

**Mars Science Laboratory**

# **DYNAMIC ALBEDO OF NEUTRONS RDR ARCHIVE VOLUME SOFTWARE INTERFACE SPECIFICATION**

July 19, 2012

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## DOCUMENT CHANGE LOG

Change	Date	Affected Portions

## TBD ITEMS

Section	Description

## ACRONYMS AND ABBREVIATIONS

ASCII	American Standard Code for Information Interchange
EDR	Experiment Data Record
ISO	International Standards Organization
NSSDC	National Space Science Data Center
PDS	Planetary Data System
RDR	Reduced Data Record
SIS	Software Interface Specification
TBD	To Be Determined

## GLOSSARY

**Archive** – An archive consists of one or more data sets along with all the documentation and ancillary information needed to understand and use the data. An archive is a logical construct independent of the medium on which it is stored.

**Archive Volume, Archive Volume Set** – A volume is a unit of media on which data products are stored; for example, one CD-ROM or DVD-ROM. An *archive volume* is a volume containing all or part of an archive; that is, data products plus documentation and ancillary files. When an archive spans multiple volumes, they are called an *archive volume set*. Usually the documentation and some ancillary files are repeated on each volume of the set, so that a single volume can be used alone.

**Catalog Information** – Descriptive information about a data set (e.g. mission description, spacecraft description, instrument description), expressed in Object Description Language (ODL) which is suitable for loading into a PDS catalog.

**Data Product** – A labeled grouping of data resulting from a scientific observation, usually stored in one file. A product label identifies, describes, and defines the structure of the data. An example of a data product is a planetary image, a spectrum table, or a time series table.

**Data Set** – An accumulation of data products. A data set together with supporting documentation and ancillary files is an archive.

**Standard Data Product** – A data product generated in a predefined way using well-understood procedures, processed in "pipeline" fashion. Data products that are generated in a nonstandard way are sometimes called *special data products*.

## 1. Introduction

### 1.1. Purpose and Scope

This Software Interface Specification is intended to be used by those who wish to understand the format and content of the Mars Science Laboratory, MSL Dynamic Albedo of Neutron Detector, DAN Reduced Data Record, RDR Archive. Typically, these individuals would be software engineers, data analysts, or planetary scientists.

The specifications in this document apply to all MSL DAN RDR standard product archive volumes that are generated by the MSL DAN Project.

### 1.2. Content Overview

The MSL DAN RDR archive includes the following five types of products.

DAN_DERIVED_ENG	Reduced housekeeping data
DAN_DERIVED_PASSIV	Reduced passive science data
DAN_DERIVED_ACTIVE	Reduced active science data.
DAN_AVERAGED_PASSIV	Normalized, averaged passive data
DAN_AVERAGED_ACTIVE	Normalized, averaged active data

The RDR data products are generated by the DAN team at the University of Arizona and delivered to the PDS Geosciences Node at Washington University, St. Louis.

This Software Interface Specification (SIS) describes the format, content, and generation of the MSL DAN RDR Archive. Section 2, Archive Volume Generation, describes the procedure for transferring data products to archive media. Section 3, Archive Volume Contents, describes the structure of the archive volumes and the contents of each file. Section 4, Archive Volume Format, describes the file formats used on the archive volumes. Finally, Section 5, Support Staff and Cognizant Persons, lists the individuals responsible for generating the archive volumes.

### 1.3. Applicable Documents and Constraints

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

1. [Mars Exploration Program Data Management Plan, Arvidson et al., Rev. 4.0, June 15, 2011.](#)
2. Mars Science Laboratory Project Archive Generation, Validation and Transfer Plan, Joy Crisp, JPL D-35281, May 28, 2010.
3. DAN FDD, JPL D-34220, MSL 375-1230
4. MSL DAN EDR SIS, JPL D-38113, SIS-SCI014-MSL.

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

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5. *Planetary Data System Archive Preparation Guide*, April 1, 2010, Version 1.4, JPL D-31224.
6. *Planetary Data System Standards Reference*, February 27, 2009, Version 3.8. JPL D-7669, Part 2.
7. ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.

Finally, this SIS is meant to be consistent with the contract negotiated between the Mars Science Laboratory and the DAN Principal Investigator (PI) in which reduced data records and documentation are explicitly defined as deliverable products.

