

2001 Mars Odyssey

**GAMMA RAY SPECTROMETER EDR
(NASA LEVEL 0)
ARCHIVE VOLUME
SOFTWARE INTERFACE
SPECIFICATION**

October 3, 2002

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October 3, 2002

DOCUMENT CHANGE LOG

Date	Description	Sections affected
5/15/02	Initial Draft	All
9/25/02	Revisions from GRS Team	All
10/3/02	Revisions from peer review	All

TBD ITEMS

Section	Description

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ACRONYMS

ASCII	American Standard Code for Information Interchange
CD-ROM	Compact Disc Read Only Memory
CEB	Common Electronics Box
DVD	Digital Versatile Disc
EDR	Experiment Data Record
GRS	Gamma Ray Spectrometer
GSH	Gamma Sensor Head
HEND	High Energy Neutron Detector
HTML	HyperText Markup Language
IEEE	Institute for Electrical and Electronics Engineers
ISO	International Organization for Standardization
NS	Neutron Spectrometer
NSSDC	National Space Science Data Center
PDF	Portable Document Format
PDS	Planetary Data System
RDR	Reduced Data Record
SIS	Software Interface Specification
TBD	To Be Determined
UTC	Universal Coordinated Time (equivalent to Greenwich Mean Time)

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 2001 Mars Odyssey Gamma Ray Spectrometer (GRS) EDR (NASA Level 0) Archive. Typically, these individuals would be software engineers, data analysts, or planetary scientists.

The specifications in this document apply to all GRS EDR archive volumes that are generated by the Odyssey Project. The GRS archive includes data acquired by the suite of three instruments collectively known as GRS: the Gamma Sensor Head (GSH), the Neutron Spectrometer (NS), and the High Energy Neutron Detector (HEND).

1.2 Content Overview

The GRS EDR archive includes the following ten types of products.

GAMMA_SPECTRA	GRS raw gamma ray spectra
PULSER_SPECTRA	Pulser calibration spectra
PROFILE_DATA	High time resolution count rates
NEUTRON_SPECTRA	Neutron spectrometer data
HEND_DATA	High Energy Neutron Detector data
CHAN_DATA	Spacecraft channelized engineering data
ENG_DATA	CEB, GRS, and NS engineering data
COMMAND_LIST	Command execution log
MESSAGE_LOG	CEB system message log
E_KERNEL	Experimenter's Notebook

The EDR data products are generated by the GRS Science Team at the University of Arizona and delivered to the PDS Geosciences Node at Washington University, St. Louis. Archive volumes are assembled by the Geosciences Node.

This Software Interface Specification (SIS) describes the content, format, and generation of the GRS EDR 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 ancillary or PDS required file. (Science data products are described in the GRS EDR SIS.) 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 Archive Volume SIS is intended to be consistent with the following documents:

1. Mars Exploration Program Data Management Plan, R. E. Arvidson et al., Rev. 3.0, March 20, 2002.
2. 2001 Mars Odyssey Orbiter Archive Generation, Validation, and Transfer Plan, Rev. 0, May 21, 2001, JPL D-20679.
3. 2001 Mars Odyssey Gamma Ray Spectrometer EDR Software Interface Specification, May 7, 2002 (draft), JPL D-23174.
4. *Planetary Data System Data Preparation Workbook*, February 17, 1995, Version 3.1, JPL D-7669, Part 1.
5. *Planetary Data System Standards Reference*, June 15, 2001, Version 3.4. JPL D-7669, Part 2.
6. ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.

1.4 Relationships with Other Interfaces

This Archive Volume SIS could be affected by changes to the design of the GRS EDR standard data products (Applicable Document #3).

2. ARCHIVE VOLUME CONTENTS

This section describes the contents of the GRS EDR Archive volumes, including the file names, file contents, file types, and organization responsible for providing the files, either the PDS Geosciences Node or the GRS Science Team.

2.1 Online and Physical Storage

The GRS EDR archive will be made available through the Planetary Data System via online Internet access and via physical media such as DVDs. The PDS will store at least three copies of the GRS EDR archive on physical media for long-term preservation.

The following description of the contents of a GRS archive volume applies to both physical volumes and online storage. The online GRS archive will be organized as one large volume.

