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Planetary Science Data Dictionary Document

A Cooperative Publication of the Planetary Data System project and the Advanced Multimission Operations System

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PREFACE

This document is a cooperative publication of the Planetary Data System (PDS) project and the Advanced Multimission Operations System (AMMOS - formerly the Space Flight Operations Center, or SFOC) project and reflects a set of standards for the cataloging of mission science and operations data. The standards were derived initially from PDS documentation. Most of the data element names and definitions were compiled over the past ten years by scientists and engineers affiliated with the PDS. These were originally published in the PDS Data Dictionary. Other entries were adopted from the AMMOS Data Dictionary. The effort to compose a Planetary Science Data Dictionary reflects the growing cooperation between the AMMOS and PDS, since these are the primary data systems that will curate mission data.

This master data dictionary database is maintained by Karen Law (representing PDS) and David Wagner (representing AMMOS). The document is created by Jean Mortellaro. However, the heart of this PSDD lies in the data modelling and mission interface work done in the PDS Object Review Committee at the Jet Propulsion Laboratory, with significant guidance provided by the staff at PDS Discipline Nodes. Core ORC members who contributed to the Version 3 PSDD include:

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The document's contents are for the most part automatically-formatted and typeset database reports from a master data dictionary database. This database is used to maintain configuration management over the data dictionary elements, and both the AMMOS and PDS operational data dictionary database contents are based on it.

It is the sincere hope of the producers that the index and the cross-referencing Data Element Classified Listings (Appendix F) will make this document an easily-referenced manual, despite its size and diverse content. Users are directed to read the section entitled Document Format (Section 1.5) so that they may use only parts of the document that are appropriate, as well. as How to Use This Document (Section 1.7) for instruction on how to read the entries.

1 INTRODUCTION

1.1 PURPOSE

The primary purpose of the Planetary Science Data Dictionary (PSDD) is to allow members of the planetary science community to benefit from standards work done in the area of data product description. The work that supports it is done at the Jet Propulsion Laboratory by individuals who participate in U.S. and international standards efforts. As a result the PSDD may serve as a guide to other data systems still in development, or to data systems that will eventually be connected with either PDS or AMMOS.

The secondary purpose of the PSDD is to serve as an interface agreement between the Planetary Data System (PDS) and the Multimission Ground Data System (MGDS) development effort of AMMOS. It is designed to reflect points of agreement between the two projects, as well as to chronicle applications or decisions on which project representatives agree to a limited set of standards.

1.2 SCOPE

This document will serve as standard reference for data product descriptions contained in the Planetary Data System and Multimission Ground Data System data catalogs. By extension, this means that it will be used in planetary mission operations and in science processing in support of all JPL-managed planetary missions. It also means that it will serve the data systems that exist at PDS Discipline Node sites.

In this edition of the PSDD, data elements describing scientific experiments reflect PDS' extensive experience with imaging and plasma data sets. Over time, as more diverse data sets are handled by the PDS and AMMOS catalogs, data elements germane to other scientific investigations will be incorporated into the dictionary.

1.3 PSDD ONLINE AVAILABILITY

In order to get the most recent entries in the PSDD, users may access our web interface. Our URL is http://pds.jpl.nasa.gov/. Please contact the PDS Operator at (818) 306-6130, via NSI/DECnet at JPLPDS::PDS_OPERATOR, or via Internet at pds_operator@jplpds.jpl.nasa.gov for further information.

1.4 APPLICABLE DOOCUMENTS

The following documents define standards or requirements affecting the content of this document:

Planetary Data System Standards Reference, JPL D-7669, Part 2, Version 3.2 (July 24, 1995). Available at url http://pds.jpl .nasa.gov/.

The following documents provide additional information related to the contents of this document:

Space Flight Operations Center Software Interface Specification, module SFOC-1-CDB-Any-Catalog2 (February, 1992).

1.5 DOCUMENT FORMAT

The Planetary Science Data Dictionary is composed of three main sections: standards for naming and describing data elements, an annotated list of data elements, and a set of appendices to show how the elements are used. The core of the dictionary, data elements definitions, are arranged in a single list in alphabetical order. After some debate, the editors opted to show only valid data elements in this main section. Aliases are listed in a separate appendix. However, aliases, data element names, and object names are all listed in the index.

Most of the valid data elements that appear in the document are appropriate for common use – that is, they have been defined in terms that allow them to be used in many systems or disciplines. Others are more appropriate to specific computing environments, data systems, or flight projects. These data elements are identified as such on the status line by a bracketed expression as follows:

CORE_UNIT [ISIS]

The bracketed expressions provide a qualification (or caveat for the user) to indicate that the data element's definition may be applicable only within a certain system's context. Any of the [PDS ...] elements can be used for other applications; prospective users need only work with the PDS to improve or broaden the definition to embrace the new use.

However, the [JPL-AMMOS-SPECIFIC] keywords are exceptions. The AMMOS data elements must not be used in PDS labels because of one or more of the following situations: 1) they are specific to the AMMOS data processing environment, 2) they are still pending approval for inclusion in the common list, or 3) they do not meet PDS nomenclature standards. AMMOS-SPECIFIC DATA ELEMENT NAMES MAY BE USED ONLY ON DATA PRODUCTS THAT ARE NOT BOUND FOR THE PDS. Only in the rarest of cases will PDS aliases be set up to accommodate these terms.

> Note: Although these "qualified" data elements may continue to appear in the PSDD, it is the goal of the dictionary's designers in PDS and AMMOS to have new data elements submitted with definitions general enough to be applicable to any system or mission.

Appendix G contains a listing of data elements classified according to the system in which it finds primary use.

1.6 CHANGE CONTROL PROCEDURE

This document is being published separately by AMMOS and PDS under the same JPL document number. This allows for each project's configuration management and documentation systems to control the document independently. By agreement between AMMOS and PDS updates to this document will be generated on a regular schedule, produced jointly, and submitted separately to their respective documentation systems for publication and distribution.

