

Mars Reconnaissance Orbiter

Mars Climate Sounder

Archive Volume

Software Interface Specification

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Prepared by:

Valerie Henderson
Elias Sayfi

Approved by:

Daniel McCleese
Principal Investigator, MCS

Reta Beebe
Director, PDS Atmospheres Node

Edwin Grayzeck
PDS Program Manager

JPL D-37434



Jet Propulsion Laboratory
California Institute of Technology

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DOCUMENT CHANGE LOG

| Change | Date | Affected Portions |
|---|-------------|---------------------------|
| Initial | 3/15/06 | all |
| Added details of EDR and RDR products and applicable document numbers | 2/5/07 | 1.3, 2, 3.2.2, 4, 5 |
| Remove software section - not applicable Update PDS standards reference to match EDR/RDR SISes | 7/2/07 | 1.3, 2.9 |
| Added info about DDR products | 5/20/08 | 1.3, 2.2, 2.4, 2.8, 4.1-5 |
| Added JPL D number for DDR SIS | 6/05/08 | 1.3 |

ACRONYMS AND ABBREVIATIONS

| | |
|--------|--|
| ASCII | American Standard Code for Information Interchange |
| CD-ROM | Compact Disk - Read-Only Memory |
| CD-WO | Write-Once Compact Disk |
| ISO | International Standards Organization |
| JPL | Jet Propulsion Laboratory |
| NSSDC | National Space Science Data Center |
| PDS | Planetary Data System |
| PSG | Project Science Group |
| SDVT | Science Data Validation Team |
| SIS | Software Interface Specification |
| TBD | To Be Determined |
| EDR | Experiment Data Record |
| RDR | Reduced Data Record |
| DDR | Derived Data Record |

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 Climate Sounder (MCS) Archive. Typically, these individuals would be software engineers, data analysts, or planetary scientists.

The specifications in this document apply to all MCS standard product archive volumes that are generated by Mars Reconnaissance Orbiter Project.

1.2. Content Overview

The MCS archive includes one type of data product, an ASCII formatted table. The data products are generated and volumes assembled by the MCS team at JPL.

This Software Interface Specification (SIS) describes the format, content, and generation of the MCS 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 Archive Volume SIS is intended to be consistent with the following documents:

1. Mars Exploration Program Data Management Plan, R. E. Arvidson, S. Slavney and S. Nelson, Rev. 3, March 20, 2002.
2. Mars Reconnaissance Orbiter Project Data Archive Generation, Validation and Transfer Plan, R. E. Arvidson, S. Noland and S. Slavney, JPL D-22246, July 27, 2005.
3. Mars Climate Sounder Telemetry Dictionary, A. S. Mazer, JPL D-28436
4. Mars Climate Sounder Experiment Data Record Software Interface Specification, JPL D-37295
5. Mars Climate Sounder Reduced Data Record Software Interface Specification, JPL D-37297
6. Mars Climate Sounder Derived Data Record Software Interface Specification, JPL D-46674
7. Planetary Data System Data Preparation Workbook, February 17, 1995, Version 3.1, JPL D-7669, Part 1.
8. Planetary Data System Standards Reference, Version 3.6, JPL D-7669, Part 2, August 1, 2003.

9. 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 MCS standard data products (Applicable Document #4 & #5).

2. Archive Volume Contents

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

2.1. Online and Physical Storage

The MCS archive will be made available through the Planetary Data System via online Internet access and via physical media such as DVDs. The following description of the contents of a MCS archive volume applies to both physical volumes and online storage. The online MCS archive will be organized as one large volume.

2.2. Archive Volume Directory

The MCS archive volumes will include the following directories.

| Directory Name | Contents |
|---------------------------|--|
| / - Volume root directory | Introduction and errata text files |
| /CATALOG | Descriptions of data set, instruments, spacecraft, and mission as found in the PDS Catalog |
| /DATA | Data product files |
| /DOCUMENT | Documentation files |
| /INDEX | Volume and cumulative index tables |
| /LABEL | Descriptions of data file formats, referenced by PDS labels |
| /CALIB | Calibration files for the RDR archive volume, Metadata for DDR |

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 |
|--------------|--|
| AAREADME.TXT | Volume content and format information |
| ERRATA.TXT | A cumulative listing of comments and updates concerning all archive volumes published to date. Only present in case of errors. |
| VOLDESC.CAT | A description of the contents of this volume in a PDS format readable by both humans and computers |

2.4. Data Directory Contents and Naming

The data products will be located in the DATA directory of the archive volume. The files will be grouped into directories with one directory per day. Each directory name will be in the format YYYYMMDD. Within each directory there will be 6 data product files and their labels. The labels will point to the corresponding data files, and contain pointers to format labels detailing the column layout of the data files. For EDR's, the data product file names will be in the format YYYYMMDDHH_EDR.TAB for the data tables, and YYYYMMDDHH_EDR.LBL for the labels. For RDR's, the data product file names will be in the format YYYYMMDDHH_RDR.TAB for the data tables, and YYYYMMDDHH_RDR.LBL for the labels. DDR data products filenames will have the format YYYYMMDDHH_DDR.TAB with the corresponding label YYYYMMDDHH_DDR.LBL.

