Mars Reconnaissance Orbiter
JPL Document Number D-32005

HiRISE
EDR, RDR, and DTM
Archive Volumes
Software Interface Specification

Version 1.5

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SIS For HiRISE EDR, RDR, and DTM Volumes Approved by:

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Table of Contents

1 Preface

This document describes the format and contents of the archive volume housing HiRISE Standard products. These products include Experiment Data Record (EDR) and Reduced Data Records (RDR) Products.

1.1 Document Change Log

Date	Who	Sections	Descriptions
09/01/2005	Eric E.	All	Draft version
12/01/2005	Eric E.	All	Updated SIS as per comments from PDS review.
2/01/2006	Eric E.	All	Developed as an RDR & EDR Volume SIS
5/1/06	Eric E.	All	Updated SIS based on reviewer comments from PDS and Brad Castalia
6/1/06	Eric E.	All	Editorial updates from comments from Betty Sword & Patty Garcia;
6/5/06	Eric E.	Appendix C	Added Appendix C describing HiRISE EDR and RDR Data product volumes.
6/7/06	Eric E.	Appendices A & B	LSUBS removed, as it was redundant with SOLAR_LONGITUDE. Changed EASTERNMOST_ and WESTERNMOST_LONGITUDE to MINIMUM_ and MAXIMUM_LONGITUDE. Removed CPMM_NUMBER as the CCD_NAME is the more appropriate value. Changed ALTITUDE to SPACECRAFT_ALTITUDE. Removed LINE_EXPOSURE_DURATION, as it is not needed. Added PROJECTION_CENTER_LATITUDE and PROJECTION_CENTER_LONGITUDE. Added LINE_PROJECTION_OFFSET and SAMPLE_PROJECTION_OFFSET values.
6/25/06	Eric E.	Section 4	Typo fix RED_RED changed to RDR_RED
6/25/06	Eric E.	Appendix B	Removed ROLL_ANGLE as EMISSION and SUB_SPACECRAFT_LATITUDE and LONGITUDE can e used to characterize stereo viewing
8/18/06	Eric E.	Section 4	Added description for the “EXTRAS” directories containing thumbnail and browse images in JPEG format. Modified directory tree to contain a single RDR directory tree.
5/10/07	Eric E.	Appendix B	As a result of the HiRISE RDR SIS review the following action was taken on the RDR image index file described in Appendices A & B: The COORDINATED_OBSERVATION_ID was removed from the index tables, as it was not possible to accurately populate this field. The latitude and longitude of the four corners of the observations, in original viewing space, were added to the RDR index table.
5/22/07	Richard L.	Section 4 Section 5	Typo fix section 4.3 mission changed from MGS to MRO. Typo fix section 5.2.5 HiRISE EDR products to HiRISE RDR products.
8/14/09	Rodney H.	Appendix D Section 1.3	Added Appendix D, description of DTMs. Added DEM,DTM definitions

		Section 4	Added Anaglyph and DTM directories to directory tree diagram
10/22/09	Rodney H.	Appendix B Appendix D Section 4.1	Removed SCALED_PIXEL_WIDTH column from the index table Added left/right observation id columns to the index table. Added DTM index tables to list of files in the INDEX directory
4/13/12	Rodney H.	Appendix A Appendix D	Added HICAL_VERSION column to the EDR INDEX table to indicate to users what version of the calibration software was applied to the EDRs making up the currently released versions of the RDRs. Updated sample product names to match new orthoimage naming convention in the latest RDR SIS Added SOURCE_DTM_ID column to the DTM index table Replaced left and right orthoimage options with orthoimage in the DATA_TYPE field, as the distinction is no longer relevant.
4/15/12	Rodney H.	Table 4.0 Appendix D	Added entries for the various types of DTM Extras products. Noted that additional orthoimages and color orthoimages will be added to the DTM project directories.

1.2 TBD Items

Sect.	Description
4.0	Should there be a DOCUMENT directory for the SISs and how should the SIS documents be organized?

1.3 Acronyms, Abbreviations, and Definitions

ASCII	American Standard Code for Information Interchange
CCD	Charge-Coupled Device
Channel	For HiRISE a CCD is divided into two readout channels
DARWG	Data Archive Working Group
DEM	Digital Elevation Model
DTM	Digital Terrain Model (DTM and DEM are synonymous acronyms)
EDR	Experiment Data Record
FELICS	Fast and Efficient Lossless Image Compression System
HiRISE	High Resolution Imaging Science Experiment
HiROC	HiRISE Operations Center
I/F	The ratio of the observed radiance and the radiance of a 100% Lambertian reflector normal to the incidence rays of the sun at the sun-to-target distance of the observation
LED	Light Emitting Diode
LUT	Lookup Table
JPL	Jet Propulsion Laboratory
MRO	Mars Reconnaissance Orbiter

ODL	Object Description Language
PDS	Planetary Data System
RDR	Reduced Data Record
SIS	Software Interface Specification
TDI	Time Delay Integration
TBD	To Be Determined
UTC	Coordinated Universal Time

1.4 Glossary

The Planetary Data System (PDS) defines the following terms:

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. 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 – High-level descriptive information about a dataset (e.g. mission description, spacecraft description, instrument description), expressed in Object Description Language (ODL) suitable for loading into a PDS catalog.

Data Product – A labeled grouping of data resulting from a scientific observation. 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. Data products that are generated in a nonstandard way are sometimes called special data products.

2 Introduction

2.1 Overview

The High Resolution Imaging Science Experiment (HiRISE) is one of the remote sensing instruments onboard the Mars Reconnaissance Orbiter (MRO) spacecraft acquiring orbital observations during the mission's primary mapping phase. MRO, launched on August 12, 2005, arrived at Mars orbit insertion in March 2006 to begin an areobraking period that achieved a 255 x 320 kilometer near-polar orbit suitable for the two-year primary mapping phase in November 2006. HiRISE is capable of unprecedented high-

resolution imaging of the Mars surface with up to 30-cm/pixel sampling at a 300-kilometer altitude.

The HiRISE Science Team is responsible for the creation of the image-products archive generated during the course of the mission. Experiment Data Record (EDR) Products created by the HiRISE team act as the permanent record of the imaging acquired by the HiRISE instrument. An EDR contains raw image data, observational related engineering data, and information about the instrument commanding parameters used to acquire the image. EDRs are used to create derived image products, described in the HiRISE Reduced Data Record (RDR) Software Interface Specification (SIS) (JPL Document Number D-32006), that are radiometrically calibrated and geometrically processed to form an image map. Both the EDRs and derived products are delivered to the Planetary Data System.

Starting in 2009, Digital Terrain Models (DTM) are being added to the HiRISE Archive Volume collection. DTMs are derived from stereoscopic image pairs where the two (or more) observations are acquired of the same surface area under different viewing perspectives. Digital photogrammetric techniques are employed to measure the stereo parallax from which elevation data are derived. See Appendix D for a details the organization of the DTM data set.

