</i>	mass	tonne		t 1 t	= 103 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 Celcius		°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		—	CAR 19.3.	No Difference		
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Chapter 3 Reference 3.3.1 Standard	<p style="text-align: center;">3.3 Application of specific units</p> <p>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.</p> <p><i>Note.— Table 3-4 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.</i></p>	CAR 19.3.	No Difference		



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Chapter 3 Reference 3.3.2 Recommendation	<p>Recommendation.— <i>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.</i></p> <p><i>Note.</i>— <i>Guidance material on human performance can be found in the Human Factors Training Manual (Doc 9683).</i></p> <p>Table 3-4. Standard application of specific units of measurement</p> <table border="1"> <thead> <tr> <th>Ref. No.</th> <th>Quantity</th> <th>Primary unit (symbol)</th> <th>Non-SI alternative unit (symbol)</th> </tr> </thead> <tbody> <tr> <td colspan="4">1. Direction/ Space/Time</td> </tr> <tr> <td>1.1</td> <td>altitude</td> <td>m</td> <td>ft</td> </tr> <tr> <td>1.2</td> <td>area</td> <td>m²</td> <td></td> </tr> <tr> <td>1.3</td> <td>distance (long)^{a)}</td> <td>km</td> <td>NM</td> </tr> <tr> <td>1.4</td> <td>distance (short)</td> <td>m</td> <td></td> </tr> <tr> <td>1.5</td> <td>elevation</td> <td>m</td> <td>ft</td> </tr> <tr> <td>1.6</td> <td>endurance</td> <td>h and min</td> <td></td> </tr> <tr> <td>1.7</td> <td>height</td> <td>m</td> <td>ft</td> </tr> <tr> <td>1.8</td> <td>latitude</td> <td>° ' "</td> <td></td> </tr> <tr> <td>1.9</td> <td>length</td> <td>m</td> <td></td> </tr> <tr> <td>1.10</td> <td>longitude</td> <td>° ' "</td> <td></td> </tr> <tr> <td>1.11</td> <td>plane angle (when required, decimal subdivisions of the degree shall be used)</td> <td>°</td> <td></td> </tr> <tr> <td>1.12</td> <td>runway length</td> <td>m</td> <td></td> </tr> <tr> <td>1.13</td> <td>runway visual range</td> <td>m</td> <td></td> </tr> <tr> <td>1.14</td> <td>tank capacities (aircraft)^{b)}</td> <td>L</td> <td></td> </tr> <tr> <td>1.15</td> <td>time</td> <td>s</td> <td></td> </tr> <tr> <td></td> <td></td> <td>min</td> <td></td> </tr> <tr> <td></td> <td></td> <td>h</td> <td></td> </tr> <tr> <td></td> <td></td> <td>d</td> <td></td> </tr> <tr> <td></td> <td></td> <td>week</td> <td></td> </tr> <tr> <td></td> <td></td> <td>month</td> <td></td> </tr> </tbody> </table>	Ref. No.	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)	1. Direction/ Space/Time				1.1	altitude	m	ft	1.2	area	m ²		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		CAR 19.3.	No Difference		
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	<p>year</p> <p>1.16 visibility_e km</p> <p>1.17 volume m³</p> <p>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) °</p> <p>2. Mass-related</p> <p>2.1 air density kg/m³</p> <p>2.2 area density kg/m²</p> <p>2.3 cargo capacity kg</p> <p>2.4 cargo density kg/m³</p> <p>2.5 density (mass density) kg/m³</p> <p>2.6 fuel capacity (gravimetric) kg</p> <p>2.7 gas density kg/m³</p> <p>2.8 gross mass or payload kg</p> <p>t</p> <p>2.9 hoisting provisions kg</p> <p>2.10 linear density kg/m</p> <p>2.11 liquid density kg/m³</p> <p>2.12 mass kg</p> <p>2.13 moment of inertia kg · m²</p> <p>2.14 moment of momentum kg · m²/s</p> <p>2.15 momentum kg · m/s</p> <p><i>Ref. No. Quantity Primary unit (symbol) Non-SI alternative unit (symbol)</i></p> <p>3. Force-related</p> <p>3.1 air pressure (general) kPa</p> <p>3.2 altimeter setting hPa</p> <p>3.3 atmospheric pressure hPa</p> <p>3.4 bending moment kN · m</p>				



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	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/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 %/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				



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Chapter 4 Reference 4.1 Standard	<p style="text-align: center;">CHAPTER 4. TERMINATION OF USE OF NON-SI ALTERNATIVE UNITS</p> <p><i>Introductory Note.— The non-SI units listed in Table 3-3 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.</i></p> <p>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.</p> <p>Table 4-1. Termination dates for non-SI alternative units</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><i>Non-SI alternative unit</i></th> <th style="text-align: left;"><i>Termination date</i></th> </tr> </thead> <tbody> <tr> <td style="padding-left: 20px;">Knot</td> <td style="text-align: center;">n</td> </tr> <tr> <td style="padding-left: 20px;">not established^{a)}</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">Nautical mile</td> <td style="text-align: center;">n</td> </tr> <tr> <td style="padding-left: 20px;">not established^{a)}</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">Foot</td> <td style="text-align: center;">n</td> </tr> <tr> <td style="padding-left: 20px;">not established^{b)}</td> <td></td> </tr> </tbody> </table> <p>a) No termination date has yet been established for use of nautical mile and knot.</p>	<i>Non-SI alternative unit</i>	<i>Termination date</i>	Knot	n	not established ^{a)}		Nautical mile	n	not established ^{a)}		Foot	n	not established ^{b)}		CAR 19.3	No Difference		
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	b) No termination date has yet been established for use of the foot.				

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