

# Mars Exploration Rover (MER)

## Software Interface Specification

Interface Title: **Mars Atmospheric Opacity Data Set**

Mission: MER

Date: June 19, 2003

Module ID: SIS-SCI017-MER

Version: Initial

Release

JPL D-22853

Module Type (REFerence Only or MISsion-specific info included):  
MIS

Reference Module ID: N/A

Date: N/A

### **SOST Generating Elements:**

Mark Lemmon  
Athena Science Team Member

### **Concurrence:**

John Callas  
MER Science Manager

Betty Sword  
PDS Central Node Data Engineer

# **Mars Exploration Rover (MER) Project**

## **Mars Atmospheric Opacity Software Interface Specification (SIS)**

### **Initial Release**

Prepared by: Edward A. Guinness  
SIS Custodian

Paper copies of this document may not be current and should not be relied on for official purposes. The current version is in the MER Project Library at <http://mars03-lib.jpl.nasa.gov>, in the Controlled Documents and Records folder.

JPL D-22853  
June 19, 2003



Jet Propulsion Laboratory  
California Institute of Technology

**CHANGE LOG**

<b>DATE</b>	<b>SECTIONS CHANGED</b>	<b>REASON FOR CHANGE</b>	<b>REVISION</b>
4/11/03	All	First draft	Draft
6/19/03	Title page	Removed "draft in preparation"	Initial Release

### TBD ITEMS

SECTION	DESCRIPTION

## CONTENTS

CHANGE LOG .....	III
TBD ITEMS .....	IV
CONTENTS .....	V
LIST OF TABLES .....	VI
ACRONYMS .....	VII
1. INTRODUCTION .....	1
1.1 Purpose and Scope .....	1
1.2 Contents .....	1
1.3 Applicable Documents and Constraints .....	1
1.4 Relationships with Other Interfaces .....	2
2. DATA PRODUCT CHARACTERISTICS AND ENVIRONMENT .....	2
2.1 Data Product Overview .....	2
2.2 Data Processing .....	2
2.2.1 Data Processing Level .....	2
2.2.2 Data Product Generation .....	3
2.2.3 Data Flow .....	4
2.2.4 Labeling and Identification .....	4
Standards Used in Generating Data Products .....	5
2.2.1 PDS Standards .....	5
2.2.2 Time Standards .....	5
2.2.3 Data Storage Conventions .....	5
2.3 Data Validation .....	5
3. DETAILED DATA PRODUCT SPECIFICATIONS .....	5
3.1 Data Product Structure and Organization .....	5
3.2 Data Format Description .....	6
3.3 PDS Label Description .....	7
4. APPLICABLE SOFTWARE .....	7
4.1 Utility Programs .....	7
4.2 Applicable PDS Software Tools .....	7
APPENDIX A - SAMPLE MARS ATMOSPHERIC OPACITY LABEL AND DATA FILE ..	8
PDS Label .....	8
Sample Data File .....	10
APPENDIX B – LABEL KEYWORD DEFINITIONS .....	1

**LIST OF TABLES**

TABLE 1. PROCESSING LEVELS FOR SCIENCE DATA SETS ..... 2

## ACRONYMS

ASCII	American Standard Code for Information Interchange
CODMAC	Committee on Data Management and Computation
EDR	Experiment Data Record
ISO	International Standards Organization
JPL	Jet Propulsion Laboratory
MER	Mars Exploration Rover
NASA	National Aeronautics and Space Administration
ODL	Object Description Language
OSS	Operations Storage Server
PDS	Planetary Data System
RDR	Reduced Data Record
SIS	Software Interface Specification
SOWG	Science Operations Working Group
STG	Science Theme Group
TBD	To Be Determined

# 1. INTRODUCTION

## 1.1 Purpose and Scope

The purpose of this data product SIS is to provide users of the MER Mars atmospheric opacity data product with a detailed description of the product and a description of how it was generated, including data sources and destinations. The product is an ASCII table of Mars atmospheric opacity values as derived from MER Pancam solar filter observations of the Sun. This SIS is intended to provide enough information to enable users to read and understand the data product. The users for whom this SIS is intended are the scientists who will analyze the data, including those associated with the MER Project and those in the general planetary science community.