2.2 Scope

This document acts as a companion to the HiRISE EDR Data Product SIS (JPL Document Number D-32004) and the HiRISE RDR Data Product SIS (JPL Document Number D-32006) documents. Those documents provide a technical description of the products while this Volume SIS describes the ancillary data that accompany the HiRISE imaging products as well as the contents and organization of the data volumes.

This document is intended to provide enough information to enable users to read and understand the archive volumes, and its intended users are software developers, engineers, and scientists interested in accessing and using the archive volumes and its products. It also provides a specification of the product volumes to be delivered to the Planetary Data System (PDS).

2.3 Applicable Documents

1. Software Interface Specification for HiRISE Experimental Data Record Products, Version 1.0, JPL D-32004, August 1, 2005.
2. Software Interface Specification for HiRISE Reduced Data Record Products, Version 1.0, JPL D-32006, [TBD]
3. Mars Exploration Program Data Management Plan, R. E. Arvidson and S. Slavney, Rev. 2, Nov. 2, 2000.
4. Mars Reconnaissance Orbiter Project Data Archive Generation, Validation and Transfer Plan, R. E. Arvidson, S. Noland and S. Slavney, March, 2005.

This document is also consistent with the following Planetary Data System (PDS) documents:

5. Planetary Data System Data Preparation Workbook, Version 3.1, JPL D-7669, Part 1, February 1, 1995.
6. Planetary Data System Data Standards Reference, Version 3.6, JPL D-7669, Part 2, August 1, 2003.
7. Planetary Science Data Dictionary Document, JPL D-7116, Rev. E, August 28, 2002.

2.4 Configuration Management and SIS Review

The HiRISE Software Development Team at the University of Arizona controls this document. Requests for changes to its scope and contents are made to the HiRISE Ground Data System Manager. An Engineering Change Request will be evaluated against its impact on the PDS User community and the HiRISE ground data processing system before acceptance.

To ensure the archives of HiRISE Image Products meet PDS standards, the HiRISE EDR and RDR Product SIS documents are reviewed and approved by a team of technical reviewers including members of the Planetary Data System. The Members from the planetary science community, PDS Geosciences, Imaging, and Engineering Nodes participated in the review. The HiRISE Volume SIS is reviewed by the PDS to ensure conformance to PDS standards. Results of the peer reviews are available at the Geosciences Node website (http://wufs.wustl.edu/missions/mro/hirise/).

3 Archive Volume Generation

3.1 Archive Preparation and Validation

The HiRISE team is responsible for developing and delivering to the PDS Imaging Node the volumes of HiRISE Data Products along with associated metadata products including index tables, instrument and dataset descriptions, and other documentation. Delivery schedules are identified in the MRO Archive Generation, Validation, and Transfer Plan. The HiRISE team performs internal product validation before delivering products to the PDS.

During active MRO operations a HiRISE Data Node is established at the HiRISE Operations Center, University of Arizona. The Data Node maintains an on-line archive of HiRISE Products for electronic distribution to the PDS user community. At the conclusion of the HiRISE Data Node activities, a copy of the archive is delivered to the PDS Imaging Node on hard media or mutually agreed upon electronic data transfer methods.

The HiRISE team validates its image products before delivery to the PDS. Images are checked for processing anomalies and data integrity. These checks include verification that the RDR products have been properly radiometrically corrected and the geometry processing meets expectations. The HiRISE team verifies the image has achieved its

observational objective. An observation may be reacquired if the intended target was missed, cloud cover or atmospheric haze obscured the target, or the operating mode of the instrument was improperly chosen for the viewing conditions.

The PDS Imaging Node carries out additional data validation activities ensuring HiRISE products meet PDS standards. The product labels are checked for valid values and proper syntax. The index tables are checked against the volume contents. The volumes are checked to ensure the required supporting documents and files are contained in the volume.

3.2 EDR Data Product Sizes and Volumes

A HiRISE observation is contained in a set of EDR products with each EDR storing the instrument data for of a single Charge Couple Device (CCD) channel. With two output channels for each of the 14 CCDs colocated on the instrument's focal plane array, up to 28 EDR products (depending on how many CCDs are commanded to operate) can be generated per observation. The acquisition of approximately 10,000 HiRISE observations is planned for the nominal mission phase. Assuming an average of 20 EDR products per observation, this amounts to approximately 200,000 EDR products. To find out more about the HiRISE instrument, commanding options, and the EDR products refer to the HiRISE EDR SIS [JPL D-32004, 2005] companion document.

The size of an EDR product depends on the instrument commanding used during an observation. Commanding parameters affecting image size include the number of observation lines, image pixel data type (8-bit or 16-bit unsigned integers), and the pixel-binning mode. The smallest EDR products, such as calibration observations, might contain a few hundred lines of 8-bit pixel data with a size of less than half a megabyte. The largest EDR products may contain over 60,000 lines of unbinned 16-bit pixels resulting in a file size exceeding 120 megabytes. The largest observations are typically reserved for high priority science observations or imaging campaigns for landing site assessment. More typically, EDR products containing 10,000-20,000 lines of 8-bit pixels have a size of about 10 to 20 megabytes.

The total data volume for the EDR products is expected to be approximately 3,688 gigabytes. For more information see Appendix C.

3.3 RDR Data Product Sizes and Volumes

RDR products are compiled from individual EDR images that make up an observation. Each EDR is radiometrically corrected for dark current, instrument offset, and detector gain variations and converted to I/F (defined as the ratio of the observed radiance and the radiance of a 100% lambertian reflector normal to the incidence rays of the sun at the sun-to-target distance of the observation). The value of I/F would equal 1.0 for an ideal 100% lambertian reflector with the sun and camera orthogonal to the planet's surface.

After calibration correction, EDR image pairs, representing the two channels of a CCD detector array, are stitched together to form a single image representing the output of a CCD. The stitched CCD images are resampled forming a map-projected image. The red-

filter CCD images are mosaicked together to form a single-band map product covering the area imaged by the red-filter CCDs. These products are called Full-Resolution Red-filter RDR products. If the infrared and blue-green filter CCDs were operating during an observation then three-color map-projected RDR products are created. Binned-Color RDR products are created at a pixel resolution defined by the minimum bin mode commanded in the infrared and blue-green CCDs. Most HiRISE Observations command infrared and blue-green CCDs at bin modes of 2 or 4. Full-Resolution Color RDR products are special products created at the end of PSP operations. These products take on the same pixel resolution as the Full-Resolution Red-filter RDR products. To find out more about the RDR products refer to the HiRISE RDR SIS [JPL D-32006, 2005] companion document.