### 1.4. Relationships with Other Interfaces

This Archive Volume SIS could be affected by changes to the design of the MSL DAN standard data products (Applicable Documents 2, 3 and 4).

## 2. Archive Volume Contents

This section describes the contents of the MSL DAN Archive volumes, including the file names, file contents, file types, and organization responsible for providing the files.

DAN RDR archive volumes will include the following directories.

<u>Directory</u>	<u>Contents</u>
Volume root directory	Introduction and errata text files
CALIBRATION	Calibration Documents files
CATALOG	Descriptions of data set, instruments, spacecraft, and mission as found in the PDS Catalog
DOCUMENT	Documentation files
INDEX	Volume and cumulative index tables
LABEL	Descriptions of data file formats, referenced by PDS labels
DATA	Data files and their detached PDS labels

The contents of these directories are described in detail in Sections 2.1 to 2.7.

### 2.1. Root Directory Contents

Files in the Root Directory include an overview of the archive, a description of the volume for the PDS Catalog, and a list of errata or comments about the archive. The following files are contained in the Root Directory.

<u>File Name</u>	<u>File Contents</u>	<u>File Provided By</u>
AAREADME.TXT	Volume content and format information	DAN

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ERRATA.TXT	A cumulative listing of comments and updates concerning all archive volumes published to date	DAN
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers	DAN

### 2.2. Data Directory Contents and Naming

DAN RDR data products are aggregated by sol; i.e., one product contains one sol's worth of data. Sol is defined to be one Mars day. Data for each sol day will be in a subdirectory named in the format DDD, indicating the sol of the data acquisition period. Within each subdirectory will be up to five PDS labels and associated data files for the five product types listed in section 1.2.

This schematic shows an example of the nesting of directories for data acquired on Sol 0002.

<Volume Root>

```
-----  
|  
-DATA  
  |- SOL0002  
    |  
    | -- <DAN_DERIVED_ENG files acquired on Sol 2>  
    |  
    | --<DAN_DERIVED_PASSIV files acquired on Sol 2>  
    |  
    | --<DAN_DERIVED_ACTIVE files acquired on Sol 2>  
    |  
    | --<DAN_AVERAGED_PASSIV files acquired on Sol 2>  
    |  
    | --<DAN_AVERAGED_ACTIVE files acquired on Sol 2>  
    |
```

File Name	File Contents	File Provided By
DNA_351797691REN_0550000000_____M1.DAT,.LBL	Housekeeping data	DAN
DNA_351797691RPA_0550000000_____M1.DAT,.LBL	Passive science data	DAN
DNA_351797691RAC_0550000000_____M1.DAT,.LBL	Active science data	DAN
DNA_351797691RAP_0550000000_____M1.DAT,.LBL	Averaged passive data	DAN
DNA_351797691RAA_0550000000_____M1.DAT,.LBL	Averaged active data	DAN



### 2.3. Index Directory Contents

Files in the Index Directory are provided to help the user locate products on this archive volume and on previously released volumes in the archive. The following files are contained in the Index Directory.

File Name	File Contents	File Provided By
INDXINFO.TXT	A description of the contents of this directory	DAN
INDEX.TAB	A table listing all data products on this volume	DAN
INDEX.LBL	A PDS detached label that describes INDEX.TAB	DAN

### 2.4. Document Directory Contents

The Document Directory contains documentation to help the user understand and use the archive data. The following files are contained in the Document Directory.

File Name	File Contents	File Provided By
DOCINFO.TXT	A description of the contents of this directory	DAN
DAN_RDR_SIS.PDF	The Data Product SIS as a PDF file	DAN
DAN_RDR_SIS.HTM	The Data Product SIS as an HTML file	DAN
DAN_RDR_SIS.LBL	A PDS detached label that describes DAN_RDR_SIS.PDF and HTML	DAN
DAN_ARCHIVE_VOL_SIS.PDF	The Archive Volume SIS (this document) as a PDF file	DAN
DAN_ARCHIVE_VOL_SIS.HTM	The Archive Volume SIS (this document) as an HTML file	DAN
DAN_ARCHIVE_VOL_SIS.LBL	A PDS detached label that describes both DAN_ARCHIVE_VOL_SIS.PDF and HTML.	DAN
PDSDD.FUL	The complete PDS Data Dictionary	Geosciences
PDSDD.LBL	A PDS detached label that describes PDSDD.FUL	Geosciences
MSL_LDD.FUL	The MSL Local Data Dictionary	Geosciences
MSL_LDD.LBL	A PDS detached label that describes MSL_LDD.FUL	Geosciences

Additional documents may be added.