The common elements (those that do not pertain to a particular data system) are currently defined by agreement between AMMOS and PDS and managed by the PSDD data administrator in the master data dictionary database. Elements that are defined by any other data system may be proposed for inclusion in the dictionary. Those that are acceptable to both systems will be included in the common list. Changes or additions may be submitted to either system.

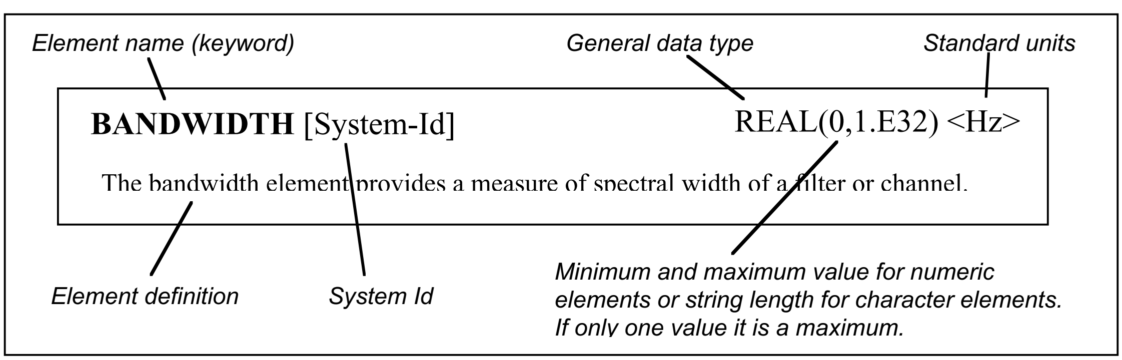
1.7 HOW TO USE THIS DOCUMENT

This document is intended to serve several purposes. First, it serves as a reference manual to users of the PDS and AMMOS data systems to define the data attributes used to describe data and meta-data. Second, it serves as a reference to producers of data products that are to be included in these systems to aid in the design of data descriptions.

The fifth type of users will be primarily interested in the definitions of data elements. These are presented in a single alphabetical list. This document also provides a general index for terms, and a classified listing where data elements are grouped under headings such as "Mission/Spacecraft Data Element", or "Geometric/Navigation Data Elements."

The second type -- the product producers -- are expected to use the document differently. A producer generally knows how to describe a data product, but needs to find the appropriate keywords to represent those attributes in data descriptions. Here too the classified cross-reference may be used to help locate existing keywords. Also provided in this document are standards for defining new keywords. Producers should note that keywords defined on the status line as AMMOS-SPECIFIC may only be used by products unique to AMMOS. More specifically, data products that will exist in both systems are restricted to using common or [PDS...] elements only.

The element definitions sections are presented in a compact listing format that provides a number of descriptive characteristics of the elements and keys to additional information. The following example illustrates the presentation format.



The general data type is one of the standard general data types defined in section 2.3. The standard units symbols are defined in section 2.6.

SECTION 2

2 DATA DICTIONARY CONVENTIONS

2.1 GENERAL

The standards included in this section refer specifically to the formation of data element names. Please refer to the PDS Standards Reference for information on the formation of names for Data Sets, Data Set Collections, volume names, file names, etc.

2.2 DATA NOMENCLATURE

The PDS data nomenclature standards define the rules for constructing Data Element and Data Object names. The purpose of establishing a standard syntax for such names is to facilitate user access to data. It is particularly important to use common nomenclature in database management systems, where searches are made covering a variety of disciplines, techniques, and flight projects.

Several organizations have succeeded in developing procedures for assigning standardized names to data elements. The method adopted by the PDS is a derivative of the "OF language" developed by IBM. It also follows closely the publication *Guide on Data Entity Naming Conventions*, NBS Special Publication 500-149.

The objective of this naming convention is to create an environment wherein any number of individuals, working independently, will select the identical name for the same data item. If achieved, this objective eliminates multiple names for the same item (synonyms), and duplicate names for different elements homonyms). The task of browsing data dictionaries by those who are unfamiliar with its contents would be greatly simplified. There would be greater consistency within the system, thus correlative analyses would be better supported.

The construction rules must yield data names that are easily grasped, are as consistent as possible with the common usage within the science community, and are also logically and methodically constructed, ideally from a predefined dictionary of component terms.

2.2.1 DATA ELEMENT NOMENCLATURE STANDARDS

2.2.1.1 Construction of Data Element Names

Data element name are composed of descriptor words (which describe what is being measured or presented in the value field) and class words (which can identify the data type of the object). Data element names are constructed using these components from left to right, from most specific (the leftmost component) to most generic (the rightmost component).

This document contains the standard data element names used to describe data products. An understanding of the syntax is necessary for two purposes: 1) as an aid in finding an already existing data element and 2) creating a new data element for inclusion in the data dictionary.

All data element names are constructed from standard ASCII alphanumeric characters and the underscore character. No special characters (e.g., "&", "*", etc.) are permitted. The first character of the first component of a data element name must be alphabetic.

The naming syntax is not case-sensitive[*]. For example, the following constructs represent the same data element name:

data_set_parameter_name

DATA_SET_PARAMETER_NAME

Data_Set_Parameter_Name

2.2.1.2 Order of Terms in Element Names

The structure of a data element name is as follows; the most specific component is placed first, the next most specific, etc., terminating with the least specific or most general.

For example, consider a phrase such as "the name of a parameter in a data set". Removing the articles and prepositions yields "name parameter data set". The most general component here is "name", and therefore is placed last in the hierarchy. Next, ask the question "name of what?". The answer is "name of a parameter", which indicates that "parameter" is more specific than "name". The question "what kind of parameter?" is answered by "data set", the most specific component. Therefore, the data object name is data_set_parameter_name

Other examples include:

"Unit of the data set parameter" translates into

data_set_parameter_unit

'Type of the host of an instrument" translates into

instrument_host_type

Components used in the nomenclature syntax are also categorized in two groups as DESCRIPTORS or CLASS WORDS. The format of a data element name is as follows:

data object name := [DESCRIPTOR(S) connector]* CLASS WORD

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[*] For a discussion of the relevant issues and specific restrictions regarding case sensitivity within AMMOS, please refer to applicable document 2, CDB-Any-Catalog2.

where connector is the underscore (_).