The Full-Resolution Red-filter RDR products are the same as the nominal 10,000 image observations acquired by HiRISE during the Primary Science Phase. Not all observations are acquired with the infrared and blue-green filter imaging; approximately 8,000 Binned-Color RDR and 8,000 Full-Resolution Color RDR products are expected during the Primary Science Phase.

As with the EDRs, RDR product sizes vary depending on the commanding modes of the instrument and the number of lines acquired during an observation. Typical RDR products are acquired with all CCD detectors operating collecting 10,000 to 20,000 lines in the observation. Typical sizes for a Full-Resolution Red-filter RDR product range from 200 to 500 megabytes with JPEG2000 data compression (see below). The largest HiRISE RDR products would exceed 2,000 megabytes with JPEG2000 Compression.

The HiRISE RDR products are stored as JPEG2000 images in JP2 file format, an imaging standard recently adopted by the PDS. This standard offers advantages for rapidly distributing imaging data through Internet resources. To find out more about the JPEG2000 images refer to the HiRISE RDR SIS [JPL D-32006, 2005] companion document.

The total volume for the RDR products is expected to be approximately 17,959 gigabytes with JPEG2000 compression (48,256 gigabytes without JPEG 2000 compression). See Appendix C for more information on data volume estimates.

3.4 Labeling and Identification

The files contained in the EDR and RDR archive volume have attached or detached PDS labels identifying and describing the objects within the file. The PDS label contains keywords for identification, and storing and organizing ancillary data. The labels also contain descriptive information needed to interpret or process the data objects in the file. PDS labels are written in Object Description Language (ODL) [JPL D-7669, Part 2, 2003]. ODL statements have the form "keyword = value". Each label statement is terminated with a carriage return character (ASCII 13) followed by a line feed character (ASCII 10) sequence.

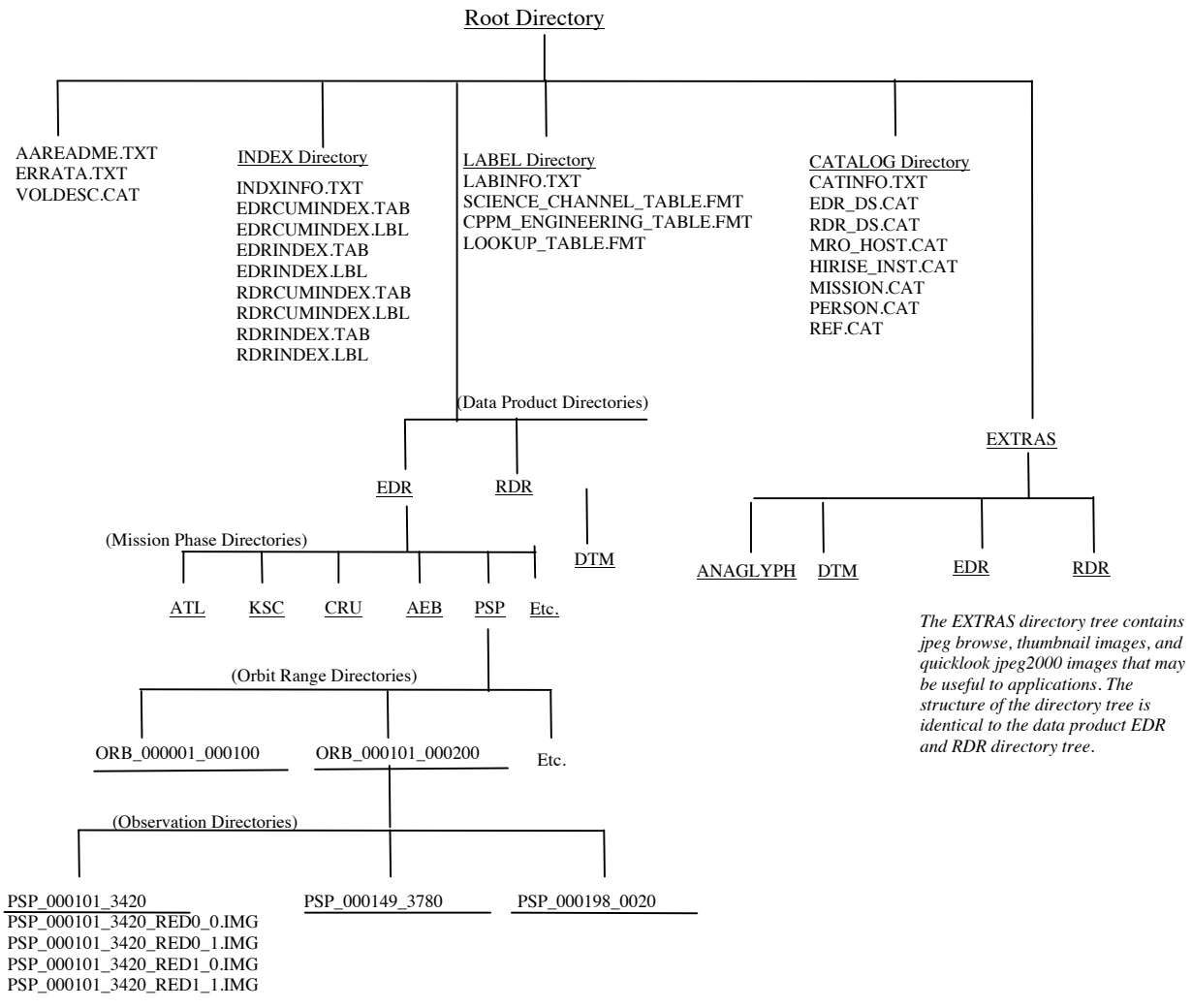
Pointer statements are used to indicate the location of data objects in the file: formatted as ^object = byte <bytes>, where the carat character (^, ASCII 39) is followed by the name

of the specific data object. The byte location value is the starting byte position for the data object within the file where the first byte in a file is byte number 1.

PDS labels are also used for identification and descriptive data elements providing information about the contents of the file. These may include identifiers for the data product, instrument, spacecraft, and mission.

4 Archive Volume Contents

This section describes the contents of the HiRISE volumes, including file names, file contents, file types, and directory organization. The directory organization is summarized in the diagram shown below. A volume contains both EDR and RDR products. The required directories are INDEX, LABEL, CATALOG, EDR, RDR, and EXTRAS.