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 |
|--------------|--|
| INDXINFO.TXT | A description of the contents of this directory |
| INDEX.TAB | A table listing all data products on this volume |
| INDEX.LBL | A PDS detached label that describes INDEX.TAB |
| CUMINDEX.TAB | A cumulative listing of all data products on this volume and on previous volumes in this set |
| CUMINDEX.LBL | A PDS detached label that describes CUMINDEX.TAB |

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 |
|-------------------------|--|
| DOCINFO.TXT | A description of the contents of this directory |
| DP_SIS.ASC | The Data Product SIS as text |
| DP_SIS.PDF | The Data Product SIS as a PDF file |
| DP_SIS.LBL | A PDS detached label that describes DP_SIS |
| DP_ARCHSIS.ASC | The Archive Volume SIS (this document) as text |
| DP_ARCHSIS.PDF | The Archive Volume SIS (this document) as a PDF file |
| DP_ARCHSIS.LBL | A PDS detached label that describes DP_ARCHSIS |
| MCCLEESE_ET_AL_2006.PDF | A description of the MCS experiment |

| | |
|-------------------------|--|
| MCCLEESE_ET_AL_2006.LBL | A PDS detached label that describes MCCLEESE_ET_AL_2006.PDF |
| MCS_ACTIVITY_LOG.PDF | A description of instrument activity during significant time periods |
| MCS_ACTIVITY_LOG.LBL | A PDS detached label that describes MCS_ACTIVITY_LOG.PDF |

2.7. 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 | MCS |
| DATASET.CAT | Data set information for the PDS catalog | MCS |
| INSTHOST.CAT | Instrument host (i.e., spacecraft) information for the PDS catalog | Geosciences |
| INST.CAT | Instrument information for the PDS catalog | MCS |
| 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) | MCS |
| REF.CAT | References mentioned in other *.CAT files | MCS |

2.8. 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 |
|---|---|
| LABINFO.TXT | A description of the contents of this directory |
| MCS_EDR.FMT or MCS_RDR.FMT or MCS_DDR1.FMT, MCS_DDR2.FMT | EDR, RDR, or DDR table data column descriptions |

2.9. Calib Directory Contents (optional)

The Calib 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 Calib Directory. Only the RDR and DDR archive volume will have this directory.

| File Name | File Contents |
|-----------------------------|---|
| CALINFO.TXT | A description of the contents of this directory |
| MCS_CENTRAL_WAVENUMBERS.ASC | The central wave numbers used in radiance calibration |
| MCS_CENTRAL_WAVENUMBERS.LBL | The label file for MCS_CENTRAL_WAVENUMBERS.ASC |
| MCS_SPECTRAL_RESPONSE.ASC | The spectral responses used in radiance calibration |
| MCS_SPECTRAL_RESPONSE.LBL | The label file for MCS_SPECTRAL_RESPONSE.ASC |

2.10. Geometry Directory Contents (optional)

The Geometry Directory contains files needed to understand observation geometry. The following files are contained in the Geometry Directory.

| File Name | File Contents |
|--------------|---|
| GEOMINFO.TXT | A description of the contents of this directory |

2.11. Browse Directory Contents (optional)

The Browse Directory contains reduced-size, easily viewed versions of data products to be used to help identify products of interest. The following files are contained in the Browse Directory.

| File Name | File Contents |
|--------------|---|
| BROWINFO.TXT | A description of the contents of this directory |

2.12. Extras Directory Contents (optional)

The Extras Directory contains documentation, utility programs, or other materials that the user may find helpful, but that are beyond the scope of the required elements of the archive. The contents of this directory are exempt from PDS requirements for labeling, etc. The Extras Directory is intended for "value-added" material, handy to have but not crucial for understanding the data. (If it's crucial, it is in one of the standard directories.) The following files are contained in the Extras Directory.

| File Name | File Contents |
|-------------|---|
| EXRINFO.TXT | A description of the contents of this directory |

3. Archive Volume Format

This section describes the format of MCS Archive Volumes. Data that comprise the Archive will be formatted in accordance with Planetary Data System specifications [Applicable Documents 6 and 7].

3.1. Disk Format

Archive Volumes have a compact disk format that is compatible with the computer operating systems MS-DOS, Macintosh, and SunOS. The volume format is in accordance with ISO 9660 level 2 Interchange Standard [Applicable Document 7].

3.2. File Formats

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

3.2.1. Document File Format

Document files with the .TXT and .ASC suffix exist in the Root, Index, Software, Catalog, and Document 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.

3.2.2. 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 left justified, and numeric fields are right justified. 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.