The components in the data element name are connected by an underscore (_) unless it is not supported by hardware or software, in which case the connecter is a hyphen (-).

A list of many components in current use can be found in Appendix H of this document.

2.2.1.3 Guidelines for addition of new data element names

Questions frequently arise as to whether to form a new data element, or to find an existing one that works and amplify the definition. Since a data dictionary is a controlled vocabulary, the general rule for administrators is to avoid proliferation of new terms. As a result, the PSDD makes broad use of the Note: convention, whereby system- or mission-specific qualifications to the general definition are acknowledged. In other cases the base definition itself is expanded to include alternate meanings.

However, addition of a new data element is called for if the domain for the new data element differs from the existing one – and/or if that domain is used for validation of the values associated with the data element. For example: data_type has an exhaustive list of machine-specific standard values. However, bit_data_type has only a subset of these. If it matters to the system that the values for the qualified term be restricted (bit_data_types only), then the more specific term should be added. On the other hand, if the values comprise a proper subset of the more general term, and if the online validation for that element is not crucial, the guideline is to continue with the broader term and, if necessary, add a note.

2.2.2 CLASS WORDS

Class words comprise the right most component in a data element name. The class word identifies the basic "information type" of the data object, where information type includes both the data type (numeric, character, logical) and a size constraint.

The use of a limited set of class words will:

REDUCE THE NEED FOR USERS AND DATA PROCESSING SOFTWARE TO ACCESS A DATA DICTIONARY TO PARSE, INTERPRET, QUERY OR DISPLAY VALUES.

ADD A GREATER LEVEL OF STRUCTURE AND CONSISTENCY TO THE NOMENCLATURE.

CONSTRAIN THE SELECTION AND USE OF DATA VALUES.

PROMOTE AUTOMATED OPERATIONS SUCH AS VALIDITY CHECKING.

PROMOTE THE DEVELOPMENT OF INTELLIGENT SOFTWARE.

If no class word is used as the rightmost component in a data element name the class word "value" is assumed to be the last component term in a data object name. For example, one would construct MAXIMUM_EMISSION_ANGLE or SOLAR_CONSTANT, as opposed to MAXUIUM_EMISSION_ANGLE_VALUE and SOLAR CONSTANT VALUE. When the class word "count" would be appropriate, the data element name can be abbreviated by making the descriptor word a plural. The plural form implies "the number of something", for example, "the number of bytes in a record".

For example:

Data Element	**PDS Data Element Name**
number of bytes in record	record_bytes
number of records in file	file_records
number of label records in file	label_records
number of samples in line	line_samples
number of suffix bytes in line	line_suffix_bytes

The following list enumerates the Class Words used at present, along with brief definitions.

CLASS WORD	**CLASS WORD DEFINITION**
count	A numeric value indicating a current total or tally. The class word count is implied by the use of plural descriptor words such as lines, bytes or bits. For example, LINES = 800 is interpreted as LINE_COUNT = 800.
date	A representation of time in which the smallest unit of measure is a day. The value is expressed in one of the standard forms. Example: PUBLICATION_DATE = 1959-05-30
description	A free-form, unlimited-length character string that provides a description of the item identified. Example: MISSION_DESC provides the description of a mission, as in The Magellan spacecraft was launched from the Kennedy Space Center on May 5, 1989. The spacecraft was deployed from the Shuttle cargo bay…. See also: the class word TEXT. Note: In the PDS, this term is abbreviated to DESC in every instance except when the word is unqualified. Hence, the data element name DESCRIPTION is spelled out, but INSTRUMENT_DESC contains the abbreviation.
direction	TBD
flag	A boolean condition indicator, limited to two states. Example: PLANETARY_OCCULTATION_FLAG = Y
format	AA specified or predetermined arrangement of data within a file or on a storage medium.
group	Names a collection or aggregation of elements. Example: ALT_FLAG_GROUP

id	A shorthand alphanumeric identifier. In some cases, a notation representing a shortened name of an NAME. See abbreviation standard. See also: 'name'. Example: SPACECRAFT_ID = VG1
mask	An unsigned numeric value representing the bit positions within a value. Example: SAMPLE_BIT_MASK = 2\#00011111\#
name	A literal value representing the common term used to identify an element. See also: 'id'. Example: SPACECRAFT_NAME = MAGELLAN.
note	A textual expression of opinion, an observation, or a criticism; a remark.
number	A quantity associated with a NAME. Example: START_SAMPLE_NUMBER = 5
range	Numeric values which identify the starting and stopping points of an interval. Note: the use of the word 'distance' supersedes the use of the word 'range' as a measure of linear separation. See: 'distance'. Example: IRAS_CLOCK_ANGLE_RANGE
ratio	The relation between two quantities with respect to the number of times the first contains the second. Example: DETECTOR_ASPECT_RATIO
sequence	1) an arrangement of items in accordance with some criterion that defines their spacewise or timewise succession; 2) an orderly progression of items or operations in accordance with some rule, such as alphabetical or numerical order.
set	A collection of items having some feature in common or which bear a certain relation to one another, e.g. all even numbers.
summary	An abridged description. Example: SCIENTIFIC_OBJECTIVES_SUMMARY
text	A free-form, unlimited length character string that represents the value of a data element. Example: ADDRESS_TEXT provides the value of an address, such as 4800 Oak Grove Dr.\nPasadena, CA 91109. In contrast, ADDRESS_DESC would describe an address such as an address consists of a street, city, state, and zip code. See also: the class word DESCRIPTION.
time	A value that measures the point of occurrence of an event expressed date and time in a standard form. Example: START_TIME = 1987-06-21T17:30:30.000

type	A literal that indicates membership in a predefined class. See: standard values for data elements. Example: TARGET_TYPE = PLANET
unit	A determinate quantity adopted as a standard of measurement.
value	The default class word for data element names not terminated with a class word. It represents the amount or quantity of a data element. For example, SURFACE_TEMPERATURE = 98.6 would be interpreted as SURFACE_TEMPERATURE_VALUE = 98.6.
vector	A quantity that has both length and direction which are independent of both the units and of the coordinate system in which each are measured. The vector direction is uniquely defined in terms of an ordered set of components with respect to the particular coordinate system for which those components have been defined.