Directory organization for EDR and RDR Product Archive

Root Directory

The contents of the root directory of each EDR Volume are shown in the table below:

File Name	File Contents	File Provided By
AAREADME.TXT	This file describes the volume organization and contents (PDS label attached).	HiRISE Team
ERRATA.TXT	A cumulative listing of comments and updates concerning HiRISE Standard Data Products on the volume set published so far (PDS label attached).	HiRISE Team
VOLDESC.CAT	A description of the contents of this volume in a PDS format readable by both humans and computers	HiRISE Team

4.1 Index Directory

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	HiRISE Team
EDRCUMINDEX.TAB	A table listing of HiRISE EDR products published to date.	HiRISE Team
EDRCUMINDEX.LBL	A PDS detached label that describes EDRCUMINDEX.TAB	HiRISE Team
EDRINDEX.TAB	A table listing of HiRISE EDR products on this volume most recently released. The table is identically formatted to the EDRCUMINDEX.TAB file.	HiRISE Team
EDRINDEX.LBL	A PDS detached label that describes EDRINDEX.TAB	HiRISE Team
RDRCUMINDEX.TAB	A table listing of HiRISE RDR products published to date.	HiRISE Team
RDRCUMINDEX.LBL	A PDS detached label that describes RDRCUMINDEX.TAB	HiRISE Team
RDRINDEX.TAB	A table listing of HiRISE RDR products on this volume most recently released. The table is identically formatted to the EDRCUMINDEX.TAB file.	HiRISE Team
RDRINDEX.LBL	A PDS detached label that describes RDRINDEX.TAB	HiRISE Team
DTMCUMINDEX.TAB	A table consisting of HiRISE DTM products published to date.	HiRISE Team
DTMCUMINDEX.LBL	A PDS detached label that describes the DTMCUMINDEX.TAB	HiRISE Team
DTMINDEX.TAB	A table listing of HiRISE DTM products on this volume most	HiRISE Team

	recently released. The table is identically formatted to the DTMCUMINDEX.TAB file.	
DTMINDEX.LBL	A PDS detached label that describes the DTMINDEX.TAB	HiRISE Team

4.2 Label Directory

This directory contains additional PDS-label "include" files that were not packaged with the data products or in the data subdirectories. Include files are referenced by a pointer in the HiRISE EDR PDS label. For the EDR products the include files contain additional labels describing the contents of the Science Channel Table, CPMM Engineering Table, and the Lookup Table for converting from 14-bit to 8-bit pixels. The Label Directory contains the following files:

File Name	File Contents	File Provided By
LABINFO.TXT	This file describes the contents of Label Directory (PDS label attached).	HiRISE Team
SCIENCE_CHANNEL_TABLE.FMT	Include file describing the Science Channel Table object in the EDR product.	HiRISE Team
CPMM_ENGINEERING_TABLE.FMT	Include file describing the CPMM Engineering Table object in the EDR product.	HiRISE Team
LOOKUP_TABLE.FMT	Include file describing the Lookup Table used in the translation from 14-bit to 8-bit pixels	HiRISE Team

4.3 Catalog Directory

The files in the Catalog directory provide a top-level understanding of the MRO spacecraft, instruments, and data sets in the form of completed PDS templates. The files are produced or collected by the HiRISE team. The files in this directory are coordinated with the PDS lead node (Geosciences Node) for MRO.

File Name	File Contents	File Provided By
CATINFO.TXT	A description of the contents of this directory	HiRISE Team
EDR_DS.CAT	PDS data set catalog description of the EDR Products	HiRISE Team
RDR_DS.CAT	PDS data set catalog description of the RDR Products	HiRISE Team
MRO_HOST.CAT	PDS instrument host (spacecraft) catalog description of the MRO Spacecraft	Geosciences Node
HIRISE_INST.CAT	PDS instrument catalog description of the HiRISE instrument	HiRISE Team
MISSION.CAT	PDS mission catalog description of the MRO mission	Geosciences Node
PERSON.CAT	PDS personnel catalog description of HiRISE Team members and other persons involved with generation of HiRISE data products	HiRISE Team
REF.CAT	HiRISE-related references mentioned in other *.CAT files	HiRISE Team

4.4 EDR and RDR Product Directories

Standard Data products are stored within the EDR and RDR directories immediately under the volume's root directory. These directories contain a cascading set of sub-directories organizing the products by mission phase (level 1), orbit range or time period range (level 2), and observation identification (level 3). There will never be more that 28 products associated with a directory. The figure shown below is an example of the layout of data directory trees. The RDR directory contains the color and red-filter products that have undergone radiometric and geometric processing with the CCDs mosaicked to form a single observation image. The DTM data product directory tree is described in Appendix D. See Table 4 for a summary of EDR and RDR products.

Directory Description	Directory Example
EDR & RDR Directory Trees	EDR/
Mission Phase Identification	PSP/ (Primary Science Phase)
Orbit Range Directory	ORB_000100_000199/ (Orbits 100 to 199)
Observation ID	PSP_000105_0300/ (Observation ID)
Data products	PSP_000105_0300_RED0_0.IMG PSP_000105_0300_RED0_1.IMG PSP_000105_0300_RED1_0.IMG PSP_000105_0300_RED1_1.IMG PSP_000105_0300_RED2_0.IMG PSP_000105_0300_RED2_1.IMG PSP_000105_0300_RED3_0.IMG PSP_000105_0300_RED3_1.IMG PSP_000105_0300_RED4_0.IMG PSP_000105_0300_RED4_1.IMG PSP_000105_0300_RED5_0.IMG PSP_000105_0300_RED5_1.IMG PSP_000105_0300_RED6_0.IMG PSP_000105_0300_RED6_1.IMG PSP_000105_0300_RED7_0.IMG PSP_000105_0300_RED7_1.IMG PSP_000105_0300_RED8_0.IMG PSP_000105_0300_RED8_1.IMG PSP_000105_0300_RED9_0.IMG PSP_000105_0300_RED9_1.IMG

4.5 EXTRAS Directory Tree

The EXTRAS directory tree contains supplemental data files that may be useful to interested users. For HiRISE, the EXTRAS directory tree contains JPEG2000 full-resolution products, JPEG thumbnail and browse images of the EDR, RDR, and DTM standard products and 3-D anaglyph products in the JPEG2000 and png formats. Under the EXTRAS subdirectory are the EDR, RDR, DTM, and ANAGLYPH subdirectories. Thumbnails, small in size, are high-level quick-look images of the products. Thumbnail images have the extension "*.thumb.jpg". Browse images, with extension "*.browse.jpg", are larger then thumbnail images providing a more detailed high-level view of the products. See Table 4 for a summary of Extras Products