## 1.2 Contents

This data product SIS describes how the Mars atmospheric opacity data product is generated, formatted, labeled, and uniquely identified. The document discusses standards used in generating the product and software that may be used to access the product. The data product structure and organization is described in sufficient detail to enable a user to read the product. Finally, an example of a data product and the PDS label is provided, along with definitions for the label keywords.

## 1.3 Applicable Documents and Constraints

This Data Product SIS is responsive to the following MER documents:

1. Mars Exploration Program Data Management Plan, R. E. Arvidson, S. Slavney, and S. Nelson, Rev. 3, March 20, 2002.
2. Mars Exploration Rover Project Archive Generation, Validation and Transfer Plan, R. E. Arvidson and S. Slavney, JPL D-19658, March 22, 2002.
3. MER Project SIS - Camera Experiment Data Record (EDR) and Reduced Data Record (RDR) Operations Data Products, H. Mortensen, D. Alexander, JPL D-22846, Revision B, January 24, 2003.

This SIS is also consistent with the following Planetary Data System documents:

4. Planetary Data System Data Preparation Workbook, Version 3.1, JPL D-7669, Part 1, February 1, 1995.
5. Planetary Data System Data Standards Reference, Version 3.5, JPL D-7669, Part 2, October, 15, 2002
6. Planetary Science Data Dictionary Document, JPL D-7116, August 28, 2002.

The reader is referred to the following documents for additional information:

7. Smith, P. H., and M. Lemmon, Opacity of the Martian atmosphere measured by the Imager for Mars Pathfinder, *J. Geophys. Res.*, 104, 8975-8995, 1999.

Finally, this SIS is meant to be consistent with the contract negotiated between the MER Project and the Athena Principal Investigator in which reduced data records and documentation are explicitly defined as deliverable products.

### 1.4 Relationships with Other Interfaces

Changes to the Pancam EDR and/or RDR data products and the SIS that describes these products [3] could affect the Mars atmospheric opacity data product and/or this SIS. In addition, changes to the processing tools used to generate the Mars atmospheric opacity data product could affect both the data product and this SIS.

## 2. DATA PRODUCT CHARACTERISTICS AND ENVIRONMENT

### 2.1 Data Product Overview

A Mars atmospheric opacity data product consists of two files, an ASCII formatted detached PDS label file and an ASCII formatted data file. The data file contains values of the Mars atmospheric opacity or optical depth derived from MER Pancam images of the Sun acquired with the two solar filters. The effective wavelengths of these filters are 440 and 880 nm. Each data file contains an ASCII table of the derived atmospheric opacity for a given rover and Pancam solar filter. Each table contains columns with the source Pancam image identifier, the time of image acquisition, the Mars season ( $L_s$ ), Sun-Mars distance, airmass, observed solar flux, and opacity.

### 2.2 Data Processing

#### 2.2.1 Data Processing Level

This SIS used the Committee On Data Management And Computation (CODMAC) data level numbering system to describe the processing level of the Mars atmospheric opacity data products. These data products are considered CODMAC "Level 5" or "Derived Data" (equivalent to NASA Level 2). The Mars atmospheric opacity data products are generated from analysis of MER Pancam images. Refer to Table 1 for a summary of the CODMAC and NASA data processing levels.

**Table 1. Processing Levels for Science Data Sets**

NASA	CODMAC	Description
Packet data	Raw - Level 1	Telemetry data stream as received at the ground station, with science and engineering data embedded.
Level-0	Edited - Level 2	Instrument science data (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed.

NASA	CODMAC	Description
Level 1-A	Calibrated - Level 3	Level 0 data that have been located in space and may have been transformed (e.g., calibrated, rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g., radiances with the calibration equations applied).
Level 1-B	Resampled - Level 4	Irreversibly transformed (e.g., resampled, remapped, calibrated) values of the instrument measurements (e.g., radiances, magnetic field strength).
Level 1-C	Derived - Level 5	Level 1A or 1B data that have been resampled and mapped onto uniform space-time grids. The data are calibrated (i.e., radiometrically corrected) and may have additional corrections applied (e.g., terrain correction).
Level 2	Derived - Level 5	Geophysical parameters, generally derived from Level 1 data, and located in space and time commensurate with instrument location, pointing, and sampling.
Level 3	Derived - Level 5	Geophysical parameters mapped onto uniform space-time grids.

