



The Republic of Sudan

Sudan Civil Aviation Regulations (SUCARs)

FOREWORD

1. Legal Background

Pursuant to Article 33 of the Civil Aviation Act, 2010 regarding the empowerment of the Board of Directors of Civil Aviation to issue and amend Sudan Civil Aviation Regulations (SUCAR) for the approval of the Competent Minister, Sudan Civil Aviation Safety Regulations are issued to ensure compliance with the Convention on International Civil Aviation, signed in Chicago on 7 December 1944 (Chicago Convention) to which the State of Sudan is a Party. The Convention, through its Annexes, provides for the minimum standards to ensure the safety of civil aviation activities and environmental protection throughout the application and implementation of common standards and technical requirements. Sudan Civil Aviation Regulations provide an appropriate and comprehensive framework for the definition and implementation of common technical requirements and administrative procedures in the field of civil aviation. Standards and Recommended Practices (SARPs) contained in ICAO Annexes as well as the technical information in its related publications form a main source in the making of Sudan Civil Aviation Regulations and therefore represent an acceptable guidance in the areas that are not covered by Sudan Civil Aviation Regulations.

- a) An aircraft, other than an aircraft registered in the State of Sudan, shall not fly over or land in the territories of the State of Sudan except under an authorization granted by the Civil Aviation Authority (CAA) on behalf of the Government of the State of Sudan.
- b) An aircraft other than an aircraft registered in the State of Sudan shall not take on-board or discharge any passengers or cargo at any location within the territories of the State of Sudan, being passengers or cargo carried or to be carried for hire or reward, without the permission of the CAA granted for the aircraft in accordance with any conditions and limitations to which such permission may be subjected.
- c) An aircraft shall not fly over or land in the territory of the State of Sudan unless it is registered in:
 - i. The State of Sudan; or
 - ii. An ICAO Contracting State; or
 - iii. Any other State where an agreement/arrangement between the State of Sudan and that State making provisions for over-flight or landing in the territory of the State of Sudan.
- d) In accordance with the provisions of **SUCAR Part 7**, an aircraft registered in the State of Sudan shall comply with the Sudan Civil Aviation Regulations.
- e) An Aircraft, registered outside the State of Sudan shall comply with the Sudan Civil Aviation Regulations while operating to/from or within the territories of the State of Sudan wherever is applicable.
- f) An aircraft registered in the State of Sudan should comply with the regulations of other States that it is overflying wherever is applicable.
- g) Sudan CAA accepts the codes of the Type Certification Authority of the State of Manufacturer and/or Design, for the purpose of issuing or Revalidation of Airworthiness Certificates, Airworthiness Directives (ADs), Minimum Equipment List (MEL), and all other related issues in that respect. The Sudan Civil Aviation Authority may impose additional requirements.



- h) Any difference that may exist between SUCAR requirements and corresponding ICAO Annex SARPs. Significant differences shall be published in the National AIP. The procedure for amending the SUCARs and filing of differences with ICAO are contained in paragraph 4 below and detailed information is found in the CAA Rule Making Manual.
- i) An effort has been made for SUCAR requirements to be fully compliant with corresponding ICAO Annexes; however, where an aviation activity for which a SUCAR regulation has not been promulgated is undertaken in the Sudan, the relevant Annex provisions shall be applicable until it is addressed in an amendment of the SUCAR.” Applicability date for SUCARs by users is set at six months after they have been promulgated (30 September 2011).

2. Layout of the SUCAR Document

Sudan Civil Aviation Regulations cover all aspects of aviation activities in the State of Sudan and comprise of the following parts;

- Part 0 SUCAR Index
- Part 1 Personnel Licensing
- Part 2 Rules of the Air
- Part 3 Meteorological Service for International Air Navigation
- Part 4 Aeronautical Charts
- Part 5 Units of Measurement
- Part 6 Operation of Aircraft
***Note:** Designated as Volumes of SUCAR Part 6 in general; Standards contained in ANR Parts VII, Part VIII, Volumes 2, 3, 4, 5, 7 and ANR Part X, as amended, have been directly adopted as Volumes of SUCAR Part 6.*
- Part 7 Aircraft Registration or Cancellation
- Part 8 Airworthiness of Aircraft and Continuing Airworthiness
***Note:** Designated as Volumes of SUCAR Part 8 in general; Standards contained in ANR Parts III, IV, V, VI, and VIII, as amended, have been directly adopted as Volumes of SUCAR Part 8.*
- Part 9 RESERVED (Facilitation)
- Part 10 Aeronautical Telecommunications
- Part 11 Air Traffic Services
- Part 12 Search and Rescue
- Part 13 Aircraft Accident and Incident Investigation
- Part 14 Aerodromes
- Part 15 Aeronautical Information Services
- Part 16 Environmental Protection
- Part 17 Aviation Security
- Part 18 The Safe Transportation of Dangerous Goods by Air

Each Part of SUCAR, but not necessarily all, is composed of :

- a) An introduction;
- b) Text;
- c) Definitions;
- d) Notes;
- e) Tables and figures;



- f) Appendices; and
- g) Attachments.

3 Rules of construction

In the Parts of these Regulations, unless the context requires otherwise:

1. Words importing the singular include the plural
2. Words importing the plural include the singular, and
3. Words importing the masculine gender include the feminine.
4. “Shall” is used in an imperative sense.
5. “May /should” is used in a permissive sense to state authority or permission to do the act prescribed, and the words “no person may....” Or “a person may not” means that no person is required, authorized or permitted to do the act prescribed, and
6. The word “Includes” means includes but is not limited to.
7. The word “Show” and its derivatives in these regulations have the exact intent as shown in the dictionary.

4 Amendment Rationale and Procedures

The existing Sudan Civil Aviation Regulations will from time to time be amended to reflect the latest updates of ICAO Standards and Recommended Practices (SARPs); it will also be amended to reflect the latest up to date aviation safety related matters detected by the Civil Aviation Authority, the aviation industry service providers or operators, and individuals and authorization holders; amendment may also be generated to ensure safety standardization and to accommodate new initiatives or technologies. The amendment procedure shall be as follows;

1. When the Civil Aviation Authority (CAA) receives an amendment to any of the current ICAO Annexes, the same will be routed by the Office of the Director General of Civil Aviation to the Standard and Safety Surveillance Committee (SSSC) which in turn will provide a copy to the concerned Directorate for their study and comments within a specified period of time and route the same back to the SSSC for final study and release.
2. When any of the different CAA Directorates requires a change to the applicable SUCAR parts, it will send a letter stating the required change along with its justified reasons for such change where it will then be studied and decided upon by the SSSC.
3. Any of the above mentioned change requests would then be prepared in draft form and sent to the concerned Directorate for further study and comments within a specified period of time.
4. All suggested changes will be drafted in the form of notices of proposed amendments and addressed to all concerned including industry representatives for comments prior to final release.
5. Any differences between the new regulations and ICAO standards and recommended practices will be reported and recorded as differences to ICAO and reflected in the Aeronautical Information Publications (AIP).
6. Entry into force time frame for any new regulations will be the responsibility of the SSSC. The SSSC will also be responsible for coordinating the identification of differences from corresponding ICAO Annexes in coordination with the concerned Directorates.
7. The Office of the Director General is responsible for filing differences with ICAO as soon as new regulations or amendments thereto have been promulgated.
8. All concerned parties will be given a copy of the new amendment and will be requested to update their copy of the regulations including their list of effective pages.