Table 4.0 – Summary of RDR, EDR, DTM, and Extras Products

Directory Location	Format / file extension	Description
EDR	.IMG	Raw image data, one per image channel (up to 28 per observation), FELICS decompressed in raster format.
RDR	_RED.JP2, .LBL	Map-projected mosaic of RED-filter CCDs in JPEG2000 format (.JP2) and losslessly compressed with 10-bits per pixel providing a dynamic range 0-1023. The .LBL file is the detached PDS label describing the product.
RDR	_COLOR.JP2, .LBL	Three-color map-projected mosaic of IR , RED, and BG bands in JPEG2000 format and losslessly compressed with 10-bits per pixel providing a dynamic range 0-1023
DTM	.JP2, .IMG, .LBL	Digital Terrain Model products formatted in PDS-labeled raster format (.IMG) and orthoimages stored in the JPEG2000 format with detached PDS labels (.JP2, .LBL).
EXTRAS/RDR	_RED.QLOOK.JP2	Quicklook version of the RDR RED mosaic product stored as 10-bits/pixel with a compression factor of 5.0 (this compression factor is high due to large areas of null pixels in the projected image and because the losslessly-compressed version is available).
EXTRAS/RDR	_COLOR.QLOOK.JP2	Quicklook version of the RDR COLOR mosaic product stored as 10-bits/pixel with a compression factor of 5.0.
EXTRAS/RDR	_RED.NOMAP.JP2	Grayscale not-map-projected image stored as 10-bits/pixel providing a dyamic range of 0-1023 with a compression ratio of 2.0.
EXTRAS/RDR	_RGB.NOMAP.JP2	Color not-map-projected image stored as 10-bits/pixel providing a dynamic range of 0-1023 losslessely

		compressed. Color data use the RED, BG, and synthetic blue bands displayed as red, green, blue respectively.
EXTRAS/RDR	_IRB.NOMAP.JP2	Color not-map-projected image stored as 10-bits/pixel providing a dynamic range of 0-1023 losslessely compressed. Color data use the IR, RED, and BG bands displayed as red, green, blue respectively.
EXTRAS/RDR	.browse.jpg	Browse versions (reduced to 2048 pixels width for RED, 512 pixels for color) for the 6 JP2 Extra products
EXTRAS/RDR	.thumb.jpg	Thumbnail versions (reduced to 512 pixels width for RED, 128 pixels for color) for the 6 JP2 Extra products
EXTRAS/DTM	.ab.jpg, .br.jpg	Annotated and non-annotated browse products similar to the RDR browse images.
EXTRAS/DTM	.th.jpg	Thumbnail versions of DTM and ortho-rectified products.
EXTRAS/DTM	.ca.jpg, .cb.jpg	Annotated and non-annotated color relief maps at browse resolution
EXTRAS/DTM	.ct.jpg	Thumbnail sized color relief map
EXTRAS/DTM	.sa.jpg, .sb.jpg	Annotated and non-annotated browse-sized shaded relief maps
EXTRAS/DTM	.st.jpg	Thumbnail-sized shaded relief maps
EXTRAS/ANAGLYPH	.JP2, .browse.png, thumb.png.	Stereo anaglyphs produced with stereo pairs at 8-bits/pixel with a lossy compression factor of 2.66.

5 Archive Volume Formats

This section describes the format of the HiRISE EDR Product Archive Volumes. Data files that comprise the volume are formatted in accordance with Planetary Data System specifications.

5.1 Distribution Media Format

During active MRO mission operations the HiRISE Data Node maintains an on-line archive of HiRISE standard products in a volume organization described in this document. The archive is housed on a disk storage array using RAID technology. At the end of the project, the Data Node server hardware and disk storage arrays will be delivered to the PDS Imaging Node for inclusion in their on-line services.

5.2 File Formats

The following section describes file formats for the kinds of files contained on the HiRISE EDR Archive volume. For more information, see the PDS Data Preparation Workbook [1995].

5.2.1 Document File Format

Documents with the .TXT suffix exist in the Root, Index, Catalog, and Label subdirectories. They are ASCII files with embedded PDS labels. All document files contain a stream record data type as recommended by the PDS. All lines are terminated with a carriage-return (ASCII 13)/linefeed (ASCII 10) sequence and will not exceed a total of 80 ASCII characters in length (including the carriage-return/linefeed sequence

5.2.2 Tabular File Format

Tabular files (.TAB suffix) exist in the Index directory. Tabular files are ASCII character text files formatted for direct reading into many database management systems and spreadsheet applications. Commas separate all fields. Non-numeric text fields are enclosed in double quotation marks (", ASCII 34). Fields are padded with spaces (inside the quotation marks for text fields) to ensure that all fields of a column are the same length. Text fields are left justified and numeric fields are right justified. The START_BYTE and BYTES values listed in the PDS labels describing the tabular files do not include the commas between fields or the quotation marks surrounding text fields. The records are of fixed length and the last two bytes of each record contain the carriage-return/linefeed sequence. This allows a table to be treated as a fixed-length record file and as a text file with embedded line delimiters. See Appendix A for a description of the columns that make up the index files.

Detached PDS labels describe all tabular files in the HiRISE EDR archive volumes. The PDS detached labels have the same name as the tabular file but with the extension .LBL. For example, the INDEX.LAB file, located in the same directory, accompanies the INDEX.TAB file.

5.2.3 Catalog and Include File Format

Catalog (suffix .CAT) and label include files (suffix .FMT) exist in the root and CATALOG, and LABEL directories. They are formatted using ODL "keyword=value" statements. The files are in a stream record (variable line size) format. For catalog and include Files, the line length is limited to 72 characters the carriage-return and linefeed characters for a total length of 74 ASCII characters per line.

5.2.4 EDR Product File Format

The HiRISE EDR products have attached PDS labels. The primary object within an EDR file is the IMAGE object containing the observation image data acquired by a CCD channel. A complete description of the file format and organization can be found in the HiRISE EDR SIS [JPL D-32004, 2005].

5.2.5 RDR Product File Format

The HiRISE RDR products have detached PDS labels. The primary object within the RDR file is the IMAGE object containing the observation image that has been radiometrically corrected and geometrically resampled to a standard map projection. The image is organized according to the JPEG2000 JP2 file format standard.

APPENDIX A – EDR Index Table Fields

Index (EDRINDEX.TAB) and cumulative index (EDRCUMINDEX.TAB) tables contain useful meta-data describing the EDR products. Each row in the table is associated with a product with each column a meta-data parameter. The index table describes the most recent products added to the volume while the cumulative index table describes all products generated up to and including the current volume. The following table lists the column fields for the index files:

Field Name	Description
VOLUME_ID	Volume identification
FILE_NAME_SPECIFICATION	Path & file name of product
INSTRUMENT_HOST_ID	Always "MRO"
INSTRUMENT_ID	Always "HIRISE"
OBSERVATION_ID	Unique identification associated with an observation. Up to 28 EDR products can be associated with an observation.
PRODUCT_ID	Unique identification associated with the product
PRODUCT_VERSION_ID	Version number of this product
HICAL_VERSION	The ISIS build version, the date of the ISIS release, and the date the last updates made to the current ISIS hical program used to process the EDR in downstream pipelines. Example field format "3.1.20 | 2009-06-10 | 2008-11-17"
TARGET_NAME	The name of the target for this product (MARS, DEIMOS, PHOBOS, CAL, MOON, SKY)
ORBIT_NUMBER	MRO orbit number when observation was acquired
MISSION_PHASE_NAME	The mission phase at the time the image was acquired
RATIONALE_DESC	Science observation rationale
OBSERVATION_START_TIME	UTC time when HiRISE started the imaging command
OBSERVATION_START_COUNT	S/C clock count when HiRISE started the imaging command.
START_TIME	UTC time when first image line of target was acquired.
SPACECRAFT_CLOCK_START_COUNT	S/C clock count when first image line of target was acquired.
STOP_TIME	UTC time when last image line of target was acquired.
SPACECRAFT_CLOCK_STOP_COUNT	S/C clock count when last image line of target was acquired.
CCD_NAME	Sequential identification of CCD Processing and Memory Module associated with the image product.
CHANNEL_NUMBER	Channel number (0 or 1), specifies which half of the CCD was used for the EDR Product
FILTER_NAME	Color filter used for this observation, values are "RED", "BLUE-GREEN", "NEAR-IR"
SCAN_EXPOSURE_DURATION	The time in microseconds between the generation of successive unbinned lines. (i.e. the time from the start of the exposure of one unbinned line to the start of exposure of the next unbinned line.) The adjustment of this parameter is used to match image line acquisition to the boresight ground velocity. The value is the same for all CCDs for a given observation.

DELTA_LINE_TIME_COUNT	The commanded value given to the HiRISE instrument that identifies the unbinned. (SCAN_EXPOSURE_DURATION = 74 + DELTA_LINE_TIME_COUNT/16)
BINNING	Instrument Binning Mode (1,2,3,4,8,16)
TDI	Number of TDI stages (8,32,64,128)
TRIM_LINES	Number of unbinned lines at the start of an observation that are trimmed from the start of the image. This parameter is use to spatially align the first line of each CCD.
FOCUS_POSITION_COUNT	The DN value of the focus position sensor located on the focus mirror.
FELICS_COMPRESSION_FLAG	Identifies if FELICS data compression was applied to the imaging. (YES, NO)
STIMULATION_LAMP_FLAG	Identifies which stimulation lamps have been turned on or off. Stimulation lamps are used to support instrument radiometric assessment throughout the mission. There are three entries in this table, one for each stimulation lamp. The first stimulation lamp corresponds to the Red Light Emitting Diode (LED), the second for the blue/green LED, and the third for the Near Infrared LED. The stimulation lamps are always turned off for science observation data (ON, OFF)
LOOKUP_TABLE_TYPE	Type of lookup table that was applied to convert 14-bit pixels to 8-bit pixels. "N/A" if a lookup table was not used. "SQUARE ROOT" = square root table "LINEAR" = linear table "STORED" = stored LUT
LOOKUP_TABLE_MINIMUM	Minimum 14-bit pixel value mapped to 0 DN output pixel. This parameter used only for LINEAR LUT table mode. A -9998 value indicates the minimum value was not used.
LOOKUP_TABLE_MAXIMUM	Maximum 14-bit pixel value mapped to 254 DN 8-bit pixels. This parameter used only for the LINEAR LUT table mode. A -9998 value indicates the maximum value was not used.
LOOKUP_TABLE_MEDIAN	Median 14-bit pixel value mapped to 128 DN 8-bit pixels. This parameter used only for the SQUARE-ROOT LUT table mode. A -9998 value indicates the table median value was not used.
LOOKUP_TABLE_K_VALUE	"Pixel spread" value. This parameter used only for the SQUARE-ROOT LUT table mode. A -9998 value indicates a K value was not used.
LOOKUP_TABLE_NUMBER	Defines which stored LUT to use. This parameter used only for the STORED LUT table mode. A -9998 indicates a table number was not used.
ADC_CONVERSION_SETTINGS	Analog to digital waveform sampling timing settings, a vector of two values
FPA_POSITIVE_Y_TEMPERATURE	Temperature of the focal plane array on the +y side.
FPA_NEGATIVE_Y_TEMPERATURE	Temperature of the focal plane array on the –y side.
FPE_TEMPERATURE	Temperature of the focal plane electronics assembly
IEA_TEMPERATURE	Temperature of the Instrument Electronics Assembly
IEA_PWS_BOARD_TEMPERATURE	Temperature of the Instrument Electronics Power Supply
CPMM_PWS_BOARD_TEMPERATURE	Temperature of the CPMM Power Supply
Information about the image array	

IMAGE_LINES	Number of image lines
LINE_SAMPLES	Number of line samples
SAMPLE_BITS	The number of Bits per Pixel
Geometry information for the observation	
SCALED_PIXEL_WIDTH	The cross-scan image resolution in meters/pixel at the center of the Observation
EMISSION_ANGLE	The emission angle at the center of the observation
INCIDENCE_ANGLE	The incidence angle at the center of the observation
PHASE_ANGLE	The phase angle at the center of the observation
IMAGE_CENTER_LATITUDE	The planetocentric latitude of the center of the observation
IMAGE_CENTER_LONGITUDE	The east longitude of the center of the observation
MINIMUM_LATITUDE	The minimum planetocentric latitude of the observation
MAXIMUM_LATITUDE	The maximum planetocentric latitude of the observation
MINIMUM_LONGITUDE	The minimum longitude of the observation
MAXIMUM_ LONGITUDE	The maximum longitude of the observation
SPACECRAFT_ALTITUDE	This field represents the center altitude for the observation on the MRO ellipsoid reference.
TARGET_CENTER_DISTANCE	The distance from the spacecraft to the target body's center in kilometers
SLANT_DISTANCE	The distance from the spacecraft to the intersection of the view vector with the target body in kilometers
NORTH_AZIMUTH	The angle in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the north pole of the target body.
SUB_SOLAR_AZIMUTH	The angle in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the sub-solar point on the target body.
SUB_SOLAR_LATITUDE	The planetocentric latitude of the sub-solar point in degrees
SUB_SOLAR_LONGITUDE	The east longitude of the sub-solar point in degrees
SUB_SPACECRAFT_LATITUDE	The planetocentric latitude of the sub-spacecraft point in degrees
SUB_SPACECRAFT_LONGITUDE	The planetocentric longitude of the sub-spacecraft point in degrees
SOLAR_DISTANCE	The distance from the center of the image on the target body to the center of the Sun in kilometers.
SOLAR_LONGITUDE	The solar longitude ('L sub S') at the time of image acquisition in the degrees from the Martian vernal equinox.
LOCAL_TIME	Local Solar Time in decimal hours from midnight at the center of the observation.
STEREO_FLAG	Indicates whether this product was intended to be part of a stereo pair. (YES or NO)

APPENDIX B – RDR Index Table Fields

Index (RDRINDEX.TAB) and cumulative index (RDRCUMINDEX.TAB) tables, containing useful meta-data describing the products, accompany the RDR products. Each row in the table is associated with a product with each column a meta-data parameter. The index table describes the products contained on the volume while the cumulative index table describes all products generated up to and including the current volume. The following table lists the column fields for the index files.