### 2.5. Catalog Directory Contents

The files in the Catalog Directory provide a top-level understanding of the mission, spacecraft, instruments, and data sets. The files in this directory are coordinated with the PDS data engineer, who is responsible for loading them into the PDS catalog. The following files are found in the Catalog Directory.

File Name	File Contents	File Provided By
CATINFO.TXT	A description of the contents of this directory	DAN

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DAN_RDR_DS.CAT	RDR Data set information for the PDS catalog	DAN
MSL_INSTHOST.CAT	Instrument host (i.e., spacecraft) information for the PDS catalog	MSL
DAN_INST.CAT	Instrument information for the PDS catalog	DAN
MSL_MISSION.CAT	Mission information for the PDS catalog	MSL
DAN_PERSON.CAT	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)	DAN
DAN_REF.CAT	References mentioned in other DAN*.CAT files	DAN
MSL_REF.CAT	References mentioned in other MSL*.CAT files	MSL

### 2.6. Label Directory Contents

The Label Directory contains files that describe data format and organization. These files are referred to in the PDS labels that accompany the data products. They are "include" files that are intended to be parsed as if they were part of the PDS labels that refer to them. The following files are contained in the Label Directory.

File Name	File Contents	File Provided By
LABINFO.TXT	A description of the contents of this directory	DAN
DAN_RDR_DERIVED_ENGFMT	Housekeeping and Engineering data column descriptions	DAN
DAN_RDR_DERIVED_PASSIV.FMT	Derived passive Neutron spectra data column descriptions	DAN
DAN_RDR_DERIVED_ACTIV.FMT	Derived active Neutron spectra data column descriptions	DAN
DAN_RDR_AVERAGE_PASSIV.FMT	Averaged passive Neutron spectra data column descriptions	DAN
DAN_RDR_AVERAGE_ACTIVE.FMT	Averaged active Neutron spectra data column descriptions	DAN

### 2.7. Calibration Directory Contents

The Calibration Directory contains calibration files used to process the data products, or calibration data needed to use the data products. The following files are contained in the Calibration Directory.

File Name	File Contents	File Provided By
CALINFO.TXT	A description of the contents of this directory	DAN
DAN_CALIBRATION_REPORT.PDF	Description of instrument and data calibration performed by DAN team in a PDF document form	DAN

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DAN_CALIBRATION_REPORT.HTM	Description of instrument and data calibration	DAN
DAN_CALIBRATION_REPORT.LBL	performed by DAN team in an HTML document form	
	Description of above document types	

## 2.8. Software Directory Contents

There are currently no plans to provide software.

## 3. Archive Volume Format

This section describes the format of MSL DAN RDR Archive Volumes. Data that comprise the Archive will be formatted in accordance with Planetary Data System specifications [Applicable Documents 5 and 6].

### 3.1. File Formats

This section describes file formats for the kinds of files contained on Archive Volumes.

#### 3.1.1. Document File Format

Document files with the .TXT suffix exist in the Root, Index, Catalog, Document, and Label directories. They are ASCII files which may have embedded PDS labels. Lines in a .TXT file end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be readable under various operating systems.

Documents in the Document directory may contain formatting and figures that cannot be rendered as ASCII text. Therefore each document is given in two formats, hypertext and PDF. The hypertext file contains ASCII text plus hypertext markup language (HTML) commands that enable it to be viewed in a Web browser such as Netscape Navigator or Microsoft Internet Explorer. The hypertext file may be accompanied by ancillary files such as images and style sheets that are incorporated into the document by the Web browser. The second format, PDF (Portable Document Format) is a proprietary format of Adobe Systems Incorporated that is frequently used for distributing documents. Adobe offers free software, Acrobat Reader, for viewing PDF files.

### 3.1.2. Tabular File Format

Tabular files (.TAB suffix) exist in the Index directory. Tabular files are ASCII files formatted for direct reading into many database management systems on various computers. All fields are separated by commas, and character fields are enclosed in double quotation marks ("). (Character fields are padded with spaces to keep quotation marks in the same columns of successive records.) Character fields are left justified, and numeric fields are right justified. The "start byte" and "bytes" values listed in the labels do not include the commas between fields or the quotation marks surrounding character fields. The records are of fixed length, and the last two bytes of each record contain the ASCII carriage return and line feed characters. This allows a table to be treated as a fixed length record file on computers that support this file type and as a text file with embedded line delimiters on those that don't.