### 2.2.2 Data Product Generation

The Mars atmospheric opacity data products are produced by the Atmospheres Science Theme Group (STG) of the MER Science Operations Working Group (SOWG) using processing procedures and software developed by Mark Lemmon, Texas A&M Univ.

The data product is generated after each sol in which opacity data is acquired. The generation is done in four steps. First, the input parameters are set up. A list of Pancam data products to be processed is read and associated values are determined for  $L_s$ , the distance of Mars from the Sun, the sol that the data were acquired, and the actual elevation angle of the Sun. It is likely that standard tools such as the NAIF toolkit will be used for these computations. For each Pancam data product, the airmass is computed by integration through a spherically symmetric atmosphere with a scale height equivalent to the gas scale height of the Martian atmosphere.

Second, the solar flux is extracted from each calibrated Pancam data product. To do this, the background is determined within an annulus at a fixed radius from the center of the Sun in the image. That background is subtracted, as it would lead to a significant departure from Beers' Law at high airmasses. After background subtraction, the solar flux is integrated over the image. The presence of a few missing pixels (e.g., a Phobos transit or a missing packet that only partly overlaps the Sun) can be accommodated by the integration algorithm. The presence of a large number of missing pixels or any saturated pixels will result in the rejection of an image (returning a flux and opacity of “-1.000”).

Third, a relative calibration is derived. Data from the afternoon of all sols during which more than 1 image was acquired are considered, together with instrumental uncertainties. The published calibration (Bell et al., in prep.) is considered as a single datum with associated uncertainty. The instrument response is varied, and a single best-fit opacity is derived for each afternoon using Beers' Law ( $I_{\text{observed}} = I_0 \exp(-\tau \eta)$ , where  $\eta = \text{airmass}$ ). A best-fitting responsivity is chosen by minimizing the reduced  $X^2$  of the fit.

Fourth, the relative calibration is used to derive opacities. All images are considered, and Beers' Law is applied to every pair of  $I_{\text{observed}}$  and airmass. The relative calibration method ensures that (1) substantial calibration uncertainty is not propagated into uncertainty in opacity once sufficient surface data are obtained, and (2) that the processing transfers smoothly from using the laboratory calibration when the first datasets are obtained to using the relative calibration when enough surface data exist.

### 2.2.3 Data Flow

The Mars atmospheric opacity data products are generated from Pancam solar filter images. These images are transferred from OSS to the Atmospheres STG workstations. The most recent version of the appropriate opacity data product is also obtained from OSS. Once a new version of an opacity data product is generated, it is transferred back to the OSS for access by other MER science and operations team members. Updates to the Mars atmospheric opacity data products will be made whenever new Pancam solar images are acquired. After a science validation period, the Mars atmospheric opacity data products are transferred to the PDS for final validation and archiving in accordance with the MER archive plan [2].

The opacity data products will be updated as new Pancam solar filter images are acquired. Thus, the size of an individual Mars atmospheric opacity data product will increase over the course of the MER mission. The final version of each data product will include opacity determinations derived from a given rover and Pancam solar filter covering the complete mission.

### 2.2.4 Labeling and Identification

Each Mars atmospheric opacity data product is identified by a unique filename, along with a unique product\_id keyword in the associated PDS label. The product filename adheres to the ISO-9660 level II filename convention of 27.3 (maximum of 27 characters followed by a 3 character extension), which is compliant with PDS standards [5]. The product\_id found in the PDS label is equal to the filename without the extension.

The file naming scheme for the Mars atmospheric opacity data products is formed by:

`<rover>TAU<filter>_<sol>_<date><version>.TAB`

where:

<i>rover</i>	=	(1 integer) MER rover mission identifier. Valid values are "1" (MER-1) or "2" (MER-2).
<i>TAU</i>	=	(3 alpha characters) Always TAU for atmospheric opacity data
<i>filter</i>	=	(3 integers) Effective wavelength of Pancam solar filter. Valid values are "440" for left eye and "880" for right eye.
<i>sol</i>	=	(3 integers) Sol number of last data entry.
<i>date</i>	=	(8 integers) Product creation date with format <code>yyyymmdd</code> for year, month, and date.
<i>version</i>	=	(1 alpha character). Product version identifier. Value of "A" for first version of given product creation date. Value increments for each new version within a given day.