2.2 Archive Volume Directories

GRS EDR archive volumes include the following directories.

Directory	Contents
Volume root directory	Introduction and errata text 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
SOFTWARE	Source code library to aid programmers in parsing the data files

Data directories

Data files and their detached PDS labels

The contents of these directories are described in detail below.

2.3 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.

File Name	File Contents	File Provided By
AAREADME.TXT	Introduction to the volume; content and format information	Geosciences
ERRATA.TXT	A cumulative listing of comments and updates concerning all archive volumes published to date	Geosciences
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers	Geosciences

2.4 Data Directory Contents and Naming

GRS EDR data products are aggregated by flight day; i.e., one product contains one day's worth of data. Flight day is defined to be noon-to-noon UTC. Data for each flight day will be in a subdirectory named in the format YYYYMMDD, indicating the date at the end of the data acquisition period. Within each subdirectory will be ten PDS labels and associated data files for the ten product types listed in section 1.2. Some product types are distributed over multiple files, but the files share a single PDS label.

In two cases there are so many files for a product type that they warrant separate subdirectories within the flight day directory. Specifically, the Channelized Data product type includes 111 data files per day, and the Engineering Data product type includes 81 data files per day. Each of these sets of data files will be stored in a subdirectory along with their PDS labels.

To prevent proliferation of hundreds of data directories at the root level of the volume, the daily data directories will be grouped by year, in directories named in the format YYYY.

This schematic shows an example of the nesting of directories for data acquired beginning at noon March 18, 2002 through noon March 19, 2002.

```
<Volume Root>
```

```
-----
```

```
|
| - 2002
|   |
|   | - 20020319
|   |   |
|   |   | - CHAN
|   |   |   |
```

```

| | | |- <channelized data files acquired March 18-19, 2002>
| | |
| | | |- ENG
| | |
| | | |- <engineering data files acquired March 18-19, 2002>
| | |
| | | |- <all other data files acquired March 18-19, 2002>

```

The table below shows the contents of a typical data directory, containing data for one flight day.

File Name	File Contents	File Provided By
COMMAND_LIST_20020319.DAT, .LBL	Command list and PDS label	GRS
GAMMA_SPECTRA_20020319.DAT, .LBL	Gamma spectra and PDS label	GRS
HEND_SPECTRA_20020319.DAT, .LBL	HEND spectrum, profile, and statistics data and PDS label	GRS
MESSAGE_LOG_20020319.DAT, .LBL	Message log and PDS label	GRS
NEUTRON_SPECTRA_20020319.DAT, .LBL	Neutron spectrum and PDS label	GRS
PROFILE_DATA_20020319.DAT, .LBL	Profile data and PDS label	GRS
PULSER_SPECTRA_20020319.DAT, .LBL	Pulser spectrum and PDS label	GRS
E_KERNEL_20020319.DAT, .LBL	E kernel file and PDS label	GRS
CHAN	Subdirectory of channelized data containing up 111 files, 1 PDS label	GRS
ENG	Subdirectory of engineering data containing 81 files, 1 PDS label	GRS

Note that not all files may be present for a given day, for example COMMAND_LIST may not be present if no commands were issued on that day.

2.5 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	Geosciences
INDEX.TAB	A table listing all data products on this volume	Geosciences
INDEX.LBL	A PDS detached label that describes INDEX.TAB	Geosciences

CUMINDEX.TAB	A cumulative listing of all data products on this volume and on previous volumes in this set. Note: in the case of an online archive volume that includes all the files in the data set, the index and the cumulative index are identical, so the cumulative index and its label are omitted.	Geosciences
CUMINDEX.LBL	A PDS detached label that describes CUMINDEX.TAB	Geosciences

2.6 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	Geosciences
EDRSIS.PDF	The GRS EDR Data Product SIS as a PDF file	Geosciences
EDRSIS.LBL	A PDS detached label that describes EDRSIS.PDF	Geosciences
ARCHSIS.PDF	The Archive Volume SIS (this document) as a PDF file	Geosciences
ARCHSIS.LBL	A PDS detached label that describes ARCHSIS.PDF.	Geosciences
BAD_CODE.TXT	Defines values of BAD_CODE columns.	GRS

Additional documents may be added.