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9. Approved amendments or corrigenda of SUCAR or part(s) thereof will be disseminated to the industry through hardcopies (news release circulars directives and other) and softcopies (online or database, Internet address, CD-ROM and other).
 10. It is the responsibility of all concerned parties to keep their copy of the regulations up to date.
 11. Where applicable, regulations contained in the Air Navigation Regulations (ANRs) that have not been revoked may be enforced should the need arise.
 12. The State may release no regulation prior to the formal approval of the Competent Minister as determined in Civil Aviation Act 2010 or the Director General of Civil Aviation on delegation by the Competent Minister.



CHAPTER 1 DEFINITIONS

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:

1. **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 $2 \times$ newton per metre of length.
2. **Becquerel (Bq).** The activity of a radionuclide having one spontaneous nuclear transition per second.
3. **Candela (cd).** The luminous intensity, in the perpendicular direction, of a surface of 1/600 000 square metre of blackbody at the temperature of freezing platinum under a pressure of 101 325 newtons per square metre.
4. **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.
5. **Coulomb (C).** The quantity of electricity transported in 1 second by a current of 1 ampere.
6. **Degree Celsius (°C).** The special name for the unit kelvin for use in stating values of Celsius temperature.
7. **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.
8. **Foot (ft).** The length equal to 0.304 8 metre exactly.
9. **Gray (Gy).** The energy imparted by ionizing radiation to a mass of matter corresponding to 1 joule per kilogram.
10. **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.
11. **Hertz (Hz).** The frequency of a periodic phenomenon of which the period is 1 second.
12. **Human performance.** Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.
13. **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.
14. **Kelvin (K).** A unit of thermodynamic temperature which is the fraction $1/273.16$ of the thermodynamic temperature of the triple point of water.
15. **Kilogram (kg).** The unit of mass equal to the mass of the international prototype of the kilogram.
16. **Knot (kt).** The speed equal to 1 nautical mile per hour.
17. **Litre (L).** A unit of volume restricted to the measurement of liquids and gases which is equal to 1 cubic decimetre.
18. **Lumen (lm).** The luminous flux emitted in a solid angle of 1 steradian by a point source having a uniform intensity of 1 candela.
19. **Lux (lx).** The illuminance produced by a luminous flux of 1 lumen uniformly distributed over a surface of 1 square metre.



20. **Metre (m).** The distance travelled by light in a vacuum during $1/299\,792\,458$ of a second.
21. **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.
22. **Nautical mile (NM).** The length equal to $1\,852$ metres exactly.
23. **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.
24. **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.
25. **Pascal (Pa).** The pressure or stress of 1 newton per square metre.
26. **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.
27. **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.
28. **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.
29. **Sievert (Sv).** The unit of radiation dose equivalent corresponding to 1 joule per kilogram.
30. **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.
31. **Tesla (T).** The magnetic flux density given by a magnetic flux of 1 weber per square metre.
32. **Tonne (t).** The mass equal to $1\,000$ kilograms.
33. **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.
34. **Watt (W).** The power which gives rise to the production of energy at the rate of 1 joule per second.
35. **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

Introductory Note.- This Part 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.

5.2.1 Applicability

The Standards and Recommended Practices contained in this Part shall be applicable to all aspects of international civil aviation air and ground operations in the Republic of Sudan.



CHAPTER 3 STANDARD APPLICATION OF UNITS OF MEASUREMENT

5.3.1 SI Units

5.3.1.1 In the Republic of Sudan, the International System of Units developed and maintained by the General Conference of Weights and Measures (CGPM) are, subject to the provisions of 5.3.2 and 5.3.3 of this SUCAR applicable as the standard system of units of measurement for all aspects of international civil aviation air and ground operations.

5.3.1.2 Prefixes

The prefixes and symbols listed in Table 3-1 are applicable in the Sudan to form names and symbols of the decimal multiples and sub-multiples 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

Note I.- As used herein the term SI unit is meant to include base units and derived units as well as their multiples and sub-multiples. Attachment B contains guidance on the general application of prefixes.

5.3.2 Non-SI Units

5.3.2.1 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 as specified in Table 3-4.

5.3.3 Non-SI Units for temporary use

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



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	1t = 10 ³ kg
plane angle	degree	°	1° = (π/180) rad
	minute	,	1'=(1/60)° = (π/10800)rad
	second	''	1'' = (1/60)' = (π/648000) rad
temperature	degree Celsius	°C	1 unit °C = 1 unit K ^{a)}
time	minute	min	1 min=60s
	hour	h	1 h=60min=3600s
	day	d	1 d=24h=86400s
	week, month, year	-	
volume	litre	L	1 L = 1dm ³ = 10 ⁻³ m ³

a) See Attachment C, Table C-2 for conversion

Table 3.3
Non-SI units for use with the SI

Specific quantities in Table 3-4 related to	unit	symbol	Definition in terms of SI units
distance long	nautical miles	nm	1nm = 1852 m
distance vertical ^{a)}	foot	ft	1 ft= 0.3048m
speed	knots	kt	1 kt = 0.0514 444 m/s

a) altitude, elevation, height, vertical speed.

5.3.4 Application of specific units

- 5.3.4.1 The application of units of measurement for certain quantities used in international civil aviation air and groundoperations in the Sudan shall be in accordance with Table 3-4.
- 5.3.4.2 Basic SUCAR provisions shall be applied for units to be used for quantities not listed in Table 3-4.
- 5.3.4.2 - Means and provisions for design, procedures and training established foroperations in environments involving the use of standard and non-SI alternatives of specific units of measurement, or thetransition between environments using different units, in the Sudan shall be made with dueconsideration to human performance.Guidance material on human performance can be found in theICAO Human Factors Training Manual (Doc 9683) andCircular 238 (Human Factors Digest No. 6 - Ergonomics).



Table 3-4
Standard application of specific units of measurement

Ref No.	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
<i>1- Direction/Space/Time</i>			
1.1	altitude	m	ft
1.2	area	m ²	NM
1.3	distance (long) ^{a)}	km	ft
1.4	distance (short)	m	ft
1.5	elevation	h and ruin	
1.6	endurance	m	
1.7	height	0''''	
1.8	latitude	m	
1.9	length	0''''	
1.10	longitude	0	
1.11	plane angle (when required, decimal subdivisions of the degree shall tie used)	m	
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	
1.16	viability ^{c)}	year	
1.17	volume	km ³	
1.18	wind direction (wind directions other than for a landing and take-off shall be expressed in degrees magnetic; for landing and take-off wind directions shall be expressed in degrees magnetic)	m ³ 0	
<i>2. Man-related</i>			
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 t	



Ref No.	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
2.9	hoisting provisions	kg	
2.10	linear density	kg/m	
2.11	liquid density	kg/ m ³	
112	mass	kg	
2.13	moment of inertia	Kg.m ²	
2.14	nsoment of momentum	Kg.m ² /s	
2.15	Momentum	Kg.m/s	
3. Forarttated			
3.1	air pressure (gencral)	kPa	
3.2	ahimeter selling	hpa	
3.3	atmospheric pccsswe	hpa	
3.4	bending moment	KN.m	
3,5	lotte	N	
3.6	fuel supply pressure	kPa	
33	hydrsolic pressure	Mpa	
3.8	modulus of elasticity	kPa	
3.9	pressure	Mpa	
3.10	stress	Mn/m	
3.11	surface irsision	mN/m	
3.12	thrust	KN	
3.13	torque	N.m	
3.14	vacuum	Pa	
4. MechanIcs			
4.1	Airspeet ^{d)}	km/h	Kt
4.2	angular acceleration	nd/s ²	
4..3	angular velocity	rad/s	
4.4	energy work	J	
4..5	cquivalcni shaft power	kW	
4.6	lreqtscncy	Hz	
4.7	ground speed	Hm/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	rateoftrim	⁰ /s	
4.13	shalt power	kW	
4.14	velocity	m/s	
4.15	vertIcal speed	m/s	Ft/min
4.16	wind speed	km/h	Kt
5. Flow			
5.1	engine airflow	kg/s	
5.2	engIne waterfiow	kg/h	
5.3	fuel coitsuniption (specific)		
	piston engines	kg/(kW.h)	
	turbo – shft engines	kg/(kW. h)	