TAB = (3 alpha characters) Always TAB to indicate a PDS ASCII table structure.

An example filename using this scheme would be: 2TAU880\_040\_20040214A.TAB.

## **2.3 Standards Used in Generating Data Products**

### **2.3.1 PDS Standards**

The Mars atmospheric opacity data product complies with Planetary Data System standards for file formats and labels, as specified in the PDS Standards Reference [5] and the Planetary Science Data Dictionary Document [6].

### **2.3.2 Time Standards**

The PDS label for a Mars atmospheric opacity data product uses keywords containing time values, such as start time and stop time. Each time value standard is defined according to the keyword definition. See Appendix B.

### **2.3.3 Data Storage Conventions**

The Mars atmospheric opacity data product and detached PDS label files are stored as ASCII text. Each line or record in the files is terminated with a two-character sequence of carriage return (<CR>, ASCII 13) and line feed (<LF>, ASCII 10) to comply with PDS standards [5]. This line terminator sequence will allow the data files and labels to be easily read on most computers, which recognize either the carriage return, the line feed, or the <CR>/<LF> sequence as an ASCII record terminator.

## **2.4 Data Validation**

Validation of Mars atmospheric opacity data product labels includes checking for correct PDS syntax, for accepted standard values of keywords, and for internal consistency of label items.

The Atmospheres STG will periodically check the relative calibration for internal consistency and will determine if a different internal calibration is better suited to the data obtained. Opacity derivations will be compared to independent but indirect estimates of opacity from other sources, such as the Pancam calibration target shadow intensity.

## **3. DETAILED DATA PRODUCT SPECIFICATIONS**

### **3.1 Data Product Structure and Organization**

Each Mars atmospheric opacity data product is structured as two files; a detached PDS label file and a separate data file. Both components are stored as ASCII text. Data within the opacity data file is organized by time with the most recent measurement being appended to the end of the file.

### 3.2 Data Format Description

Each Mars atmospheric opacity data product consists of two parts. The first part of the data file contains header information, which includes parameter values used in the opacity computations and column names for the data rows. The second part of the file, starting at line 10 consists of a PDS table object [5]. The table has eight columns and a variable number of rows. There is one row for each opacity measurement. The number of rows in a data product will increase as new measurements of atmospheric opacity are made. Each row is 88 bytes long including the carriage return and line feed characters. All columns are fixed-width as described in the PDS label and are also delimited with commas. Text columns are surrounded by double-quotes and are left-justified. Numeric columns are right-justified. Table 2 contains the column definitions for the opacity data product.

**Table 2. Mars Atmospheric Opacity Column Definitions**

COLUMN NUMBER	NAME	DATA TYPE	DESCRIPTION
1	Pancam Product_id	Text	Product identifier for the source Pancam image used for the opacity measurement.
2	Solar Longitude	Real	Martian season in degrees past northern spring equinox.
3	Solar Distance	Real	Mars-Sun distance in AU at time of observation.
4	Local Time	Real	Observation time in sols past the local midnight preceding landing. The local solar time is given by multiplying the fractional component by 24 hours. Sol number is obtained by rounding up the local time value. For example, noon on Sol 2 is given as local time of 1.5.
5	Airmass Factor	Real	Airmass factor relative to the zenith. It can be approximated as the secant of zenith angle for most observations, but is computed using a 13-km scale height to improve accuracy for low-Sun observations.
6	Solar Flux	Real	Observed solar flux after subtracting background in units of $W/m^2/nm$ . Computed using Pancam calibration parameters. A value of -1.0 indicates an image that resulted in a non-measurement of opacity (e.g., due to missing packet and/or data saturation).
7	Opacity Value	Real	Measured atmospheric opacity using the current best relative calibration. A value of -1.0 indicates an image that resulted in a non-measurement of opacity (e.g., due to missing packet and/or data saturation).
8	Relative Opacity Error	Real	Relative error in the opacity measurement. A value -1.0 indicates an image that resulted in a non-measurement of opacity (e.g., due to missing packet and/or data saturation).