2.2.3 DESCRIPTOR WORDS

There are two sources from which to select a descriptor word: the descriptor word list in this section, which contains definitions for a limited number of words, and the component list (Appendix H), which enumerates many the Descriptor and Class words that are in current use.

If no term in either of the two lists is deemed appropriate for a new data element, the data producer shall construct a new data name and submit it to the PDS for review.

Examples of descriptor words include angle, altitude, location, radius and wavelength.

For descriptor words of a scientific nature (as opposed to the computer systems-oriented words such as "bits"), the definitions are intended to convey the meaning of each word within the context of planetary science, and thus to facilitate the standardization of nomenclature within the planetary science community.

Certain descriptor words may have more than one meaning, depending upon the context in which they are used. It is believed that it is appropriate to include these words and their (multiple) definitions in the list, and that the context will suggest which definition is applicable in a given case.

In some cases (such as "elevation"), the example given for the descriptor word may contain just the word itself. In general, however, the descriptor word is one of several components of a data element's name.

Plural Descriptor Words

Plural descriptor words are used to indicate "count of " or "number of " in data object names (e.g., "sample_bits" rather than "number_of_bits_in_sample").

DESCRIPTOR WORD	DESCRIPTOR WORD DEFINITION
albedo	Reflectivity of a surface or particle. Example: BOND_ALBEDO
altitude	The distance above a reference surface measured normal to that surface. Altitudes are not normally measured along extended body radii, but along the direction normal to the geoid; these are the same only if the body is spherical. See also: 'elevation', 'height.' Example: SPACECRAFT_ALTITUDE
angle	A measure of the geometric figure formed by the intersection of two lines or planes. Definitions for data element names containing the word 'angle' should include origin and relevant sign conventions where applicable. Example: MAXIMUM_EMISSION_ANGLE
axis	A straight line with respect to which a body or figure is symmetrical. Example: ORBITAL_SEMIMAJOR_AXIS
azimuth	One of two angular measures in a spherical coordinate system. Azimuth is measured in a plane which is normal to the principal axis, with increasing azimuth following the right hand rule convention relative to the positive direction of the principal axis. PDS adopts the convention that an azimuth angle is never signed negative. The point of zero azimuth must be defined in each case. Example: SUB_SOLAR_AZIMUTH
bandwidth	The range within a band of wavelengths, frequencies or energies.
base	A quantity to be added to a value.
bits	A count of the number of bits within an elementary data item. Examples: SAMPLE_BITS
bytes	A count of the number of bytes within a record, or within a subcomponent of a record. Example: RECORD_BYTES
channel	A band of frequencies or wavelengths.
circumference	The length of any great circle on a sphere.

coefficient	A numeric measure of some property or characteristic.
columns	A count of the number of distinct data elements within a row in a table.
component	1) The part of a vector associated with one coordinate. 2) A constituent part. Example: VECTOR_COMPONENT_1
constant	A value that does not change significantly with time.
consumption	The usage of a consumable. Example: INSTRUMENT_POWER_CONSUMPTION
contrast	The degree of difference between things having a comparable nature. Example: MAXIMUM_SPECTRAL_CONTRAST
declination	An angular measure in a spherical coordinate system, declination is the arc between the Earth's equatorial plane and a point on a great circle perpendicular to the equator. Positive declination is measured towards the Earth's north pole, which is the positive spin axis per the right hand rule; declinations south of the equator are negative. The Earth mean equator and equinox shall be as defined by the International Astronomical Union (IAU) as the 'J2000' reference system unless noted as the 'B1950' reference system. See also: 'right_ascension'.
density	1) The mass of a given body per unit volume. 2) The amount of a quantity per unit of space. Example: MASS_DENSITY
detectors	A count of the number of detectors contained, for example, in a given instrument.
deviation	Degree of deviance.
diameter	The length of a line passing through the center of a circle or a circular NAME. Example: TELESCOPE_DIAMETER
distance	A measure of the linear separation of two points, lines, surfaces, or NAMEs. See also 'altitude', which refers to a specific type of distance. The use of the word 'distance' supersedes the use of the word 'range' as a measure of linear separation. See also: 'range'. Example: SLANT_DISTANCE
duration	A measure of the time during which a condition exists. Example: INSTRUMENT_EXPOSURE_DURATION
eccentricity	A measure of the extent to which the shape of an orbit deviates from circular. Example: ORBITAL_ECCENTRICITY