Ref No.	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
5.4	jet engines	kg/(kW. h)	
5.4	fuel flow	kg/h	
5.5	fuel tank filling rate (gravimetric)	kg/min	
5.6	gas flow	kg/s	
5.3	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 airflow	m ³ /min	
5.14	viscosity (dynamic)	Pa · s	
5.15	viscosity (kinematic)	m ² /s	
6. Thermodynamic			
6.1	coefficient of heat transfer		
6.2	heat flow per unit area		
6.3	heat flow rate		
6.4	extensivity (absolute)		
6.5	coefficient of fineness expansion		
6.6	intensity of heat		
6.7	temperature		
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	luminance exitance	In/m ²	
8.4	luminance flux	lm	
8.5	luminance intensity	cd	



Ref No.	Quantity	Primary unit (symbol)	Non-SI alternative unit (symbol)
8.6	Quantity of light	Im.s	
8.7	radiant energy	J	
8.8	wavelength	m	
<i>9. Acoustics</i>			
9.1	frequency	Hz	
9.2	mass density	Kg/m ²	
9.3	noise level	dB	
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	
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	
<i>10. Nuclear physics</i>			
<i>wad ieaithn.g</i>			
<i>rnketion</i>			
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 4.000 m.			
b) Such as aircraft fuel, hydraulic; fuel, 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.			



CHAPTER 4 TERMINATION OF USE OF NON-SI ALTERNATIVE UNITS

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 effected 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.

- 5.4.1 The use in international civil aviation operations of the alternative non-SI units listed in Table 3-3 shall be terminated on the dates that may be published by ICAO and are listed in Table 4-1 below.

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

non-SI alternative units	Termination date
Knot } Nautical mile	not established
Foot	not established

- 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.



**ATTACHMENT A
DEVELOPMENT OF THE INTERNATIONAL SYSTEM OF UNITS (SI)**

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**Information on Development of the International System of Units (SI)
can be found in Annex 5, Attachment A
to the
Convention on International Civil Aviation**



ATTACHMENT B GUIDANCE ON THE APPLICATION OF THE SI

1. Introduction

- 1.1 The International System of Units is a complete, coherent system which includes three classes of units:
- a) base units;
 - b) supplementary units; and
 - c) derived units.
- 1.2 The SI is based on seven units, which are dimensionally independent and are listed in Table B-1.

Table B-1. SI base units

Quantity	Unit	Symbol
amount of a substance	mole	mol
electric current	ampere	A
length	metre	m
luminous intensity	candela	cd
mass	kilogram	kg
thermodynamic temperature	kelvin	K
time	second	s

- 1.3 The supplementary units of the SI are listed in Table B-2 and may be regarded either as base units or as derived units.

Table B-2. SI supplementary units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

- 1.4 Derived units of the SI are formed by combining base units, supplementary units and other derived units according to the algebraic relations linking the corresponding quantities. The symbols for derived units are obtained by means of the mathematical signs for multiplication, division and the use of exponents. Those derived SI units which have special names and symbols are listed in Table B-3.

Note.- The specific application of the derived units listed in Table 8-3 and other units common to international civil aviation operations is given in Table 3-4.

Table B-3. SI supplementary units with special names

Quantity	Unit	Symbol	Derivation
absorbed dose (radiation)	gray	Gy	J/kg
activity of radionuclides	becquerel	Bq	1/s
capacitance	farad	F	C/v
conductance	siemens	S	A/V



dose equivalent (radiation)	sievert	Sv	J/kg
electric potential, potential difference, electromotive force	volt	V	W/A
electric resistance	ohm	Ω	V/A
energy, work, quantity of heat	joule	J	N.m
force	newton	N	Kg.m/s^2
frequency (of a periodic phenomenon)	hertz	Hz	1/s
illuminance	lux	lx	lm/m^2
inductance	henry	H	Wb/A
luminous flux	Lumen	lm	cd.sr
magnetic flux	weber	Wb	V.s
magnetic flux density	tesla	T	Wb/m^2
power, radiant flux	watt	W	J/s
pressure, stress	pascal	Pa	N/m^2
quantity of electricity, electric charge	coulomb	C	A.s

- 1.5 The SI is a rationalized selection of units from the metric system which individually are not new. The great advantage of SI is that there is only one unit for each physical quantity - the metre for length, kilogram (instead of gram) for mass, second for time, etc. From these elemental or base units, units for all other mechanical quantities are derived. These derived units are defined by simple relationships such as velocity equals rate of change of distance, acceleration equals rate of change of velocity, force is the product of mass and acceleration, work or energy is the product of force and distance, power is work done per unit time, etc. Some of these units have only generic names such as metre per second for velocity; others have special names such as newton (N) for force, joule (J) for work or energy, watt (W) for power. The SI units for force, energy and power are the same regardless of whether the process is mechanical, electrical, chemical or nuclear. A force of 1 newton applied for a distance of 1 metre can produce 1 joule of heat, which is identical with what 1 watt of electric power can produce in 1 second.
- 1.6 Corresponding to the advantages of SI, which result from the use of a unique unit for each physical quantity, are the advantages which result from the use of a unique and well-defined set of symbols and abbreviations. Such symbols and abbreviations eliminate the confusion that can arise from current practices in different disciplines such as the use of "b" for both the bar (a unit of pressure) and barn (a unit of area).
- 1.7 Another advantage of SI is its retention of the decimal relation between multiples and sub-multiples of the base units for each physical quantity. Prefixes are established for designating multiple and sub-multiple units from "exa" (10^{18}) down to "atto" (10^{-18}) for convenience in writing and speaking.
- 1.8 Another major advantage of SI is its coherence. Units might be chosen arbitrarily, but making an independent choice of a unit for each category of mutually comparable quantities would lead in general to the appearance of several additional numerical factors in the equations between the numerical values. It is possible, however, and in practice more convenient, to choose a system of units in such a way that the equations between numerical values, including the numerical factors, have exactly the same form as the corresponding equations between the quantities. A unit system defined in this way is called coherent with respect to the system of quantities and equations in question. Equations between units of a coherent unit system contain as numerical factors only the number 1. In a coherent



system the product or quotient of a and equations in question. Equations between units of a coherent unit system contain as numerical factors only the number 1. In a coherent system the product or quotient of any two unit quantities is the unit of the resulting quantity. For example, in any coherent system, unit area results when unit length is multiplied by unit length, unit velocity when unit length is divided by unit time, and unit force when unit mass is multiplied by unit acceleration.

Note.- Figure B-1 illustrates the relationship of the units energy: of the SI.