### 3.3 PDS Label Description

Each Mars atmospheric opacity data product has a detached PDS label, which is stored as ASCII text. The PDS label is object-oriented with keywords for product identification, along with the data object definition. The data object definition within the label contains descriptive information needed to interpret or process the data.

PDS labels are written in Object Description Language (ODL) [5]. PDS label statements have the form of "keyword = value". Each label statement is terminated with a carriage return character (ASCII 13) and a line feed character (ASCII 10) sequence to allow the label to be read by many operating systems. Pointer statements with the following format are used to indicate the location of data objects in the data product:

^object = location

where the carat character (^, also called a pointer) is followed by the name of the specific data object. For detached PDS labels, location is the name of the file that contains data object and optionally the starting record number of the data object within the file or byte offset from the start of the file.

Appendix A lists an example PDS label for a Mars atmospheric opacity data product, along with a sample data file.

## 4. APPLICABLE SOFTWARE

### 4.1 Utility Programs

The ASCII format of the Mars atmospheric opacity data product means that the data can be displayed using a text editor. In addition, the use of the PDS table structure for this data product means the data can be readily imported into spreadsheet and plotting programs.

### 4.2 Applicable PDS Software Tools

PDS-labeled tables can be viewed with the program NASAView, developed by the PDS. NASAView is available in versions that run on SUN/SOLARIS, Windows, and LINUX operating systems. NASAView can be obtained from the PDS web site <http://pdsproto.jpl.nasa.gov/Distribution/license.html>. There is no charge for NASAView.

## APPENDIX A - SAMPLE MARS ATMOSPHERIC OPACITY LABEL AND DATA FILE

### PDS Label

```

PDS_VERSION_ID          = PDS3

/* FILE DATA ELEMENTS */
RECORD_TYPE             = STREAM
FILE_RECORDS            = TBD (9 + number of opacity records)
^HEADER                 = ("NAME_OF_FILE", 1)
^TABLE                  = ("NAME_OF_FILE", 10)

/* IDENTIFICATION DATA ELEMENTS */
DATA_SET_ID             = "MER-M-PANCAM-5-ATMOS-OPACITY-V1.0"
PRODUCT_ID              = "2TAU440_040_20040212A"
PRODUCT_TYPE            = "OPACITY"
INSTRUMENT_HOST_ID     = <MER1 or MER2>
INSTRUMENT_HOST_NAME   = "MARS EXPLORATION ROVER 1" (or 2)
FILTER_NAME             = PANCAM_L8_440NM (or PANCAM_R8_880NM)
INSTRUMENT_ID           = PANCAM_LEFT (or PANCAM_RIGHT)
MISSION_NAME            = "MARS EXPLORATION ROVER"
TARGET_NAME             = SUN
PRODUCT_CREATION_TIME   = YYYY-MM-DDThh:mm:ss
START_TIME              = YYYY-MM-DDThh:mm:ss
STOP_TIME               = YYYY-MM-DDThh:mm:ss

OBJECT                  = HEADER
  BYTES                 = UNK
  RECORDS               = 9
  HEADER_TYPE           = SPREADSHEET
  INTERCHANGE_FORMAT    = ASCII
  DESCRIPTION           = "The header contains key parameter values
                        used in the opacity computations, along
                        with column headings for the table object."

END_OBJECT              = TABLE_HEADER

OBJECT                  = TABLE
  INTERCHANGE_FORMAT    = ASCII
  ROWS                  = TBD (number of opacity records)
  ROW_BYTES             = 88
  COLUMNS              = 8
  DESCRIPTION           = "Tables containing the opacity
                        determinations for a given rover and
                        solar filter. Columns in the table
                        are fixed-width and separated by
                        commas. The start byte and bytes
                        keywords of the column definitions do
                        not include quotes or commas in the table."

OBJECT                  = COLUMN
  COLUMN_NUMBER         = 1
  NAME                  = PANCAM_PRODUCT_ID
  DATA_TYPE            = CHARACTER
  START_BYTE            = 2