2.7 Calibration Directory Contents

The Calibration Directory contains calibration reports.

File Name	File Contents	File Provided By
CALINFO.TXT	A description of the contents of this directory	Geosciences
GRS_CALIBRATION_REPORT.PDF	Describes instrument and data calibration performed by GRS team	GRS

2.8 Catalog Directory Contents

The files in the Catalog Directory provide a top-level understanding of the mission, spacecraft, instrument, and data set. The files in this directory are coordinated with the PDS Central Node 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	Geosciences

DATASET.CAT	Data set information for the PDS catalog	GRS
INSTHOST.CAT	Instrument host (i.e., spacecraft) information for the PDS catalog	Geosciences
INST.CAT	Instrument information for the PDS catalog	GRS
MISSION.CAT	Mission information for the PDS catalog	Geosciences
PERSON.CAT	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)	Geosciences
REF.CAT	References mentioned in other *.CAT files	Geosciences

2.9 Label Directory Contents

The Label Directory contains files that describe data format. These files are referenced 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	Geosciences
CHAN_DATA_COLS.FMT	Channelized data column descriptions	GRS
COMMAND_LIST_COLS.FMT	Command list column descriptions	GRS
ENG_DATA_COLS.FMT	Engineering data column descriptions	GRS
GAMMA_SPECTRA_COLS.FMT	Gamma spectra column descriptions	GRS
HEND_SPECTRA_COLS.FMT	HEND spectra column descriptions	GRS
MESSAGE_LOG_COLS.FMT	Message log column descriptions	GRS
NEUTRON_SPECTRA_COLS.FMT	Neutron spectra column descriptions	GRS
PROFILE_DATA_COLS.FMT	Profile data column descriptions	GRS
PULSER_SPECTRA_COLS.FMT	Pulser data column descriptions	GRS

2.10 Software Directory Contents

The Software Directory contains utilities or application programs to aid the user in viewing or extracting data from the data product files. The following files are contained in the Software Directory.

File Name	File Contents	File Provided By
SOFTINFO.TXT	A description of the contents of this directory	GRS
EDR_CODE.JAR	Java Archive with source and binary code for parsing GRS EDR data files.	GRS
GRS_EDR_CODE_DOC.ZIP	Documentation in the form of HTML files, compressed into a ZIP file.	GRS

GRS_EDR_CODE_DOC.LBL A PDS label that describes GRS
GRS_EDR_CODE_DOC.ZIP.

A library of source code to parse the EDR data product files is included on the archive volumes. This library allows a programmer to build applications that display or manipulate the EDR data. This source is written in the Java language, and requires version 1.3 of the Java Runtime Environment (JRE) or Java Software Development Kit (SDK).

3. ARCHIVE VOLUME FORMAT

This section describes the format of GRS EDR Archive Volumes. Data that comprise the Archive will be formatted in accordance with Planetary Data System specifications [Applicable Documents 4 and 5].

3.1 Disk Format

GRS EDR Archive Volumes on physical media use a storage format that is compatible with the computer operating systems Windows, Macintosh, and SunOS. The volume format is in accordance with ISO 9660 level 2 Interchange Standard [Applicable Document 6].

3.2 File Formats

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

3.2.1 Document File Format

Document files with the .TXT suffix exist in the Root, Catalog, Document, Index, Label, and Software directories. They are ASCII files that 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.

3.2.2 Tabular File Format

Tabular files (.TAB suffix) exist in the Index directory. Tabular files are ASCII files formatted for direct reading into spreadsheets and 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 of .TAB files 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.

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.

3.2.3 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 GRS EDR Data Product SIS [Applicable Document 3].

A PDS label, whether embedded or detached from its associated file, provides descriptive information about the associated file. The PDS label is an object-oriented structure consisting of sets of 'keyword=value' declarations. The object to which the label refers (e.g. IMAGE, TABLE, etc.) is denoted by a statement of the form:

```
^object = location
```

in which the carat character (^, also called a pointer in this context) indicates where to find the object. In an embedded label, the location is an integer representing the starting record number of the object (the first record in the file is record 1). In a detached label, the location denotes the name of the file containing the object. For example:

```
^TIME_SERIES = ("GAMMA_SPECTRA_20020501.DAT")
```

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 readable under various operating systems.