2. Mass, force and weight

- 2.1 The principal departure of SI from the gravimetric system of metric engineering units is the use of explicitly distinct units from mass and force. In SI, the name kilogram is restricted to the unit of mass, and the kilogram-force (from which the suffix force was in practice often erroneously dropped) is not to be used. In its place the SI unit of force, the newton is used. Likewise, the newton rather than the kilogram-force is used to form derived units which include force, for example, pressure or stress ($\text{N}/\text{m}^2 = \text{Pa}$), energy ($\text{N} \cdot \text{m} = \text{J}$), and power ($\text{N} \cdot \text{m}/\text{s} = \text{W}$).
- 2.2 Considerable confusion exists in the use of the term weight as a quantity to mean either force or mass. In common use, the term weight nearly always means mass; thus, when one speaks of a person's weight, the quantity referred to is mass. In science and technology, the term weight of a body has usually meant the force that, if applied to the body, would give it an acceleration equal to the local acceleration of free fall. The adjective "local" in the phrase "local acceleration of free fall" has usually meant a location on the surface of the earth; in this context the "local acceleration of free fall" has the symbol g (sometimes referred to as "acceleration of gravity") with observed values of g differing by over 0.5 per cent at various points on the earth's surface and decreasing as distance from the earth is increased. Thus, because weight is a force = mass \times acceleration due to gravity, a person's weight is conditional on his location, but mass is not. A person with a mass of 70 kg might experience a force (weight) on earth of 686 newtons ($\approx 155 \text{ lbf}$) and a force (weight) of only 113 newtons ($\approx 22 \text{ lbf}$) on the moon. Because of the dual use of the term weight as a quantity, the term weight should be avoided in technical practice except under circumstances in which its meaning is completely clear. When the term is used, it is important to know whether mass or force is intended and to use SI units properly by using kilograms for mass or newtons for force.
- 2.3 Gravity is involved in determining mass with a balance or scale. When a standard mass is used to balance the measured mass, the direct effect of gravity on the two masses is cancelled, but the indirect effect through the buoyancy of air or other fluid is generally not cancelled. In using a spring scale, mass is measured indirectly, since the instrument responds to the force of gravity. Such scales may be calibrated in mass units if the variation in acceleration of gravity and buoyancy corrections are not significant in their use.

3. Energy and torque

- 3.1 The vector product of force and moment arm is example, in any coherent system, unit area results when unit widely designated by the unit newton metre. This unit for length is multiplied by unit length, unit velocity when unit bending moment or torque results in confusion with the unit length is divided by unit time, and unit force when unit mass for energy, which is also newton metre. If torque is



expressed is multiplied by unit acceleration as newton metre per radian, the relationship to energy is clarified, since the product of torque and angular rotation is

$$(N \cdot m/\text{rad}) \cdot \text{rad} = N \cdot m$$

2. If vectors were shown, the distinction between energy and torque would be obvious, since the orientation of force and length is different in the two cases. It is important to recognize this difference in using torque and energy, and the joule should never be used for torque.

4. SI prefixes

4.1 Selection of prefixes

- 4.1.1 In general the SI prefixes should be used to indicate orders of magnitude, thus eliminating non-significant digits and leading zeros in decimal fractions, and providing a convenient alternative to the powers-of-ten notation preferred in computation. For example:

12 300 mm becomes 12.3 m
 12.3 x 10³m becomes 12.3 km
 0.00123 μ A becomes 1.23 nA

- 4.1.2 When expressing a quantity by a numerical value and a unit, prefixes should preferably be chosen so that the numerical value lies between 0.1 and 1 000. To minimize variety, it is recommended that prefixes representing powers of 1 000 be used. However, in the following cases, deviation from the above may be indicated:
- in expressing area and volume, the prefixes hecto, deca, deci and centi may be required: for example, square hectometre, cubic centimetre;
 - in tables of values of the same quantity, or in a discussion of such values within a given context, it is generally preferable to use the same unit multiple throughout; and
 - for certain quantities in particular applications, one particular multiple is customarily used. For example, the hectopascal is used for altimeter settings and the millimetre is used for linear dimensions in mechanical engineering drawings even when the values lie outside the range 0.1 to 1 000.

4.2 Prefixes in compound units'

It is recommended that only one prefix be used in forming a multiple of a compound unit. Normally the prefix should be attached to a unit in the numerator. One exception to this occurs when the kilogram is one of the units. For example: V/m, *not* mV/mm; MJ/kg, *not* kJ/g

4.3 Compound prefixes

Compound prefixes, formed by the juxtaposition of two or more SI prefixes, are not to be used. For example:

1 nm *not* 1 μm; 1 pF *not* 1 μμF

If values are required outside the range covered by the prefixes, they should be expressed using powers of ten applied to the base unit.



- 5.1.1 Unit symbols should be printed in Roman (upright) type regardless of the type style used in the surrounding text.
- 5.1.2 Unit symbols are unaltered in the plural.
- 5.1.3 Unit symbols are not followed by a period except when used at the end of a sentence.
- 5.1.4 Letter unit symbols are written in lower case (cd) unless the unit name has been derived from a proper name, in which case the first letter of the symbol is capitalized (W, Pa). Prefix and unit symbols retain their prescribed form regardless of the surrounding typography.
- 5.1.5 in the complete expression for a quantity, a space should be left between the numerical value and the unit symbol. For example, write 35 mm not 35mm, and 2.37 lm, not 2.371m. When the quantity is used in an adjectival sense, a hyphen is often used, for example, 35-mm film.
- Exception:** No space is left between the numerical value and the symbols for degree, minute and second of plane angle, and degree Celsius.
- 5.1.6 No space is used between the prefix and unit symbols.
- 5.1.7 Symbols, not abbreviations, should be used for units. For example, use "A", not "amp", for ampere.

5.2 Rules for writing unit names

- 5.2.1 Spelled-out unit names are treated as common nouns in English. Thus, the first letter of a unit name is not capitalized except at the beginning of a sentence or in capitalized material such as a title, even though the unit name may be derived from a proper name and therefore be represented as a symbol by a capital letter (see 5.1.4). For example, normally write "newton" not "Newton" even though the symbol is N.
- 5.2.2 Plurals are used when required by the rules of grammar and are normally formed regularly, for example, henries for the plural of henry. The following irregular plurals are recommended:

Singular Plural

Lux lux

Hertz hertz

Siemens siemens

¹. A compound unit is a derived unit expressed in terms of two or more units, that is, not expressed with a single special name.

- 5.2.3 No space or hyphen is used between the prefix and the unit name.

5.3 Units formed by multiplication and division

5.3.1 *With unit names:*

Product, use a space (preferred) or hyphen:

newton metre **or** newton-metre in the case of the watt hour the space may be omitted, thus: watt hour.

Quotient, use the word per and not a solidus: metre per second *not* metre/second.

Powers, use the modifier squared or cubed placed after the unit name:

metre per second squared

In the case of area or volume, a modifier may be placed before the unit name:

square millimetre, cubic metre.

This exception also applies to derived units using area or volume: watt per square metre.



Note.- To avoid ambiguity in complicated expressions, symbols are preferred to words.

5.3.2 With unit symbols:

Product may be indicated in either of the following ways:

Nm *or* N . m for newton metre.

Note.- When using for a prefix a symbol which coincides with the symbol for the unit, special care should be taken to avoid confusion. The unit newton metre for torque should be written, for example, Nm or N . m to avoid confusion with mN, the millinewton.

An exception to this practice is made for computer printouts, automatic typewriter work, etc., where the dot half high is not possible, and a dot on the line may be used.

Quotient, use one of the following forms:

m/s *or* m . s⁻¹ *or* m/s

In no case should more than one solidus be used in the same expression unless parentheses are inserted to avoid ambiguity.

For example, write:

J/(mol . K) *or* J . mol⁻¹ . K⁻¹ *or* (J/mol)/K but *not* J/mol/K.

5.3.3 Symbols and unit names should not be mixed in the same expression. Write:

joules per kilogram *or* J/kg *or* J . kg⁻¹

but *not* joules/kilogram *or* joules/kg *or* joules . kg⁻¹.

5.4 Numbers

5.4.1 The preferred decimal marker is a point on the line (period); however, the comma is also acceptable. When writing numbers less than one, a zero should be written before the decimal marker.