```

```

      BYTES = 27
      DESCRIPTION = "The product_id of the Pancam solar
                    filter image used for a given opacity
                    determination."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 2
  NAME = SOLAR_LONGITUDE
  DATA_TYPE = ASCII_REAL
  START_BYTE = 31
  BYTES = 6
  DESCRIPTION = "Martian season in degrees past
                northern spring equinox."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 3
  NAME = SOLAR_DISTANCE
  DATA_TYPE = ASCII_REAL
  START_BYTE = 38
  BYTES = 6
  DESCRIPTION = "Mars-Sun distance in AU at time of
                observation."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 4
  NAME = LOCAL_TIME
  DATA_TYPE = ASCII_REAL
  START_BYTE = 45
  BYTES = 8
  DESCRIPTION = "Observation time in sols past the local
                Midnight preceding landing. The local
                solar time is given by multiplying the
                fractional component by 24 hours.
                Sol number is obtained by rounding up
                the local_time value. For example, noon
                on Sol 2 is given as local_time of 1.5."
END_OBJECT = COLUMN

OBJECT = COLUMN
  COLUMN_NUMBER = 5
  NAME = AIRMASS
  DATA_TYPE = ASCII_REAL
  START_BYTE = 54
  BYTES = 7
  DESCRIPTION = "Airmass factor relative to the
                zenith. It can be approximated as
                the secant of zenith angle for
                most observations, but is computed
                using a 13-km scale height to
                improve accuracy for low-Sun
                observations."
END_OBJECT = COLUMN

OBJECT = COLUMN

```

```

COLUMN_NUMBER      = 6
NAME               = SOLAR_FLUX
DATA_TYPE         = ASCII_REAL
START_BYTE        = 62
BYTES             = 8
DESCRIPTION        = "Observed solar flux in W m-2
                    nm-1 after subtracting
                    background light. Computed using
                    Pancam calibration parameters.
                    A value of -1.0 indicates an image
                    that resulted in a non-measurement
                    opacity (e.g., due to missing packet
                    and/or data saturation)."
```

END\_OBJECT = COLUMN

```

OBJECT             = COLUMN
COLUMN_NUMBER      = 7
NAME               = ATMOSPHERIC_OPACITY
DATA_TYPE         = ASCII_REAL
START_BYTE        = 71
BYTES             = 7
DESCRIPTION        = "Measured atmospheric opacity using
                    the current best relative calibration.
                    A value of -1.0 indicates an image
                    that resulted in a non-measurement
                    opacity (e.g., due to missing packet
                    and/or data saturation)."
```

END\_OBJECT = COLUMN

```

OBJECT             = COLUMN
COLUMN_NUMBER      = 8
NAME               = OPACITY_ERROR
DATA_TYPE         = ASCII_REAL
START_BYTE        = 79
BYTES             = 8
DESCRIPTION        = "Relative error in the opacity
                    measurement.
                    A value of -1.0 indicates an image
                    that resulted in a non-measurement
                    opacity (e.g., due to missing packet
                    and/or data saturation)."
```

END\_OBJECT = COLUMN

END\_OBJECT = TABLE

END

## Sample Data File

The sample data file listed below consists of two parts. The first nine lines contains header information with parameter values used in the opacity computations. The header also includes the column names for the data rows. The second part of the file, starting at line 10 contains the opacity determinations.

MER opacity measurements for Pancam 440 nm solar filter images.  
Flux\_1AU = 0.9876 W m<sup>-2</sup> nm<sup>-1</sup> in the current best fit.  
Abs\_Err = 0.025 (absolute error in tau derivation at AM=1).  
The date of the current best fit is 2004-Jan-07 11:59:59 UTC.  
N\_ENTRIES = 3

Comments or questions to Mark Lemmon, lemmon@tamu.edu.

Product_ID,	L_s,	R_au,	Sol,	AM,	Flux,	TAU,	Rel_err
"1P123456787EDR010300062L8M1",	328.5,	1.561,	1.234,	1.123,	0.7291,	0.489,	0.015
"1P123456788EDR010300062L8M1",	328.5,	1.561,	1.456,	1.123,	0.7291,	0.489,	0.015
"1P123456789EDR010300062L8M1",	328.5,	1.561,	1.678,	1.123,	-1.0,	-1.000,	-1.000

## APPENDIX B – LABEL KEYWORD DEFINITIONS

Note see the Planetary Science Data Dictionary [6] for the definitions of keywords within the header and table objects.