Field Name	Description
VOLUME_ID	Volume identification.
FILE_NAME_SPECIFICATION	Path & file name of product.
INSTRUMENT_HOST_ID	Always "MRO".
INSTRUMENT_ID	Always "HIRISE".
OBSERVATION_ID	Unique identification associated with an observation. Up to 28 EDR products can be associated with an observation.
PRODUCT_ID	Unique identification associated with the product.
PRODUCT_VERSION_ID	Version number of this product.
TARGET_NAME	The name of the target for this product (MARS, DEIMOS, PHOBOS, CAL, MOON, SKY).
ORBIT_NUMBER	MRO orbit number when observation was acquired.
MISSION_PHASE_NAME	The mission phase at the time the image was acquired.
RATIONALE_DESC	Science observation rationale.
OBSERVATION_START_TIME	UTC time when HiRISE started the imaging command.
OBSERVATION_START_COUNT	S/C clock count when HiRISE started the imaging command.
START_TIME	UTC time when first image line of target was acquired.
SPACECRAFT_CLOCK_START_COUNT	S/C clock count when first image line of target was acquired.
STOP_TIME	UTC time when last image line of target was acquired.
SPACECRAFT_CLOCK_STOP_COUNT	S/C clock count when last image line of target was acquired.
Information about the image array	
IMAGE_LINES	Number of image lines.
LINE_SAMPLES	Number of line samples.
Geometry information for the observation	
EMISSION_ANGLE	The emission angle at the center of the observation.
INCIDENCE_ANGLE	The incidence angle at the center of the observation.
PHASE_ANGLE	The phase angle at the center of the observation
ALTITUDE	The areodetic altitude of the center of the observation in kilometers. This field represents the center altitude for the observation on the MRO ellipsoid reference.
TARGET_CENTER_DISTANCE	The distance from the spacecraft to the target body's center in kilometers.
SLANT_DISTANCE	The distance from the spacecraft to the intersection of the view vector with the target body in kilometers
NORTH_AZIMUTH	The angle in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the north pole of the

	target body. This angle is relative to the RDR products
SUB_SOLAR_AZIMUTH	The angel in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the sub-solar point on the target body. This angle is relative to the RDR products
SUB_SOLAR_LATITUDE	The planetocentric latitude of the sub-solar point in degrees.
SUB_SOLAR_LONGITUDE	The east longitude of the sub-solar point in degrees
SUB_SPACECRAFT_LATITUDE	The planetocentric latitude of the sub-spacecraft point in degrees.
SUB_SPACECRAFT_LONGITUDE	The planetocentric longitude of the sub-spacecraft point in degrees.
SOLAR_DISTANCE	The distance from the center of the image on the target body to the center of the Sun in kilometers.
SOLAR_LONGITUDE	The solar longitude ('L sub S') at the time of image acquisition in the degrees from the Martian vernal equinox.
LOCAL_TIME	Local Solar Time in decimal hours from midnight at the center of the observation.
STEREO_FLAG	Indicates whether this product was intended to be part of a stereo pair. (YES or NO).
CORNER_1_LATITUDE, CORNER_2_LATITUDE CORNER_3_LATITUDE CORNER_4_LATITUDE	The latitude values of the original four corners of the EDR image.
CORNER_1_LONGITUDE CORNER_2_LONGITUDE CORNER_2_LONGITUDE CORNER_2_LONGITUDE	The longitude values of the original four corners of the EDR image.
Map information about the map projection	
MINIMUM_LATITUDE	Minimum latitude of the projected image.
MAXIMUM_LATITUDE	Maximum latitude of the projected image.
MINIMUM_LONGITUDE	Minimum longitude of the projected image.
MAXIMUM_LONGITUDE	Maximum longitude of projected image.
MAP_SCALE	Map scale in meters/pixel.
MAP_RESOLUTION	Map resolution in pixels/degree.
MAP_PROJECTION_TYPE	EQUIRECTANGULAR or POLAR STEREOGRAPHIC.
PROJECTION_CENTER_LATITUDE	Center latitude of the map projection. This does not necessarily equal the center latitude of the image.
PROJECTION_CENTER_LONGITUDE	Center longitude of the map projection. This does not necessarily equal the center longitude of the image.
LINE_PROJECTION_OFFSET	The line_projection_offset element provides the line offset value of the map projection origin position from the line and sample 1,1 (line and sample 1,1 is considered the upper left corner of the digital array). Note: that the positive direction is to the right and down.
SAMPLE_PROJECTION_OFFSET	The sample_projection_offset element provides the sample offset value of the map projection origin position from line and sample 1,1 (line and sample 1,1 is considered the upper left corner of the digital array). Note: that the positive direction is to the right and down.

APPENDIX C – Table of Data Volume Estimates

The total data volumes for the two-year Primary Science Phase is estimated to be 3,688 gigabytes for the EDR data products and 17,959 gigabytes for RDR Products assuming JPEG2000 compression (48,256 gigabytes without JPEG2000 compression). These estimates are based on the assumptions shown in the Table C-1. HiRISE expects to return about 2,188 gigabytes of raw science data. Assuming an average FELICS compression ratio of 1.70 and a small overhead for storing metadata the resulting volume for the EDR products will be 3,688 gigabytes. The computation for RDR product volume is more complex involving several factors. The assumed average pixel scale for the raw products is 29 cm/pixel and an after-resampling scale of 25 cm/pixel resulting in an increase in volume of 1.35. Because RDR products are rotated after the map projection, we assume a 30% 0 DN (null pixel) increase in the products. There is an additional volume increase because binned imaging is converted to unbinned products for the full-resolution RDR products. The RDR products use 16-bit pixels thereby additionally increasing the RDR product volume over the 8-bit/pixel EDR products. The JPEG2000 compression ratio varies as a function of binning mode ranging from 3.28 (bin 4 imaging converted to bin 1 scale) to 1.42 (bin 1 imaging left at bin 1 scale). Table C2 shows the expected volumes for the different RDR products.