5.4.2 The comma is not to be used to separate digits. Instead, digits should be separated into groups of three, counting from the decimal point towards the left and the right, and using a small space to separate the groups. For example:

73 655 7 281 2.567 321 0.133 47

The space between groups should be approximately the width of the letter "5" and the width of the space should be constant even if, as is often the case in printing, variable-width spacing is used between the words.

5.4.3 The sign for multiplication of numbers is a cross (X) or a dot half high. However, if the dot half high is used as the multiplication sign, a point on the line must not be used as a decimal marker in the same expression.

5.4.4 Attachment of letters to a unit symbol as a means of giving information about the nature of the quantity under consideration is incorrect. Thus MWe for "megawatt electrical (power)", Vac for "volts ac" and kJt for "kilojoules thermal (energy)" are not acceptable. For this reason, no attempt should be made to construct SI equivalents of the abbreviations "psia" and "psig", so often used to distinguish between absolute and gauge pressure. If the context leaves any doubt as to which is meant, the word pressure must be qualified appropriately. For example:

". . . at a gauge pressure of 13 kPa".

or ". . . at an absolute pressure of 13 kPa".



ATTACHMENT C CONVERSION FACTORS

1. General

- 1.1 The list of conversion factors which is contained in this Attachment is provided to express the definitions of miscellaneous units of measure as numerical multiples of SI units.
- 1.2 The conversion factors are presented for ready adaptation to computer read-out and electronic data transmission. The factors are written as a number greater than 1 and less than 10 with six or less decimal places. This number is followed by the letter E (for exponent), a plus or minus symbol, and two digits which indicate the power of 10 by which the number must be multiplied to obtain the correct value. For example:
 $3.523\ 907\ \text{E} - 02$ is $3.523\ 907 \times 10^{-2}$ or 0.035 239 07
 Similarly,
 $3.386\ 389\ \text{E} + 03$ is $3.386\ 389 \times 10^3$ or 3 386.389
- 1.3 An asterisk (*) after the sixth decimal place indicates that the conversion factor is exact and that all subsequent digits are zero. Where less than six decimal places are shown, more precision is not warranted.

1.4 Further examples of use of the tables:

<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
pound-force per square foot	Pa	4.788 026 E + 01
inch	m	2.540 000*E-02

thus:

$$1\ \text{lb}/\text{ft}^2 = 47.880\ 26\ \text{Pa}$$

$$1\ \text{inch} = 0.025\ 4\ \text{m (exactly)}$$

2. Factors not listed

- 2.1 Conversion factors for compound units which are not listed herein can easily be developed from numbers given in the list by the substitution of converted units, as follows.

Example: To find conversion factor of lb.ft/s to kg.m/s:

first convert

$$1\ \text{lb to } 0.453\ 592\ 4\ \text{kg}$$

$$1\ \text{ft to } 0.304\ 8\ \text{m}$$

then substitute:

$$(0.453\ 592\ 4\ \text{kg}) \times (0.304\ 8\ \text{m})/\text{s}$$

$$= 0.138\ 255\ \text{kg.m/s}$$

Thus the factor is 1.382 55 E-01.

<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
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abampere	ampere (A)	1.000 000 * E + 0.1
abcoulomb	coulomb (C)	1.000 000 * E + 0.1
abfarad	farad (F)	1.000 000 * E + 0.9
abhenry	henry (H)	1.000 000 * E – 0.9
abmho	siemens (S)	1.000 000 * E + 0.9
abohm	ohm(Ω)	1.000 000 * E – 0.9
abvolt	volt(V)	1.000 000 * E – 0.8
acre (U.S. survey)	square metre (m ²)	4.046 873 * E+03
ampere hour	coulomb (C)	3.600 000 * E+03
are	square metre (m ²)	1.000 000 * E + 0.2
atmosphere (standard)	pascal (Pa)	1.013 250 * E + 0.5
atmosphere (technical - 1kgf/cm ²)	pascal (Pa)	9.806 650 * E + 04
bear	pascal (Pa)	1.000 000 * E + 0.5
barrel (for petroleum, 42 U.S. liquid gal)	cubic metre(m ³)	1.559 873 *E -1

An asterisk (*) after the sixth decimal place indicates that the conversion factor is exact and that all subsequent digits are zero. Where less than six decimal places are shown, more precision is not warranted.

<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
British thermal unit (International Table)	joule (J)	1.055 056 E+0.3
British thermal unit (mean)	joule (J)	1.055 870 E+0.3
British thermal unit (thermochemical)	joule (J)	1.054 350 E+0.3
British thermal unit (39°F)	joule (J)	1.059 67 E+0.3
British thermal unit (59°F)	joule (J)	1.054 80 E+0.3
British thermal unit (60°F)	joule (J)	1.054 68 E +0.3
Btu (International Table) ft/h-ft ² - °F (k, thermal conductivity)	watt per metre kelvin (W/m-K)	1.730 735 E+0.0
Btu (thermochemical)- ft/h -ft ² - °F (k, thermal conductivity)	watt per metre kelvin (W/m-K)	1.729 577 E+0.0
Btu (International Table) -in/h- ft ² - °F (k, thermal conductivity)	watt per metre kelvin (W/m-K)	1.442 279 E-0.1
Btu (thermochemical) in/h - ft ² - °F (k, thermal conductivity)	watt per metre kelvin (W/m-K)	1.441 314 E-0.1
Btu (International Table)- in/s ft ² -°F (k, thermal conductivity)	watt per metre kelvin (W/m-K)	5.192 204 E+0.2
Btu (thermochemical)-in/s' ft ² °F (k. thermal conductivity)	watt per metre kelvin (W/m-K)	5.188 732 E+02
Btu (international Table)/h	watt (W)	2.930711 E-0.1
Btu (thermochemical)/fh	watt (W)	2.928 751 E-0.1
Btu (thermochemical)/min	watt (W)	1.757 250 E+0.1
Btu (thermochemical)/s	watt (W)	1.054 350 E+0.3
Btu (international Table)/ft ²	joule per square metre (J/m ²)	1.135653 E+0.4
Btu (thermochemical)/ft ²	joule per square metre (J/m ²)	1.134 893 E+0.4
Btu (thermochemical)/ ft ² . h	watt per square metre (W/m ²)	3,152481 E+0.0
Btu (thermochemical)/ ft ² .mm	watt per square metre (W/m ²)	1.891 489 E+0.2
Btu (thermochemical)/ ft ² .s	watt per square metre (W/m ²)	1.134893 E+0.4
Btu (thermochemical)/in ² . s	watt per square metre (W/m ²)	1.634246 E+0.6
Btu (International Table)/h - ft ² - °F (C, thermal conductance)	watt per square metre kelvin (W/m ² .k)	5.674 466 E+0.0