elevation	1) The distance above a reference surface measured normal to that surface. Elevation is the altitude of a point on the physical surface of a body measured above the reference surface; height is the distance between the top and bottom of a NAME. 2) An angular measure in a spherical coordinate system, measured positively and negatively on a great circle normal to the azimuthal reference plane, and positive elevation is measured towards the direction of the positive principal axis. See also: 'azimuth'.
epoch	A specific instance of time selected as a point of reference. Example: COORDINATE_SYSTEM_REFERENCE_EPOCH
error	The difference between an observed or calculated value and a true value. Example: TELESCOPE_T_NUMBER_ERROR
factor	A quantity by which another quantity is multiplied or divided. Example: SAMPLING_FACTOR
first	An indication of the initial element in a set or sequence. As with minimum and maximum, the values in the set may be out of order or discontinuous. For examples of the use of range-related terms, please see the following section.
flattening	A measure of the geometric oblateness of a solar system body, defined as the ratio of the difference between the body's equatorial and polar diameters to the equatorial diameter, or '(a-c)/a'.
fov	(field_of_view) The angular size of the field viewed by an instrument or detector. Note that a field may require multiple field_of_view measurements, depending upon its shape (e.g., height and width for a rectangular field). Example: HORIZONTAL_FOV
fovs	A count of the number of different fields of view characteristic of an instrument or detector.
fraction	The non-integral part of a real number. See also: 'base'.
frequency	The number of cycles completed by a periodic function in unit time.
gravity	The gravitational force of a body, nominally at its surface. Example: SURFACE_GRAVITY
height	The distance between the top and bottom of an NAME. Example: SCALED_IMAGE_HEIGHT

images	A count of the number of images contained, for example, in a given mosaic. Example: MOSAIC_IMAGES
inclination	The angle between two intersecting planes, one of which is deemed the reference plane and is normally a planet's equatorial plane as oriented at a specified reference epoch. Example: RING_INCLINATION
index	An indicator of position within an arrangement of items.
interval	1) The intervening time between events. 2) The distance between points along a coordinate axis. See also: 'duration'. Example: SAMPLING_INTERVAL
last	An indication of the final element in a set or sequence. As with minimum and maximum, the values in the set may be out of order or discontinuous. For examples of the use of range-related terms, please see the following section.
latitude	In a cylindrical coordinate system the angular distance from the plane orthogonal to the axis of symmetry. See also: 'longitude'. Example: MINIMUM_LATITUDE
length	A measured distance or dimension. See also: 'height', 'width'. Example: TELESCOPE_FOCAL_LENGTH
level	The magnitude of a continuously varying quantity. Example: NOISE_LEVEL
line	1) A row of data within a two-dimensional data set; 2) A narrow feature within a spectrum.
lines	1) A count of the number of data occurrences in an image array; 2) Any plural of 'line'.
location	The position or site of an NAME.
longitude	In a cylindrical coordinate system, the angular distance from a standard origin line, measured in the plane orthogonal to the axis of symmetry. (See also: 'latitude'.) Example: MAXIMUM_LONGITUDE
mass	A quantitative measure of a body's resistance to acceleration. Example: INSTRUMENT_MASS
maximum	An indicator of the element in a range that has the greatest value, regardless of the order in which the values are listed or stored. For example, in the set {4,5,2,7,9,3}, the minimum is 2, the maximum

is 9. The use of minimum and maximum, as with first and last, implies that the set may be out of order or discontinuous. For examples of the use of range-related terms, please see the following section.

minimum	An indicator of the element in a range that has the least value, regardless of the order in which the values are listed or stored. For example, in the set {4,5,2,7,9,3}, the minimum is 2, the maximum is 9. The use of minimum and maximum, as with first and last, implies that the set may be out of order or discontinuous. For examples of the use of range-related terms, please see the following section.
moment	The product of a quantity (such as a force) and the distance to a particular point or axis. Example: MAGNETIC_MOMENT
obliquity	Angle between a body's equatorial plane and its orbital plane.
parameter	A variable. Example: MAXIMUM_SAMPLING_PARAMETER
parameters	A count of the number of parameters in a given application. Example: IMPORTANT_INSTRUMENT_PARAMETERS
password	An alphanumeric string which must be entered by a would-be user of a computer system in order to gain access to that system.
percentage	A part of a whole, expressed in hundredths. Example: DATA_COVERAGE_PERCENTAGE
period	The duration of a single repetition of a cyclic phenomenon or motion. Example: REVOLUTION_PERIOD
points	A count of the number of points (i.e., data samples) occurring, for example, within a given bin. Example: BIN_POINTS
pressure	Force per unit area. Example: MEAN_SURFACE_ATMOSPHERIC_PRESSURE
radiance	A measure of the energy radiated by a NAME. Example: SPPECTRUM_INTEGRATED_RADIANCE
radius	The distance between the center of and a point on a circle, sphere, ellipse or ellipsoid. Example: MEAN_INNER_RADIUS
rate	The amount of change of a quantity per unit time. Example: NOMINAL_SPIN_RATE

records	A count of the number of physical or logical records within a file or a subcomponent of a file. Example: FILE_RECORDS
resolution	A quantitative measure of the ability to distinguish separate values. Example: SAMPLING_PARAMETER_RESOLUTION
right ascension	The arc of the celestial equator between the vernal equinox and the point where the hour circle through the given body intersects the Earth's mean equator reckoned eastward, in degrees. The Earth mean equator and equinox shall be as defined by the International Astronomical Union (IAU) as the 'J2000' reference system unless noted as the 'B1950' reference system. Note: In the PDS, this term is abbreviated to RA in most instances, except when the term is unqualified. Hence, the data element name RIGHT_ASCENSION is spelled out, but other terms referring to specific right ascensions contain the abbreviation.
rows	A count of the number of data occurrences in a table.
samples	A count of the number of data elements in a line of an image array or a set of data. Example: SEQUENCE_SAMPLES
scale	A proportion between two sets of dimensions. Example: MAP_SCALE
start	An indication of the beginning of an activity or observation. For examples of the use of range-related terms, please see the following section.
stop	An indication of the end of an activity or observation. For examples of the use of range-related terms, please see the following section.
temperature	The degree or intensity of heat or cold as measured on a thermometric scale. Example: MEAN_SURFACE_TEMPERATURE
title	A descriptive heading or caption. Example: SEQUENCE_TITLE
transmittance	The ratio of transmitted to incident energy. Example: TELESCOPE_TRANSMITTANCE
wavelength	The distance that a wave travels in one cycle. Example: MINIMUM_WAVELENGTH
width	The distance between two sides of a NAME. See also: 'height', 'length'. Example: SCALED_IMAGE_WIDTH

2.2.4 RANGE-RELATED DATA ELEMENT COMPONENTS – FIRST, LAST, START, STOP, MINIMUM, AND MAXIMUM

The PDS recommends that users employ one of three pairs of descriptor words to indicate the bounds of a range. These three pairs are first/last, start/stop, and minimum/maximum.