Table C1 - Assumptions	
Raw Downlink (GB):	2,188
Average input scale:	29.00
Output scale:	25.00
Scale Increase:	1.35
% Average 0 DN Fill:	30.00 %
FELICS Comp Ratio:	1.70

Table C2 - RDR & EDR Product Volumes (Gigabytes)		
Product Type	No JP2	With JP2
EDR Products:	3,688	N/A
RDR Full-Res Red:	28,226	10,810
RDR Binned Color:	2,647	1,386
RDR Full-Res Color:	17,383	5,763
Total RDR:	48,256	17,959
Total EDR & RDR:	51,945	21,648

APPENDIX D – Digital Terrain Models (DTMs)

Starting in 2009, Digital Terrain Models (DTMs) are added as part of the set of products released by the HiRISE team. The standard set of products include one DTM plus two orthoimages for each source image used to create the DTM, for a total of five standard products for each DTM. One of the orthoimages is at the full resolution of the source image, while the second orthoimage is scaled to the ground sample distance (pixel scale) of the DTM. In 2012, additional orthoimages from unrelated observations that overlap a DTM will be added to the DTM project directory as part of the set of products related to a given DTM. In addition, orthorectified color imagery will be included as well. These products will be included on a best effort basis. Not all DTM projects will have additional orthoimages included in them.

DTM and Orthoimage File Format

The HiRISE DTM products have attached and detached PDS labels. The primary object within a DTM file is the IMAGE object containing the derived digital terrain model created from at least two HiRISE observations. The four orthoimages are JPEG2000 compressed images with detached labels. A complete description of the file formats and organization can be found in the HiRISE RDR SIS, Section 5 and Appendices B and C.

Estimated Data Volume

The expected file size of a typical DTM is about 800 MB. The full resolution orthoimages should have a size of roughly 750 MB with JPEG2000 compression, while the DTM resolution orthoimages have an expected size of 50MB with JPEG2000 compression. There are currently 50 DTMs that have been produced for internal use by the HiRISE science team, the estimated data volume of these products once converted into standard PDS products is approximately 80 GB. Assuming a DTM production rate of 25 DTMs per year, the DTM data volume can be expected to increase by roughly 40 GB per year for the duration of the MRO mission.

DTM Directory Structure

The directory structure of the DTMs within the HiRISE PDS Volume is similar to that defined for the EDRs and RDRs defined in [4.4]. The top level directory is defined in essentially the same way, however, the Mission Phase Identification and Orbit Range directories are chosen based on the left observation id of the DTM, while the actual product directory is based on both the left and right observation ids used in the production of the DTM:

Directory Description	Directory Example
DTM Directory Trees	DTM/
Mission Phase Identification	PSP/ (Primary Science Phase)
Orbit Range Directory	ORB_000100_000199/ (Orbits 100 to 199)

Source Observation IDs	PSP_008669_1705_PSP_009025_1705/ (Source Observation IDs)
Data products	DTEEC_008669_1705_009025_1705_A01.IMG PSP_008669_1705_RED_C_01_ORTHO.LBL PSP_008669_1705_RED_C_01_ORTHO.JP2 PSP_008669_1705_RED_A_01_ORTHO.LBL PSP_008669_1705_RED_A_01_ORTHO.JP2 PSP_009025_1705_RED_C_01_ORTHO.LBL PSP_009025_1705_RED_C_01_ORTHO.JP2 PSP_009025_1705_RED_A_01_ORTHO.LBL PSP_009025_1705_RED_A_01_ORTHO.JP2 PSP_008669_1705_IRB_A_01_ORTHO.LBL PSP_008669_1705_IRB_A_01_ORTHO.JP2

Tabular Files

A DTMCUMINDEX.TAB file is placed in the INDEX directory of the PDS volume and contains entries for all DTM products released to the PDS to date. The DTMCUMINDEX.LBL file is also placed in the INDEX directory and is the PDS detached label describing the format of the DTMCUMINDEX.TAB. In addition, DTMINDEX.TAB and DTMINDEX.LBL files is also included to list DTMs recently released to the PDS and have the same format as the DTMCUMINDEX.TAB and DTMCUMINDEX.LBL files. The file format of these files is the same as that described in section [5.2.2].

The index table fields are listed below:

Field Name	Description
VOLUME_ID	Volume identification.
FILE_NAME_SPECIFICATION	Path & file name of product.
INSTRUMENT_HOST_ID	Always "MRO".
INSTRUMENT_ID	Always "HIRISE".
PRODUCT_ID	Unique identification associated with the product.
PRODUCT_VERSION_ID	Version number of this product.
TARGET_NAME	The name of the target for this product (MARS, DEIMOS, PHOBOS).
RATIONALE_DESC	Science observation rationale.
LEFT_OBSERVATION_ID	The HiRISE Observation ID of the left image used in the creation of the DTM, or the HiRISE Observation ID of the source observation if the product is an orthoimage.
RIGHT_OBSERVATION_ID	The HiRISE Observation ID of the right image used in the creation of the DTM, NA if the product is an orthoimage.
SOURCE_DTM_ID	For orthoimages, the DTM used to orthorectify the image. NA for DTM products
Information about the image array	
DATA_TYPE	The type of data the pixel values represent(ELEVATION,

	RADII, ORTHOIMAGE)
IMAGE_LINES	Number of image lines.
LINE_SAMPLES	Number of line samples.
Geometry information for the observation	
NORTH_AZIMUTH	The angle in degrees clockwise from the reference axis of the observation (a line from the center to the right edge of the observation) to the direction to the north pole of the target body. This angle is relative to the DTM products
CORNER_1_LATITUDE, CORNER_2_LATITUDE CORNER_3_LATITUDE CORNER_4_LATITUDE	The latitude values of the four corners of the DTM product.
CORNER_1_LONGITUDE CORNER_2_LONGITUDE CORNER_3_LONGITUDE CORNER_4_LONGITUDE	The longitude values of the four corners of the DTM product.
Map information about the map projection	
MINIMUM_LATITUDE	Minimum latitude of the projected image.
MAXIMUM_LATITUDE	Maximum latitude of the projected image.
MINIMUM_LONGITUDE	Minimum longitude of the projected image.
MAXIMUM_LONGITUDE	Maximum longitude of projected image.
MAP_SCALE	Map scale in meters/pixel.
MAP_RESOLUTION	Map resolution in pixels/degree.
MAP_PROJECTION_TYPE	EQUIRECTANGULAR or POLAR STEREOGRAPHIC.
PROJECTION_CENTER_LATITUDE	Center latitude of the map projection. This does not necessarily equal the center latitude of the image.
PROJECTION_CENTER_LONGITUDE	Center longitude of the map projection. This does not necessarily equal the center longitude of the image.
LINE_PROJECTION_OFFSET	The line_projection_offset element provides the line offset value of the map projection origin position from the line and sample 1,1 (line and sample 1,1 is considered the upper left corner of the digital array). Note: that the positive direction is to the right and down.
SAMPLE_PROJECTION_OFFSET	The sample_projection_offset element provides the sample offset value of the map projection origin position from line and sample 1,1 (line and sample 1,1 is considered the upper left corner of the digital array). Note: that the positive direction is to the right and down.