All tabular files are described by PDS labels, either embedded at the beginning of the file or detached. If detached, the PDS label file has the same name as the data file it describes, with the extension .LBL; for example, the file INDEX.TAB is accompanied by the detached label file INDEX.LBL in the same directory.

### 3.1.3. PDS Label Format

All data files in the archive have PDS labels, either embedded at the beginning of the file or detached in a separate file. For examples of PDS labels for each type of data product, see the Data Product SISs [Applicable Documents 3 and 4].

A PDS label, whether embedded or detached from its associated file, consists of lines of ASCII text in the form of keyword = value statements that provide descriptive information about the data file. The label is intended to be readable both by humans and by software. Details of the syntax and semantics of PDS labels can be found in the PDS Standards Reference (Applicable Document 6), and definitions of the keywords used in the label can be found by using the PDS Data Dictionary Lookup web service at [http://pds.jpl.nasa.gov/tools/data\\_dictionary\\_lookup.cfm](http://pds.jpl.nasa.gov/tools/data_dictionary_lookup.cfm).

Lines of text in detached labels end with a carriage return character (ASCII 13) and a line feed character (ASCII 10). This allows the files to be read under various operating systems.

### 3.1.4. Software File Format

None provided at this time.

### 3.1.5. Catalog File Format

Catalog files (suffix .CAT) exist in the Root and Catalog directories. Like PDS labels, they are text files formatted as keyword = value statements. They contain descriptions of the data set, instrument, spacecraft, and mission, as well as personnel contact information and references to published literature. They are called Catalog Files because they are loaded into the PDS online catalog to make the information available to users searching for data.

### 3.1.6. Science Data File Formats

DAN RDR data files are in the form of binary time-series tables. The binary tables include columns of most-significant-byte-first ("big-endian") unsigned integers. One file contains one sol's worth of data.

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For more information about the format and content of the data products, see the Data Product SISs [Applicable Documents 3 and 4].

### **4. Archive Volume Generation**

#### **4.1. Data Transfer and Validation Methods**

DAN RDR products are generated by the DAN team at the Lunar and Planetary Laboratory, University of Arizona. The products are delivered to the PDS Geosciences Node at Washington University electronically using ftp according to the schedule in the MSL Data Management and Archive Plan (Applicable Document 1).

#### **4.2. Data Product Sizes and Delivery Rates**

The DAN team releases RDR data products according to the schedule outlined in the MSL Archive Generation, Validation and Transfer Plan [Applicable Document 2].

#### **4.3. Interface Media Characteristics**

All volumes in the MSL DAN RDR Standard Product Archive conform to ISO 9660 standards [ISO 9660, 1988].

#### **4.4. Backup and Duplicates**

Backup copies of DAN RDR products will be stored at the University of Arizona until the final versions of the products have been archived on physical media with the PDS.

Duplicate copies of DAN archive volumes on physical media will be stored at the PDS Geosciences Node, the PDS Central Node and the NSSDC.

#### **4.5. Labeling and Identification**

Each DAN RDR archive volume will be identified by a unique volume ID formed according to the scheme `MSLDAN_1XXX` where:

MSL represents the mission,

DAN represents the instrument, and

1XXX is an RDR volume sequence number. If DAN RDR data need to be stored on multiple physical volumes, the XXX will be replaced with a volume sequence number starting with 001.

If the entire DAN RDR data set is revised, and the data set ID version number is incremented, the keyword `VOLUME_VERSION_ID` in the file `VOLDESC.CAT` will be incremented on volumes containing the revised data set.

## **5. Support Staff and Cognizant Persons**

Igor Mitrofanov, DAN Principal Investigator, Russian Space Institute

William Boynton, DAN Co Investigator, University of Arizona

Karl Harshman, DAN SOC Manager, University of Arizona

Questions and comments regarding the DAN RDR Archive Volume may be directed to the PDS Geosciences Node, Washington University, [geosci@wunder.wustl.edu](mailto:geosci@wunder.wustl.edu).