3.2.3. PDS Label Format

All data files in the archive have detached PDS labels. The PDS label 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, along with the starting record or byte number, if there is more than one object in the file. For example:

`^HEADER = ("F01.IMG",1)`

`^IMAGE = ("F01.IMG",1025 <BYTES>)`

indicates that the IMAGE object begins at byte 1025 of the file F01.IMG, in the same directory as the detached label file. Below is a list of the possible formats for the ^object definition.

| | |
|----------------------|---|
| <code>^object</code> | <code>= n</code> |
| <code>^object</code> | <code>= n<BYTES></code> |
| <code>^object</code> | <code>= "filename.ext"</code> |
| <code>^object</code> | <code>= ("filename.ext",n)</code> |
| <code>^object</code> | <code>= ("[dirlist]filename.ext",n)</code> |
| <code>^object</code> | <code>= ("filename.ext",n<BYTES>)</code> |
| <code>^object</code> | <code>= ("[dirlist]filename.ext",n<BYTES>)</code> |

where

n is the starting record or byte number of the object, counting from the beginning of the file (record 1, byte 1),

<BYTES> indicates that the number given is in units of bytes,

filename is the up to 27 character, alphanumeric upper-case file name,

ext is the 3 character upper-case file extension,

dirlist is a period-delimited path-list of parent directories, in upper case, that specifies the object file directory (used only when the object is not in the same directory as the label file). The list begins at the directory level below the root directory of the CD-ROM. '[dirlist]' may be omitted when the object being described is located either in the same directory as the detached label, or in a subdirectory named LABEL that is located in a higher level of the directory tree, typically the CD-ROM root itself.

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

None at this time.

3.2.5. Catalog File Format

Catalog files (suffix .CAT) exist in the Root and Catalog directories. They are text files formatted in an object-oriented structure consisting of sets of 'keyword=value' declarations.

3.2.6. Science Data File Formats

MCS data files are all in the form of ASCII tables. One file contains 4 hours worth of data. For more information about the format and content of the data products, see the Data Product SIS [Applicable Document 4, 5].

4. Archive Volume Generation

4.1. Data Transfer and Validation Methods

MCS EDR, RDR and DDR products are generated by the MCS Science Team JPL. The MCS Team assembles the EDR, RDR, and DDR archive volumes and delivers the volumes by Internet transfer to the PDS Atmospheres Node at New Mexico State University according to the schedule in the MRO Archive Plan. The MCS Team validates the EDR, RDR, and DDR products for compliance with PDS standards as part of the product generation process.

The Atmospheres Node validates the EDR, RDR, and DDR products and completed archive volumes for science content and for compliance with PDS standards and with the Data Product SIS and Archive Volume SIS documents, and makes the volumes available to the public via the Atmospheres Node web site.

The Atmospheres Node will also transfer MCS archive volumes to the National Space Science Data Center (NSSDC) for long term storage according to PDS policy, using a transfer medium agreed upon by PDS and NSSDC.

4.2. Data Product Sizes and Delivery Rates

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

Table 1 – Standard Product Sizes and Delivery Rates

| Product | Product Size | Production Rate | Expected Number of Products for Primary Mission (730 days) | Expected Total Data Volume for Primary Mission |
|---------|--------------|----------------------------|--|--|
| MCS EDR | 14 MB | 6 data table files per day | 4380 | 60GB |
| MCS RDR | 24 MB | 6 data table files per day | 4380 | 103GB |
| MCS DDR | 4 MB | 6 data table files per day | 4380 | 20G |

After a data validation period of 6 months, the MCS team will assemble the data products and ancillary files into archive volumes and transfer the archive to the Atmospheres Node. The MCS archive will be made available via data releases scheduled at three month intervals as specified in the Mars Reconnaissance Orbiter Project Data Archive Generation, Validation and Transfer Plan (see Applicable document #2).

4.3. Interface Media Characteristics

All volumes in the MCS Standard Product Archive conform to ISO 9660 Level II Standards [ISO 9660, 1988].

4.4. Backup and Duplicates

Backup copies of MCS EDR, RDR, and DDR products will be stored at JPL until the final versions of the products have been archived on physical media with the PDS. Duplicate copies of MCS archive volumes on physical media will be stored at the PDS Atmospheres Node and the NSSDC.

4.5. Labeling and Identification

Each MCS EDR, RDR and DDR archive volume will be identified by a unique volume ID formed according to the scheme MROM_Xnnn, where

MRO is the Mission ID

M is the Instrument ID

X equals 0 denotes EDR, 1 denotes RDR, 2 denote DDR

nnn is the volume sequence number starting with 001

5. Support Staff and Cognizant Persons

Daniel McCleese, MCS Principal Investigator, JPL.

Elias Sayfi, MCS Downlink Engineer, JPL

David Kass, MCS Uplink Engineer, JPL

Jim Murphy, PDS Atmospheres Node, New Mexico State University.

Lyle Huber, PDS Atmospheres Node, New Mexico State University.