The use of minimum and maximum is the easiest to distinguish from the others. These words should be used to indicate the least and greatest values in a numeric range, regardless of the order to the elements in a set. Hence, in the set {2,5,1,7,4}, the minimum would be 1, and the maximum 7.

Start and stop allow data suppliers to indicate the bounds of a phenomenon that has some kind of motion in time or space. This is the only pair of words that can imply a contiguous, increasing order to the values within a range.

At times data suppliers wish to indicate the first and last occurrence of a phenomenon, regardless of the primary ordering attribute. Consider the following table of image attributes:

1	2	3	4	(picno)
22	13	42	87	(latitude)
03:05	07:15	01:32	16:47	(time)

These image products are in picno order. Each has center latitude and a time associated with it. To indicate the picno range it would make sense to say start_picno, stop_picno. Latitude may be indicated in two ways:

minimum_latitude	=	13	and, if it matters,
first_latitude	=	22	

Time can be indicated likewise:

start_time	=	"1992-123T01:32"	and, if it matters,
first_time	=	"1992-123T03:05"	

In this scheme, the terms first and last end up serving to indicate placement of secondary attributes – ones that do not constitute the primary ordering attribute.

2.2.5 PROHIBITED WORDS

The words in the Prohibited Words list aare not to be used as descriptor words. For each word, the list explains why the word was not included in the Descriptor Words list and providees an alternative that is a recognized PDS descriptor word.

Formerly used (or proposed) descriptor words which have been superceded by other words are also enumerated in the Prohibited Words list.

PROHIBITED WORD	**ALTERNATIVES**
begin	See the descriptor words: start, first, or minimum.
code	Use 'id'.
comment	See the class words: note, description, or text.
date/time	Please use 'time' alone when naming fields that indicate either both date and time information, or time information alone. Use 'date' alone in data elements that only indicate date information.
definition	Use 'description'.
divissor	Use 'factor'.
end	See the descriptor words: 'stop', 'last', 'minimum'. See the descriptor wwords: 'stop', 'last', 'minimum'.
field of view	Use 'fov'.
identification	Use 'id'.
increment	Use 'interval'.
indicator	Use 'id' or 'state'.
information	Use 'description'.
multiplier	Use 'factor'.
periapsis	Use 'closest_approach'.
program	Please use this term only in reference to software, not in reference to missions or projects.
slant range	Use 'slant distance'.

2.2.6 ABBREVIATION RULES

The maximum length of a data element name is 30 characters. Names must be limited 30 characters because of the limitations of the software engineering tools used by PDS. There are instances, therefore, when it becomes necessary to abbreviate terms within a name in order to comply with this limit.

Construction of Terse Data Element Names

Terse names are sometimes required for use in processing environments where names are restricted in length to 7, 8, 10, or 12 characters. The terse name for a given data element is based upon the "formal" full name of the element. A standard list of twelve-character terse names for the data elements in the PDS Catalog is maintained in the online data dictionary along with the list of the elements' thirty-character full names. This terse name list is intended as a reference for use by database implementors at the PDS Nodes and by other PDS developers.

Rules

1. Abbreviate only if necessary to fit a name within the character limit.

2. There may be multiple allowable abbreviations for a number of terms. This is to support the construction of terse names of varying length (i.e., 12, 8, or even 6 characters), while maintaining maximum readability. Each abbreviation, however, will be unique and correspond to one and only one full word.

3. READABILITY is the primary goal.

4. Use the component list abbreviations in Appendix H. Some words are always abbreviated. If more than one form is available, the longest one which will fit should be used first, subject to rule 7, below.

5. Abbreviations are constructed only for root words.

6. Plural descriptor words are given the root word abbreviation followed by an s.

7. Other words with the same root (such as operations and operational) are given the same abbreviation.

8. When abbreviation is necessary, the most important word in the element name should be preserved in the longest state.

9. In elements with more than three words, a word can be left out of the terse name if clarity is preserved.

10. Connector words such as "or" and "from" can be dropped.

11. The first letter of the terse name must be the same as the first letter of the full element name. First letters of abbreviations do not have to follow this rule unless the abbreviation begins the terse name.

12. Words containing four letters are left as four letters unless it is necessary, due to length considerations, to further abbreviate them. Longer words may or may not be shortened in all cases, depending primarily on frequency of use and the availability of a clear abbreviation.

13. When the component term "description" is used in the construction of terse names always use the abbreviation "desc," except when the term "description" is used alone.

2.3 DATA TYPE STANDARDS

In order to enhance the compatibility of the PSDD with other projects and data systems, a method for specifying the general (non-implementation dependent) data type of each data element is needed, as well as a non-ambiguous method for representing data types in written documentation. This standard is intended to meet these needs.

The following list of general data types conforms with ISO and JPL standards and is available for use. Currently, only a subset of these terms is used, i.e., CHARACTER, INTEGER, REAL, TIIME, DATE, and CONTEXT DEPENDENT.

Data Types Available for Use

- CHARACTER*
    - ALPHABET
    - ALPHANUMERIC

- NUMERIC
    - INTEGER*
    - REAL*
    - NON DECIMAL*

- TIME*
    - DATE*

- CONTEXT DEPENDENT*

*Marked types are those in current use by PDS or AMMOS.

2.3.1 CHARACTER Data Type

The CHARACTER data type is provided to represent arbitrary ASCII character strings – particularly values that cannot be represented as NUMERIC or TIME. CHARACTER data include both text strings and literal values. CHARACTER values may include any alphabetic (A-Z, a-z) or numeric (0-9) ASCII characters and the underscore character without being quoted. If other characters are to be used or if the value is to include whitespace (defined as any of: space character, horizontal or vertical tab character) the value shall be quoted, using the single or double quotation marks.