3.2.4 Software File Format

Software is provided in a Java Archive (JAR) file. This library file may be used directly with any Java Runtime Environment of version 1.3 or higher. In addition, source code may be extracted from this file with an unzip or jar utility, such as the one provided with the Java Software Development Kit.

3.2.5 Catalog File Format

Catalog files (suffix .CAT) exist in the Root and Catalog directories. They are text files containing descriptive information about the data set, instrument, spacecraft, and mission. These files are used as input to the PDS Catalog so that the information can be available to users who search the catalog. The files are formatted using "keyword=value" statements similar to those in a PDS label, so that they can be read both by humans and by computers.

3.2.6 Science Data File Formats

GRS EDR data files are all in the form of binary time-series tables except for the Message Log files, which are ASCII text tables. The binary tables include columns of most-significant-byte-first (“big-endian”) unsigned integers, IEEE-format real numbers, boolean values, and ASCII characters. One file contains one flight day’s worth of data, from noon to noon, which covers several orbits.

For more information about the format and content of the data products, see the GRS EDR Data Product SIS [Applicable Document 3].

4. ARCHIVE VOLUME GENERATION

4.1 Data Transfer and Validation

GRS EDR products are generated by the GRS Science Team at the Lunar and Planetary Laboratory, University of Arizona. The products are delivered by Internet transfer to the PDS Geosciences Node at Washington University according to the schedule in section 4.2. The Geosciences Node assembles the EDR archive volumes.

The GRS Team validates the EDR products for science content as part of the product generation process. The Geosciences Node validates the EDR products and completed archive volumes for compliance with PDS standards and with the Data Product SIS and Archive Volume SIS documents.

EDR archive volumes are made available via Internet web access and FTP access at the Geosciences Node.

The Geosciences Node will generate DVD-R copies of archive volumes for delivery to PDS Central Node and the NSSDC. A copy of each volume will be kept at the Geosciences Node.

4.2 Data Product Sizes and Delivery Schedule

Table 1 summarizes expected sizes and production rates for the GRS EDR Standard Products.

Table 1 – Standard Product Sizes and Delivery Rates

Product	Product Size	Production Rate	Expected Number of Products for Primary Mission (917 days)	Expected Total Data Volume for Primary Mission
GRS-EDR	300 MB	1 per day	917	275.1 GB

The GRS Team releases EDR data products to PDS according to the schedule outlined in the 2001 Mars Odyssey Archive Generation, Validation, and Transfer Plan [Applicable Document 2]. In accordance with the Mars Exploration Program data release policy, a six-month period after data acquisition is allotted for product generation and validation. The first Mars Odyssey data release is scheduled for October 1, 2002, and will consist of data acquired during cruise, aerobraking, and the first month of mapping. Thereafter, data releases will occur every three months. The second delivery will consist of data collected in months 2 and 3 of the science mission. Each of the remaining deliveries will include three months' worth of data, acquired six to nine months previously. No neutron spectrometer data will be included in the first delivery, instead this data will be postponed until a subsequent delivery.

4.3 Interface Media Characteristics

All physical volumes in the GRS EDR Standard Product Archive conform to ISO 9660 Level 2 standards [Applicable Document 6].

4.4 Backup and Duplicates

Backup copies of GRS EDR 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 GRS 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 GRS EDR archive volume will be identified by a unique volume ID formed according to the scheme ODGEv_xxxx, where:

- OD represents the Odyssey mission,
- G represents the GRS instrument suite,
- E indicates the EDR data set,
- v indicates the version of the data set, starting with 1, and
- xxxx is a volume sequence number, starting with 0001.

If the entire GRS EDR data set is revised, and the data set ID version number is incremented, then the archive volume version will be incremented.

5. SUPPORT STAFF AND COGNIZANT PERSONS

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Questions and comments regarding the GRS EDR Archive Volume may be directed to the PDS Geosciences Node, Washington University, geosci@wundow.wustl.edu, 314-935-5493.