Keyword Name	Definition	Type	Units	Valid Values
DATA_SET_ID	<p>A unique alphanumeric identifier for a data set or a data product. The DATA_SET_ID value for a given data set or product is constructed according to flight project naming conventions. In most cases the DATA_SET_ID is an abbreviation of the DATA_SET_NAME.</p> <p>Note: In the PDS, the values for both DATA_SET_ID and DATA_SET_NAME are constructed according to standards outlined in the Standards Reference.</p>	string(40)		"MER-M-PANCAM-5-ATMOS-OPACITY-V1.0"
FILE_RECORDS	<p>Indicates the number of physical file records, including both label records and data records. Note: In the PDS the use of FILE_RECORDS along with other file-related data elements is fully described in the Standards Reference.</p>	integer		
FILTER_NAME	<p>Provides the commonly-used name of the instrument filter through which an image or measurement was acquired or which is associated with a given instrument mode</p>	string array		"PANCAM_L8_440NM" "PANCAM_R8_880NM"
INSTRUMENT_HOST_ID	<p>Provides a unique identifier for the host where an instrument is located.</p>	string(6)		"MER1", "MER2"
INSTRUMENT_HOST_NAME	<p>Provides the full name of the host on which an instrument is based.</p>	string array		"MARS EXPLORATION ROVER 1"  "MARS EXPLORATION ROVER 2"
INSTRUMENT_ID	<p>Provides an abbreviated name or acronym which identifies an instrument.</p> <p>Note: INSTRUMENT_ID is not a unique identifier for a given instrument.</p>	string(12)		"PANCAM_LEFT" "PANCAM_RIGHT"
MISSION_NAME	<p>Identifies a major planetary mission or project. A given planetary mission may be associated with one or more spacecraft.</p>	string array		"MARS EXPLORATION ROVER"

Keyword Name	Definition	Type	Units	Valid Values
PDS_VERSION_ID	Represents the version number of the PDS standards documents that is valid when a data product label is created. Values for the PDS_version_id are formed by appending the integer for the latest version number to the letters 'PDS'.  Examples: PDS3, PDS4.	string(6)		"PDS3"
PRODUCT_CREATION_TIME	Defines the UTC system format time when a product was created. Formation rule: YYYY-MM-DDThh:mm:ss[.fff]	string		
PRODUCT_ID	Represents a permanent, unique identifier assigned to a data product by its producer. See also: source_product_id.  Note: In the PDS, the value assigned to product_id must be unique within its data set.  Additional note: The product_id can describe the lowest-level data object that has a PDS label.	string(40)		Filename less the extension
PRODUCT_TYPE	Identifies the type or category of a data product within a data set.	string(8)		"OPACITY"
RECORD_TYPE	Indicates the record format of a file.  Note: In the PDS, when record_type is used in a detached label file it always describes its corresponding detached data file, not the label file itself. The use of record_type along with other file-related data elements is fully described in the PDS Standards Reference.	string(20)		"FIXED_LENGTH"
START_TIME	Provides the date and time of the beginning of an event or observation (whether it be a spacecraft, ground-based, or system event) in UTC system format. Formation rule: YYYY-MM-DDThh:mm:ss[.fff]"	string		
STOP_TIME	Provides the date and time of the beginning of an event or observation (whether it be a spacecraft, ground-based, or system event) in UTC system format. Formation rule: YYYY-MM-DDThh:mm:ss[.fff]"	string		
^TABLE	This is a pointer to the table object. See the PDS Standards Reference for more information on pointer usage.	string		
^TABLE_HEADER	This is a pointer to the table_header object. See the PDS Standards Reference for more information on pointer usage.	string		

Keyword Name	Definition	Type	Units	Valid Values
TARGET_NAME	Identifies a target. The target may be a planet, satellite, ring, region, feature, asteroid or comet.	string(30)		"MARS",