APPENDIX I. PHYSICAL UNITS

Unit systems

A coherent system of physical units is based on a certain set of base units (e.g., meter, kilogram, second) that are well defined in terms of actual physical phenomena (e.g., length, mass, and time, respectively). Derived units in a coherent system are formed as products of powers of base units without introducing numerical factors. Their algebraic expressions in terms of the base units can be replaced by special names and their symbols (e.g., 1 N = 1 $mkgs^{-2}$). Derived units can themselves be used to form other derived units and their symbols (e.g., 1 Pa = 1 Nm^{-2}). Values of dimensionless quantities are expressed by pure numbers. The corresponding unit is the ratio of a unit to itself, or the dimensionless unit of the coherent system, and may be expressed by the number 1 (Weast et al., 1985).

There are two commonly known coherent systems of units: the Système International d'Unités (SI) and the centimeter-gram-second (CGS) system. The SI is the only internationally recommended system and should be used throughout for ODP physical measurements and analyses.

The obsolescent "electrostatic CGS" and "electromagnetic CGS" units cannot strictly be compared to the corresponding units of the SI. This is because the electromagnetic CGS system is a three-dimensional system of units in which the electric and magnetic quantities are considered to be derived from the centimeter, gram, and second as base units, whereas the SI has four dimensions for these quantities (meter, kilogram, second, and ampere). The complexities involved in such conversions are well known to those working with rock magnetic properties.

SI UNITS

The SI name was adopted by the Conference des Poids et Mesure (CGPM) in 1960. It is based on the seven base units (CGPM 1960, 1971) listed in Table A-1 (see Weast et al., 1985, for definitions).

Table Appendix—1SI base units.

Base quantity	Name	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

The base unit of mass is the only one with a name that, for historical reasons, contains a prefix. Several subsystems of the SI are used in different fields of science (e.g., the meter-kilogram-second [MKS] system in mechanics).

Derived SI units are listed in Table A-2.

Table Appendix—2Derived SI units.

Quantity	Name	Symbol	Base unit	Other SI
Plane angle	radian	rad	$m\ m^{-1}$	
Solid angle	steradian	sr	$m^2\ m^{-2}$	
Frequency	hertz	Hz	s^{-1}	
Force	newton	N	$m\ kg\ s^{-2}$	J/m
Pressure, stress	pascal	Pa	$m^{-1}\ kg\ s^{-2}$	N/m^2
Energy, work, quantity of heat	joule	J	$m^2\ kg\ s^{-2}$	N m
Power, radiant flux	watt	W	$m^2\ kg\ s^{-2}$	J/s
Quantity of electricity, electric charge	coulomb	C	s A	A s
Electric potential, potential difference, electromotive force	volt	V	$m^2\ kg\ s^{-3}\ A^{-1}$	W/A
Capacitance	farad	F	m^{-2} kg-1 $s^4\ A^2$	C/V
Electric resistance	ohm	W	$m^2\ kg\ s^{-3}\ A^{-2}$	V/A
Conductance	siemens	S	m^{-2} kg-1 $s^3\ A^2$	A/V
Magnetic flux	weber	Wb	$m^2\ kg\ s^{-2}\ A^{-1}$	V s
Magnetic flux density	tesla	T	$kg\ s^{-2}\ A^{-1}$	Wb/m^2
Inductance	henry	H	$m^2\ kg\ s^{-2}\ A^{-2}$	Wb/A
Luminous flux	lumen	lm		cd sr
Illuminance	lux	lx		m^{-2} cd sr
Activity	becquerel	Bq	s^{-1}	
Absorbed dose	gray	Gy	$m^2\ s^{-2}$	J/kg

The radian and steradian actually belong to a third class of “supplementary SI units” for which the CGPM (1960) declined to state whether they were base units or derived units.

In addition to the set of formal derived units listed in Table A-2, there are scores of additional SI derived units and unit symbols for other quantities (volume, density, velocity, magnetic field strength, etc.). These are either trivial or defined within the appropriate context. Other units exactly defined in terms of SI units, but not part of the SI, are listed in Table A-3.

Table Appendix—3Units exactly defined in terms of SI units.

Quantity	Name	Symbol	Base unit
Time	minute	min	60 s
	hour	h	3,600 s
	day	d	86,400 s
Angle	degree	°	(π/180) rad
	minute	'	(π/10,800) rad
	second	"	(π/648,000) rad
Temperature	degree Celsius	°C	= T(K) - 273.15 K

Similarly, the use of certain decimal fractions and multiples of SI units, including those listed in Table A-4, is considered appropriate.

Table Appendix—4 Accepted decimal multiples and fractions of SI units.

Quantity	Name	Symbol	SI base unit
Length	ångström	A	10^{-10} m
Cross section	barn	b	10^{-28} m^2
Volume	liter	lL	10^{-3} m^3
Mass	tonne	t	10^3 kg
Pressure	bar	bar	10^5 Pa

OBSOLESCENT UNITS

Table A-5 lists a selection of units used in the ODP and which are to be abandoned. The conversion to SI units is also listed.

Table Appendix—5Obsolescent units and their conversion to SI units.

Quantity	Name	Symbol	SI base unit
Length	inch	in	2.54 x 10^{-2} m
	foot	ft	0.3048 m
	mile	mi	1609 m
Mass	pound	lb	0.453592 kg
	short ton	-	907.2 kg
Force	kilogram-force	kgf	9.80665 N
	pound	lb	4.448 N
	kilo-pound	kip	4.448 kN
Pressure	kg/m^2	kg/m^2	9.8067 Pa
	$dyne/cm^2$	$dyne/cm^2$	0.1 Pa
	atmosphere	atm	1.0133 x 10^5 Pa
	mm Hg (0°C)	mm Hg	1.3332 x 10^2 Pa

Table Appendix—5Obsolescent units and their conversion to SI units.

	pounds per square inch	psi	6.8948×10^3 Pa
	pounds per square foot	psf	47.880 Pa
	tons per square foot	tsf	9.5761×10^4 Pa
Magnetic flux density	gauss	G	10^{-4} T = 10^{-4} $kgs^{-2}A^{-1}$
	electromag. units/cm^3	emu/cm^3	1.257 10^{-3} T = 10^{-3} Am^2
Magnetic force	oersted	oe	equivalent to 10^{-4} T