PDS and AAMMOS labeling conventions dictate that double quotation marks are always used in unlimited-length text fields. Quoted phrases within a text field are delimited with single quotation marks (apostrophes).

For example, the MISSION_DESC definition would read:

MISSION_DESC = "The Magellan spacecraft was launched from the Kennedy Space Center on May 5, 1989. The spacecraft was deployed from the Shuttle cargo bay after the Shuttle achieved parking orbit. …"

2.3.2 INTEGER and REAL Data Types

The INTEGER and REAL data types encompass all values that can be represented as a single real number (imaginary numbers must currently be represented using two separate keyword statements where the imaginary nature of the number must be conveyed in the definition of the keywords). Detailed specifications for these are defined in ISO 6093 as NR1 and NR2, respectively. Note that these specifications are hierarchical such that NR2 includes all of NR1. Thus an attribute defined as a REAL data type may have values expressed as REAL or INTEGER with equal validity.

2.3.3 LENGTH AND RANGE SPECIFICATIONS

Since the unit of measurement and the maximum length or range associated with a data element are also critical to the correct usage of the element, a standard has been adopted for specifying these attributes. When defining a new data element or including a non-standard element in a data set, the following attributes shall be supplied.

GENERAL_DATA_TYPE
UNIT
VALID_MINIMUM
VALID_MAXIMUM
MINIMUM_LENGTH
MAXIMUM_LENGTH

If the general data type is INTEGER or REAL, VALID_MINIMUM and VALID_MAXIMUM refer to the minimum and maximum values valid for the field. Alternately, if the data type is CHARACTER or TIME, MINIMUM_LENGTH and MAXIMUM_LENGTH denotes the number of characters permissible for the value. The two fields that are not applicable to the data type shall be given values of "N/A".

Example:

```
GENERAL_DATA_TYPE        = CHARACTER
UNIT                     = "N/A"
MINIMUM_LENGTH           = 23
MAXIMUM_LENGTH           = 23
VALID_MINIMUM            = "N/A"
VALID_MAXIMUM            = "N/A"
```

This example illustrates also that if the MINIMUM_ and MAXIMUM_LENGTH fields are identical, the value is the required length for the field, i.e., no more, and no foewer characters are permitted in values.

In documentation a shorthand shall be used:

CHARACTER(23,23)	(23-character input is required)
CHARACTER(6,10)	(input must have no fewer than 6, or more than 10 chars)
CHARACTER(60)	(60-character maximum length – no minimum length)
CHARACTER	(an unlimited-length, text field is indicated)

For numeric data types:

INTEGER(1, 100)	(minimum value=1, maximum value=100)
INTEGER(<=360)	(minimum value=0, maximum value=360)
INTEGER	(the minimum and maximum is not applicable as far as the data are concerned, but the numeric implementation of "not applicable" depends upon the system-specific data type assigned in the host database. In the PDS, the system maximum and minimum integer values are reserved to represent N/A and UNK for INTEGERs.)
REAL(-90, 180)	(minimum range of valid entries lies between –90 and 180)
REAL(<=1000)	(minimum=N/A, maximum=1000)
REAL	(the minimum and maximum is not applicable as far as the data are concerned, buut the numeric implementation of "not applicable" depends upon the sysstem-specific data type assigned in the host database. In the PDS, the values ±1.E32 are reserved to represent N/A and UNK for REALs.)

2.3.4 NON DECIMAL Data Type

Non-decimal values shall be represented in either binary, octal or hexadecimal using the NON DECIMAL data type. This data type consists of a decimal integer radix (either 2, 8, or 16) followed by a number string expressed in appropriate ASCII characters and enclosed in # symbols. The negative value shall be represented using a minus sign before the number string and after the first #. Binary values shall be interpreted as positive and uncomplemented. Because it may be useful to embed spaces in long number strings, spaces are allowed anywhere within the representation and will be ignored. Foor example, the string, 2#1001# represents the decimal value 9.

Non-decimal values are intended to be used to represent bit masks and other bit patterns associated with a specific computing environment. As such, it is inadvisable for a cataloguing system to interpret and/orr store them according to a numeric scheme, since this may significantly change the pattern of bits, and may preclude the retrieval of the original string. It is recommended that catalog interpreters store non-decomal values as character strings. In some cases, users may wish to query a system according to the numeric value of a non-decimal entry. To allow this, systems may be configured to store the decimal value in addition to the string value.

In this light, although the non-decimal type is defined as a numeric subtype it should not be treated solely as a numeric, but rather as a special implementation rule for string values.

2.3.5 TIME Data Type

All event time attributes shall measure time in Universal Time Coordinated (UTC) unless specifically defined otherwise. Note that it is generally ambiguous to label data with a time-of-day-without including a date, and so the TIME type shall always include both the date and UTC time.

Event times shall be represented in the ISO/CCSDS/JPL standard form as follows (brackets […] enclose optional fields):

YYYY-MM-DDThh:mm:ss[.fff] –or- YYYY-DDDThh:mm:ss[.fff]

where:

YYYY	Represents the year (0001 to 9999)
-	Is a required delimiter between date fields
MM	Represents the month (01 to 12)
DD	Represents the day of month (01 to 28,29,30 or 31)
DDD	Represents the day of year (001 to 365 or 366)
T	Is a required delimiter between date and time
hh	Represents the UTC hour (00 to 23)
:	Is a required delimiter between time fields
mm	Represents the UTC minute (00 to 59)
ss	Represents the UTC whole seconds (00 to 60)
fff	Represents fractional seconds, from one to three decimal places.

