Chapter 18

Units of Measurement

The uniform usage of units is essential in a broadly-based catalog system, for obvious reasons. One cannot search for all the instruments covering 400 to 700 nm wavelength if some of the entries are in Angstroms and some in microns. The PDS standard shall be *Systeme Internationale d'Unites* (SI) where applicable. For example, micrometers should be used rather than microns.

The units for the data elements used in PDS data product labels and templates have been determined by the discipline scientists on a data element by data element basis. The Planetary Science Data Dictionary defines the desired units for each database element used in the system. In addition, there is a table in the PSDD that gives unit definitions.

In cases where more than one type of unit is possible for a given data element, an additional data element shall be used to identify the applicable unit. For example, the value of the element SAMPLING_PARAMETER_RESOLUTION may be given in different units, depending on the situation. Therefore, an additional element, SAMPLING_PARAMETER_UNIT, accompanies it, in order to specify the applicable unit of measure. The PDS allows exceptions to SI units when needed for consistency with previous community usage (e.g. an angle measurement in degrees instead of radians).

Both the name of the unit and the symbol are allowed as well as singular or plural form. In addition, the double asterisk (**) is used, rather than the caret (^) to indicate exponentiation, in order to comply with the preferences of the European science community.

SI Units

The following summary of SI unit information is extracted from *The International System of Units.*

Base units — As the system is currently used, there are seven fundamental SI units, termed "base units”:

QUANTITY	NAME OF UNIT	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

SI units are all written in lowercase style; symbols are also lowercase except for those derived from proper names. No periods are used with any of the symbols in the international system.

Derived units — In addition to the base units of the system, a host of derived units, which stem from the base units, are also employed. One class of these is formed by adding a prefix, representing a power of ten, to the base unit. For example, a kilometer is equal to 1,000 meters, and a millisecond is .001 (that is, 1/1,000) second. The prefixes in current use are as follows:

SI PREFIXES

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10**18	exa	E	10**-1	deci	d
10**15	peta	P	10**-2	centi	c
10**12	tera	T	10**-3	milli	m
10**9	giga	G	10**-6	micro	
10**6	mega	M	10**-9	nano	n
10**3	kilo	k	10**-12	pico	p
10**2	hecto	h	10**-15	femto	f
10**1	deka	da	10**-18	atto	a

Although, for historical reasons, the kilogram rather than the gram was chosen as the base unit, prefixes are applied to the term gram instead of the official base unit: megagram (Mg), milligram (mg), nanogram (ng), etc.

Another class of derived units consists of powers of base units and of base units in algebraic relationships. Some of the more familiar of these are the following:

QUANTITY	NAME OF UNIT	SYMBOL
area	square meter	m**2
volume	cubic meter	m**3
density	kilogram per cubic meter	kg/m**3
velocity	meter per second	m/s
angular velocity	radian per second	rad/s
acceleration	meter per second squared	m/s**2
angular acceleration	radian per second squared	rad/s**2
kinematic viscosity	square meter per second	m**2/s
dynamic viscosity	newton-second per square meter	N*s/m**2
luminance	candela per square meter	cd/m**2
wave number	1 per meter	m**-1
activity (of a radioactive source)	1 per second	s**-1

Many derived SI units have names of their own:

QUANTITY	NAME OF UNIT	SYMBOL	EQUIVALENT
frequency	hertz		s**-1
angular acceleration	hertz	Hz	s**-1
force	newton	N	kg*m/s**2
pressure (mechanical stress)	pascal	Pa	N/m**2
work,energy,quantity of heat	joule	J	N*m
power	watt	W	J/s
quantity of electricity potential difference	coulomb	C	A*s
electromotive force	volt	V	W/A
electrical resistance	ohm	-	V/A
capacitance	farad	F	A*s/V
magnetic flux	weber	Wb	V*s
inductance	henry	H	V*s/A
magnetic flux density	tesla	T	Wb/m**2
magnetomotive force	ampere	A	
luminous flux	lumen	lm	cd*sr
illuminance	lux	lx	lm/m**2

Supplementary units are as follows:

QUANTITY	NAME OF UNIT	SYMBOL
plane angle	radian	rad
solid angle	steradian	sr

Use of figures with SI units —In the international system it is considered preferable to use only numbers between 0.1 and 1,000 in expressing the quantity of any SI unit. Thus the quantity 12,000 meters is expressed 12 km, not 12,000 m. So too, 0.003 cubic centimeters is preferably written 3 mm3, not 0.003 cm3.