To convert from	to	Multiply by
Btu (thermochemical))/h - ft ² - °F (C, thermal conductance)	watt per square metre kelvin (W/m ² .k)	5.678 263 E+0.0
Btu (International Table)/s- ft ² - °F	watt per square metre kelvin (W/m ² .k)	2.044 175 F-i-0.4
Btu (thermochemical)/s- ft ² - °F	watt per square metre kelvin (W/m ² .k)	2.042808 F.+0.4
Btu (International Table) Ib	joule per kilogram (J/kg)	2.316 000*E +0.3
Btu (thermochemical)/Ib	joule per kilogram (J/kg)	2.324444 E +0.3
Btu (international Tabte) Ib.°F (c, heat capacity)	joule per kilogram kelvin (J/kg.k)	4.186 800*E-+0.3
Btu (thermochemical)/Ib.°F (c, heat capacity)	joule per kilogram kelvin (J/kg.k)	4.184 000 E+0.3
calorie (inch)	metre (m)	2.540 000* E+ 0.2
calorie (International Table)	joule (J)	4.186 800* E+0.0
calorie (mean)	joule (J)	4.19002 E+0.0
calorie (thermochemical)	joule (J)	4.184 000* E+0.0
calorie (15°C)	joule (J)	4.18580 E+0.0
calorie (20°C)	joule (J)	4.181 90 E+0.0
calorie (kilogram. International Table)	joule (J)	4.186 800* E+0.3
calorie (kilogram, mean)	joule (J)	4.190 02 E+ 0.3
calorie (kilogram, thermochemical)	joule (J)	4.184 000* E+0.3
cal (thernioehemical)/cm ²	joule per square metre (J/m ²)	4. 184 000* E+ 0.4
cal (International Table)/g	joule per kilogram (J/kg)	4.186800*E-+0.3
cal (thermochemical)/g	joule per kilogram (J/kg)	4.184 000*E+0.3
cal (International Table)/g-°C	joule per kilogram (J/kg)	4.186 800*E 0.3
cal (thermochemical)/ g-°C	joule per kilogram (J/kg)	4.184 000*E+03
cal (thermochemical)/min	watt (W)	6.373 333 E-0.2
cal (thermochemical)/s	watt (W)	4.184 000*E+00
cal (thermochemical)/cm ² - mm	watt per square metre (W/m ²)	6.973 333 E +02
cal (thermochemical)/ cm ² -s	watt per square metre (W/m ²)	4.184 000*E+04
cal (thermochemical)/ cm-s - °C	watt per metre kelvin (W/m.k)	4.184 000*E+02
centimetre of mercury (0°C)	Pascal (Pa)	1.33322 E+ 0.3
centimetre of water (4°C)	Pascal (Pa)	9.80638 E+ 0.1
centipoise	Pascal second (Pa.s)	1.000 000*E-0.3
centistokes	metre square per second (m ² /s)	1.000 000 *E-0.6
Circular mil	square metre (m ²)	5.067 075 E-1.0
Clo	kelvin metre square per watt (k. m ² /W)	2.003 712 E-0.1
Cup	qupic metre (m ³)	2.365 882 E-0.4
curie	becquerel (Bq)	3.700 000* E+1.0
day (mean solar)	second (s)	8.640 000 E+0.4
day (sidereal)	second (s)	8.616 409 E+0.4
degree (angle)	Radian (rad)	1.745 329 E-0.2
°F-h-ft ² /Btu (International Table) (R, thermal resistance)	kelvin metre square per watt (k. m ² /W)	1.161 102 E-0.1
°F-h-ft ² /Btu (thermochemical) (R, thermal resistance)	kelvin metre square per watt (k. m ² /W)	1.762 280 E-0.1



<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
dyne	newton (N)	1.000 000*E-0.5
dyne-cm	newton metre (N-m)	1.000 000*E-0.7
dyne/cm ²	pascal (Pa)	1.000 000*E-0.1
electronvolt	joule (J)	1.602 19 E-1.9
EMU of capacitance	farad (F)	1000 000*E-0.9
EMU or current	ampere (A)	1.000 000*E -0.9
EMU of electric potential	volt (v)	1.000 000*E – 0.5
EMU of inductance	henry (H)	1.000 000*E- 0.7
EMU of resistance	ohm (Ω)	1.000 000*E – 0.1
erg	joule (J)	1000 000*E- 0.7
erg/ cm ² -s	watt per square metre (W/m ²)	1.000 000*E -0.3
erg/s	watt (W)	1000 000*E- 0.7
ESU of capacitance	farad (F)	1.112 650 E-1.2
ESU of current	ampere (A)	3.335 6 E-1.0
ESU of electric potential	volt (v)	2.397 9 E-0.2
ESU of inductance	henry (H)	8.987 554 E+1.1
ESU of resistance	ohm (Ω)	8.987 554 E+1.2
faraday (based on carbon-12)	coulomb (C)	9.648 70 E+0.4
faraday (chemical)	coulomb (C)	9.349 57 E+0.4
faraday (physical)	coulomb (C)	9352 19 E+0.4
fathom	metre (m)	1.828 8 E+0.0
fermi (femtoenetre)	metre (m)	1.000 000*E- 15
fluid ounce (U.S.)	cubic metre (m ³)	2.957 353 E-0.5
foot	metre (m)	3348 000*E-0.1
foot (U.S survey)	metre (us)	3.048 006 E-0.1
foot of water (39.2°F)	pascal (Pa)	2.988 98 E+0.3
ft ²	square metre (m ²)	9.290 304*E-0.2
ft ² /h(thermal diffusivity)	metre squared per second (m ² /s)	2.580 640 *E-0.5
ft ² /s	metre squared per second (m ² /s)	9.290 304*E -0.2
ft ² (volume; sectsom modulus)	cubic meter (m ³)	2.831 685 E-0.2
ft ² /min	cubic metre per second (m ³ /s)	4.719 474 E-0.4
ft ² /s	cubic metre per second (m ³ /s)	2.831 685 E-0.2
ft ² (moment of section)	metre to the fourth power (m ⁴)	8.630 975 E -0.3
ft- lbf	joule (J)	1.355 818 E+0.0
ft- lbf /h	watt (W)	3.766 161 E-0.6
rt- lbf /min	wait (W)	2,259 697 E -0.2
ft- lbf /s	watt (W)	1.355 818 E +0.0
ft-poundal	jmsle(J)	4.214011 E -0.2
free fall standard (g)	metre per second squared (sn/s ²)	9.806 650*E +0.0
ft/h	metre pee second (m/s)	8.466 667 E -0.5
ft/min	metre per second (m/s)	5.080 000*E -0.3
ft/s	metre per second (m/s)	3.048 000 *E-0.1
ft/s ²	metre per second squared (m/s ²)	3.048 000*E -0.1
footcandle	lux (Ix)	1.076 391 E +0.1
footlambert	candela per square metre (cd/m ²)	3,426 259 E +0.0
gal	metre per second squared (nt/s ²)	1.000 000 *E -0.2
gallon (Canadian liquid)	cubic metre (m ³)	4.546 090 E -0.3
gallon (U.K. liquid)	cubic metre (m ³)	4.546 092 E -0.3
gallon (U.S. dry)	cubic metre (m ³)	4.404 884 E -0.3