The year-month-day and year-day-of-year formats are fully equivalent and interchangeable. For more information regarding date/times, refer to the Date/Time Format standard in *the PDS Standards Reference*. For event times that require only the date, the following subset is defined as the subtype DATE (where field definitions are the same as above):

YYYY-MM-DD –or- YYYY-DDD

Spacecraft clock (SCLK) values are not considered to be the same as time since they follow different formation rules and have a different semantic meaning. SCLK values shall be represented using a CHARACTER data type. For more information regarding dates, refer to the Date Format standard in the PDS Standards Reference.

2.3.6 CONTEXT DEPENDENT Data Type

The PDS has added CONTEXT DEPENDENT to the list of data types in order to accommodate situations in which data elements take on the data type of the data objects they help to describe.

A classic example is the data element MISSING, used to indicate the value inserted into a data object to flag missing telemetry data. In an integer data field, the data type of MISSING needs to be INTEGER. In floating point data fields, the missing value must be REAL, and so on. Since this data element, and the others classified as context dependent, can be character as well as numeric values, the PSDD indicates that the data type can vary.

2.3.7 Data Types and Concerns Not Addressed by This Standard

Since the precision of a number is hard to codify, that specification shall be included in the list of formation rules for a data element, not in the GENERAL_DATA_TYPE. Data Set specific types such as BIT_STRING are not included in the GENERAL_DATA_TYPE domain. Such data types are better represented in the DATA_TYPE attribute that appears iin the actual data structure objects.

Imaginary numbers are left in the realm of local implementation. System managers might choose to represent imaginary numbers as two real expressions, or as aggregate, complex expressions.

2.4 STANDARD VALUES

A general description of the conventions used to categorize standard values may be found at the beginning of Appendix A. A brief, additional appendix lists standard values particular to the AMMOS data base.

2.5 SPECIAL VALUES

The Object Definition Language used to express keyword=value relationships requires that there always be some value on the right-hand side of an expression. However, cases frequently arise in which a value is not forthcoming either because none is applicable or known at the time the statement is expressed. The special token values "N/A", and "UNK" are provided for situations. [At the time of this writing, formal definitions of these values, and the token NULL are still being established.]

2.6 UNITS OF MEASUREMENT

The following table defines the set of standard units and symbols based on the Systeme Internationale and amplified by the PDS.

For the standards governing this list of units of measurement, please refer to the PDS Standards Reference.

Unit Name	Symbol	Measured Quantity
TBD	localday/24	TBD
ampere	A	electric current, magnetomotive force

ampere per meter	A/m	magnetic field strength
ampere per square meter	A/m**2	current density
arcsecond	arcsecond	angular diameter
bar	bar	pressure
becquerel	Bq	activity (of a radionuclide)
bits per pixel	b/pixel	
bits per second	b/s	data rate
candela	cd	luminous intensity
candela per square meter	cd/m**2	luminance
coulomb	C	electric charge, quantity of electricity
coulomb per cubic metter	C/m**3	electric charge density
coulomb per kilogram	C/kg	exposure (x and y rays)
coulomb per square meter	C/m**2	electric flux density
cubic meter	m**3	volume
cubic meter per kilogram	m**3/kg	specific volume
day	d	time
decibel	dB	signal strength
degree	deg	plane angle
degree Celsius	degC	temperature
degree per second	deg/s	angular velociity
farad	F	capacitance
farad per meter	F/m	permittivity
gram per cubic centimeter	g/cm**3	mass density
gray	Gy	absorbed dose, specific energy imparted
gray per second	Gy/s	absorbed dose rate
henry	H	inductance
henry per meter	H/m	permeability
hertz	Hz	frequency
hour	h	time
joulee	J	work, energy, quantity of heat
joule per cubic meter	J/m**3	energy density
joule per kelvin	J/K	heat capacity, entropy
joule per kilogram	J/kg	specific energy
joule per kilogram kelvin	J/(kg.K)	specific heat capacity, specific entropy
joule per mole	J/mol	molar energy
joule per mole kelvin	J/(mol.K)	molar entropy, molar heat capacity
joule per sq. meter per second	J/(m**2)/s	radiance
joule per tesla	J/T	magnetic moment
kelvin	K	thermodynamic temperature
kilogram	kg	mass
kilogram per cubic meter	kg/m**3	mass density (density)
kilometer	km	length
kilometer per pixel	km/pix	map scale
kilometers per second	km/s	speed
kilometers squared	km**2	area
lumen	lm	luminous flux

lux	lx	illuminance
meter	m	length
	meter per second	m/s speed, velocity
meter per second squared	m/s**2	acceleration
meters per pixel	m/pixel	
micrometer	micron	length
microwatts	uW	power, radiant flux
millimeter	mm	length
millisecond	ms	time
minute	min	time
mole	mol	amount of substance
mole per cubic meter	mol/m**3	concentration (of amount of substance)
nanometer	nm	length
nanotesla	nT	magnetic flux density
newton	N	force
newton meter	N.m	moment of force
newton per meter	N/m	surface tension
newton per square meter	N/m**2	pressure (mechanical stress)
no unit of measurement defined	none	NULL
ohm	ohm	electric resistance
pascal	Pa	pressure, stress
pascal second	Pa.s	dynamic viscosity
pixel	pixel	TBD
pixel per degree	pix/deg	map scale
pixels per line	p/line	
radian	rad	plane angle
radian per second squared	rad/s**2	angular acceleration
reciprocal meter	m**-1	wave number
second	s	time
siemens	S	electric conductance
sievert	Sv	dose equivalent, dose equivalent index
square meter	m**2	area
square meter per second	m**2/s	kinematic viscosity
steradian	sr	solid angle
tesla	T	magnetic flux density
united states dollars	us_dollar	money
volt	V	potential difference, electromotive force
volt per meter	V/m	electric field strength
watt	W	power, radiant flux
watt per meter kelvin	W/(m.K)	thermal conductivity
watt per square meter	W/m**2	heat flux density, irradiance
watt per square meter steradian	W.m**-2.sr**-1	radiance
watt per steradian	W/sr	radiant intensity
weber	Wb	magnetic flux