<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
gallon (U.S. liquid)	cubic metre (m ³)	3.785 412 E -0.3
gal (U.S. liquid)/day	cubic metre per second (m ³ /s)	4.381 264 E -0.8
gal (U.S. liquid)/min	cubic metre per second (m ³ /s)	6.309 020 E -0.5
gal (U.S. liquid)/hp-h (SFC. specific fuel consumption)	cubic metre per joule (m ³ /J)	1.410 089 E -0.9
gamma	tesla (T)	1.009 000*E -0.9
gauss	tesla(T)	1,009 000*E-0.4
gilbert	ampere (A)	7.957 747 E-O.1
grad	degree (angular)	9.000 000*E -0.1
grad	radian (rad)	1.570 796 E-0.2
gram	kilogram (kg)	t.000 000*E -0.3
gm/cm ³	kilogram per cubic metre (kg/ m ³)	1.000 090*E+0.3
gram.force/ cm ²	pascal (Pa)	9.806 630*E+0.1
hectare	square metre (m ²)	1.000 030*E + 0.4
horsepower (550 II' lbf/s)	watt (W)	7.456 999 E +0.2
horsepower (electric)	watt (W)	7,460 000*E + 0.2
horsepower (metric)	watt (W)	7.354 99 E+0.2
horsepower (water)	watt (W)	7.460 43 E+0.2
horsepower (U.K.)	watt (W)	7.457 0 E+0.2
hour (mean solar)	second (s)	3.600 000 E +0.3
hour (sidereal)	second (s)	3.590 170 E+ 0.3
hundredweight (long)	kilogram (kg)	5.080 235 E+0.1
hundredweight (short)	kilogram (kg)	4.535 924 E+0.1
inch	metre (m)	2.540 000 *E-02
inch of mercury (32°F)	pascal (Pa)	3.386 38 E +03
inch of mercury (60°F)	pascal (Pa)	3.376 85 E +03
inch of water (39.2°F)	pascal (Pa)	2.490 2 *E +02
inch of water (60°F)	pascal (Pa)	2.488 4 E.02
in ²	square metre (m ²)	6.451 600 *E-04
In ³ (volume; section modulus)	cubic metre (m ³)	1.638106 E-05
In ³ /min	cubic metre per second (m ³ /s)	2.731 177 E-07
in ⁴ (moment of section)	metre to the fourth power (m ⁴)	4.162 314 E-07
In/s	metre per second (m/s)	2,540 000 *E-02
In/s ²	metre per second squared (m/s ²)	2.540 000 *E-02
kilocalorie (International Table)	joule (J)	4.186 800 *E+03
kilocalorie (mean)	joule (J)	4.190 02 *E+03
kilocalorie (thermochemical)	joule (J)	4.184 000 E+03
kilocalorie (thermochemical)/min	watt (W)	6.973 333* E+01
kilocalorie (thermochemical)/s	watt (W)	4.184 000*E+03
kilogram-force (kgf)	newton (N)	9.806 650*E+00
Kgf/m	newton metre (N.m)	9.806 650*E + 00
Kgf.s ² /m (mass)	kilogram (kg)	9.806 650*E+00
kgf/cm ²	pascal (Pa)	9.806 650*E+04
kgf/m ²	pascal (Pa)	9.106 650*E+00
kgf/mm ²	pascal (Pa)	9.106 650*E+06
km/h	metre per second (m/s)	2.777 778 E-01
kilopond	newton (N)	9.806 650*E+00
kW.h	joule (J)	3.600 000*E+06



<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
kip (1 000 lbf)	newton (N)	4.448 212 E+03
kip/in ² (ksi)	pascal (Pa)	6.894 757 E+06
knot (international)	metre per second (m/s)	5.144 444 E-01
lambert	candela per square metre (cd/m ²)	1/π *E+04
lambert	candela per square metre (cd/m ²)	3.183 099 E+03
langly	joule per square metre (J/m ²)	4.184 000*E+04
lb-ft ² (moment of inertia)	kilogram metre squared (kg- m ²)	4.214 011 E-02
Lb.in ³ (moment of inertia)	kilogram metre squared (kg-m ²)	2.926 397 E-04
lb/ft.h	pascal second (Pa-s)	4.1789 E-04
lb/ft.s	pascal second (Pa-s)	1.488 14 E+DO
lb/ft ²	kilogram per square metre (kg/m ²)	4.882 28 E+00
lb/ft ³	kilogram per cubic metre (kg/m ³)	1.601 846 E+01
lb/gal (U.K. liquid)	kilogram per cubic metre (kg/m ³)	9.977633 E+01
lb/gal (U.S. liquid)	kilogram per cubic metre (kg/m ³)	1.198264 E+02
lb/h	kilogram per second (kg/s)	1.259979E-04
lb/hp.h (SEC. specific fuel consumption)	kilogram per joule (kg/J)	1.689659 E-07
lb/in ³	kilogram per cubic metre (kg/m ³)	2.767990 E+04
lb/min	kilogram per second (kg/s)	7.559 873 E -03
lb/s	kilogram per second (kg/s)	4.535924 E -01
lb/yd ³	kilogram per cubic metre (kg/m ³)	5.932 764 E -01
lbf -ft	newton metre (N.m)	1.355 818 E +00
lbf- ft/in	newton metre per metre (N.m/m)	5337 866 E +01
lbf.in	newton metre (N.m)	1.129 848 E-01
lbf.in/in	newton metre per metre (N.m/m)	4.448222 E+00
lbf.s/ft ²	pascal second (Pa.s)	4.780 026 E+01
lbf/ft	newton per metre (N/m)	1.459 390 E+01
lbf/ft ²	pascal (Pa)	4.780 026 E+01
lbf/in	newton per metre (N/m)	1.751 260 E+02
lbf/in ² (psi)	pascal (Pa)	6.894757 E+03
lbf/lb (thrust/weight (mass) ratio)	newton per kilogram (N/kg)	9.806650 E+00
light year	metre (m)	9.46055 E+15
liter	cubic metre (m ³)	1.000 000*E -03
maxwell	weber (Wb)	1.000 000*E-0.8
mho	siemens (S)	1.000000*E+00
microinch	metre (m)	2.540 000*E-08
micron	metre (m)	1.000 000*E-06
mile	metre (m)	2.540 000*E-05
mile (international)	metre (m)	1.609 344*E+03
mile (statute)	metre (m)	1.409 3 E+03
mile (US. survey)	metre (m)	1.609 347 E+03
mile (international nautical)	metre (m)	1.852 000*E+03
mile (U.K. nautical)	metre (m)	1.853 104*E+03



<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
mile (U.S. nautical)	metre (m)	1.852 000*E + 03
mi ² (international)	square metre (m ²)	2.589 988 E+06
mi ² (U.S. sarsey)	square metre (m ²)	2.589 998 E+06
mi/h (international)	metre per second (m/s)	4.470 400*E-01
mi/h (international)	kilometre per hour (km/h)	1.609 344*E+00
mi/min (international)	metre per second (m/s)	2.682 240*E + 01
mi/s (international)	metre per second (m/s)	1.609 344*E+03
millibar	pascal (Pa)	1.000 000*E+ 02
millimetre of mercury (0°C)	pascal (Pa)	1.333 22 E+02
minute (angle)	radian (rad)	2.908 882 E-04
minute (mean solar)	second (s)	6.000 000 E+01
minute (sidereal)	second (s)	5.983 617 E+01
month (mean calendar)	second(s)	2.628 000 E+06
oersted	ampere per metre (A/m)	7.957 747 E+01
ohm centimetre	ohm metre (Ω.m)	1.000 000*E -02
ohm circular.mil per ft	ohm millimetre squared per metre (Ω.mm ² /m)	1.662 426 E-03
ounce (avoirdupois)	kilogram (kg)	2.834 952 E-02
ounce (troy or apothecary)	kilogram (kg)	3.110 348 E-02
ounce (U.K. fluid)	cubic metre (m ³)	2.841 307 E-05
ounce (U.S. fluid)	cubic metre (m ³)	2.957 353 E-05
ounce-force	newton (N)	2.780 139 E-01
ozf .in	newton metre (N.m)	7.061552 E -03
oz (avoirdupois)/gal (U.K. liquid)	kitograni per cubic metre (kg/m ³)	6.236 021 E+00
oz (avoirdupois)/gal (U.S. liquid)	kilogram per cubic metre (kg/m ³)	7,409 152 E- 00
oz (avoirdupois)/in ²	kilogram per cubic metre (kg/m ³)	1.729994 E+03
oz (avoirdupois)/ft ²	kilogram per square metre (kg/m ²)	3.051 817 E-01
oz (avoirdupois)/yd ²	kilogram per square metre (kg/m ²)	3.390575 E -02
parsec	metre (m)	3.085 678 E+16
pennyweight	kilogram (kg)	1.555 174 E-03
perm(0°C)	kilogram per pascal second metre squared (kg/Pa.s.m ²)	5.721 35 E-11
perm (23°C)	kilogram per pascal second metre squared (kg/Pa.s.m ²)	5.745 25 E-11
perm.in (0°C)	kilogram per pascal second metre squared (kg/Pa.s.m)	1.453 22 E-12
perm.in (23°C)	kilogram per pascal second metre squared (kg/Pa.s.m)	1.459 29 E-12
phot	lumen per square metre (lu/m ²)	1.000 000 *E+04
pint (U.S. dry)	cubic metre (m ³)	5.506 105 E-08
pint (U.S. liquid)	cubic metre (m ³)	4.731 765 E-04
poise (absolute viscosity)	pascal second (Pa.s)	1.000 000*E-01
pound (lb avoirdupois)	kilogram (kg)	4.535 924 E-01
pound (troy or apothecary)	kilogram (kg)	3.732 417 E-03



<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
poundal	newton (N)	1.382 550 E-01
potindal/ft ³	pascal (Pa)	1.488 164 E.00
Poundal. s/ft	pascal second (Pa.s)	1.488 164 E.00
pouesd.force (Ibf)	newton (N)	4.442 222 E+00
quart (U.S. dry)	cubic metre (m ³)	1.101 221 E-03
quart (U.S. liquid)	cubic metre (m ³)	9.463 529 E-04
rad (radiation dose absorbed)	gray (Gy)	1.000 000*E-02
rem	sievert (Sv)	1.000 000*E-02
rhe	1 per pascal second (1/Pa.s)	1.000 000*E.01
roentgen	coulomb per kilogram (C/kg)	2.58 E-04
second (angle)	radian (rad)	4.848 137 E-06
second (sidereal)	second (a)	9.972 696 E-01
slug	kilogram (kg)	1.459 390 E+01
slug/ft.s	pascal second (Pa.s)	4.781 1026 E+01
slug/ft ²	kilogram per cubic metre (kg/m ³)	5.153 788 E+02
statampere	ampere (A)	3.335 640 E-10
suatcoulomb	coulomb (C)	3.335 640 E-10
statfarad	farad (F)	1.112 650 E-12
stathenry	henry (H)	8.987554 E+11
statmho	siemens (S)	1.312 650 E-12
statohm	ohm (Ω)	8.987 554 E+11
statvolt	volt (v)	2.997925 E+02
stere	cubic metre (m ³)	1.000 000*E÷ 00
stilb	candela per square metre (cd/m ²)	1.000 000*E. 04
stokes (kinematic viscosity)	metre squared per second (m ² /s)	1.000 000*E-04
therm	joule (J)	1.055056 E+08
ton (assay)	kilogram (kg)	2.916667 E-02
ton (long. 2 240 lb)	kilogram (kg)	1.016047 E.03
ton (metric)	kilogram (kg)	1.000 000*E.03
ton (nuclear equivalent of TNT)	joule (J)	4.184 E+09
ton (refrigeration)	watt (W)	3.516 800 E+03
ton (register)	cubic metre (m ³)	2.831 685 E+ 00
ton (short, 2 000 lb)	kilogram (kg)	9.071 847 E +02
ton (long)/yd ³	kilogram per cubic metre (kg/m ³)	1.328 939 E+03
ton (short)/h	kilogram per second (kg/s)	2.519 958 E-01
ton -force (2 000 lbf)	newton (N)	8.896 444 E+03
tonne	kilogram (kg)	1.000 000 *E + 03
torr (mm Hg, 0°C)	pascal (Pa)	1.333 22 E+02
unit pole	weber (Wb)	1.256 637 E-07
W.h	joule (J)	3.600 000*E + 03
W.s	joule(J)	1.000 000*E+00
W/cm ²	watt per square metre (W/m ²)	1.000 000*E + 04
W/in ²	watt per square metre (W/m ²)	1.550 003 E+03
yard	metre (m)	9.144 000*E -01
yd ²	square metre (m ²)	8.361 274 E-01
yd ³	cubic metre (m ³)	7.645 549 E-01
yd ³ /min	cubic metre per second (m ³ /s)	1.274 258 E-02



<i>To convert from</i>	<i>to</i>	<i>Multiply by</i>
year (calendar)	second (s)	3.153 600 E+07
year (sidereal)	second (s)	3.155 815 E+07
year (tropical)	second (s)	3.155 693 E+07

Table C-2. Temperature conversion formulae

<i>To convert from</i>	<i>To</i>	<i>Use formula</i>
Celsius temperature (t°_C)	Kelvin temperature (t_K)	$t_K = t_{oC} + 273.15$
Fahrenheit temperature (t°_F)	Celsius temperature (t°_C)	$t_{oC} = (t^{\circ}_F - 32) / 1.8$
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)	$t_K = t^{\circ}_R / 1.8$



ATTACHMENT D
CO-ORDINATED UNIVERSAL TIME

The Republic of Sudan has accepted Co-ordinated Universal Time (UTC) as the accepted international time for clock time. It is therefore the time used in the Republic of Sudan for world-wide time signal broadcasts in aviation.



ATTACHMENT E PRESENTATION OF DATE AND TIME

1. Introduction

The International Organization for Standardization (ISO) Standards 2014 and 3307 specify the procedures for writing the date and time in all-numeric form and ICAO will be using these procedures in its documents where appropriate in the future.

2. Presentation of Date

Where dates are presented in all-numeric form, ISO 2014 specifies that the sequence year-month-day should be used. The elements of the date should be:

- four digits to represent the year, except that the century digits may be omitted where no possible confusion could arise from such an omission. There is value in using the century digits during the period of familiarization with the new format to make it clear that the new order of elements is being used;
- two digits to represent the month;
- two digits to represent the day.

Where it is desired to separate the elements for easier visual understanding, only a space or a hyphen should be used as a separator. As an example, 25 August 1983 may be written as:

19830825 or 830825
or 1983-08-25 or 83-08-25
or 1983 08 25 or 83 08 25

It should be emphasized that the ISO sequence should only be used where it is intended to use an all-numeric presentation. Presentations using a combination of figures and words may still be used if required (e.g. 25 August 1983).

3. Presentation of Time

- 3.1 Where the time of day is to be written in all-numeric form, ISO 3307 specifies that the sequence hours-minutes-seconds should be used.
- 3.2 Hours should be represented by two digits from 00 to 23 in the 24-hour timekeeping system and may be followed either by decimal fractions of an hour or by minutes and seconds. Where decimal fractions of an hour are used, the normal decimal separator should be used followed by the number of digits necessary to provide the required accuracy.
- 3.3 Minutes should likewise be represented by two digits from 00 to 59 followed by either decimal fractions of a minute or by seconds.
- 3.4 Seconds should also be represented by two digits from 00 to 59 and followed by decimal fractions of a second if required.
- 3.5 Where it is necessary to facilitate visual understanding a colon should be used to separate hours and minutes and minutes and seconds. For example, 20 minutes and 18 seconds past 3 o'clock in the afternoon may be written as:
- 152018 or 15:20:18 in hours, minutes and seconds
or 1520.3 or 15:20.3 in hours, minutes and decimal fractions of a minute
or 15.338 in hours and decimal fractions of an hour.



4. Combination Date and Time Groups

This presentation lends itself to a uniform method of writing date and time together where necessary. In such cases, the sequence of elements year-month-day-hour-minute-second should be used. It may be noted that not all the elements need be used in every case - in a typical application, for example, only the elements day-hour-minute might be used.

-END-