CASSINI PROJECT

IMAGING SCIENCE SUBSYSTEM (ISS)

ARCHIVE VOLUME SOFTWARE INTERFACE SPECIFICATION (SIS)

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SIGNATURE PAGE

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DOCUMENT CHANGE LOG

Date	Change
2-27-03	Various. Also updated version number (to 0.6). Affected portions: throughout Version 1 draft document.
11-1-03	Peer Design Review/Sample Volume comments incorporated modifications resulting from sample volume generation/review process. Updated Version number (to 1.0) and JPL Document number for signature distribution. Affected portions: throughout Version 1 draft document.
2-1-04	Signature SIS version post first sample volume review. Affected portions: throughout Version 1 document.
12-10-04	Archive Volume Peer Review release; Version updated to 2.0. Affected portions: Peer Review Volume Release; Incorporates second sample review comments; Initial calibration dataset release.
04-20-05	Implemented additional changes following Archive Peer Review. Major affected portions: directory contents, description of file formats, description of Calibration volume.
05-26-05	Updated Calibration volume numbering references and some minor edits concerning filenames.

TBD ITEMS

Section	Description
2.2 Calibration Volume - Data Directory	Complete calibration filename set
4.3 Data Product Sizes and Delivery Rates	Expected number of calibration dataset volumes; Total expected dataset size

ACRONYMS AND ABBREVIATIONS

ASCII	American Standard Code for Information Interchange
CICLOPS	Cassini Imaging Central Laboratory for Operations
CISSCAL	Cassini Imaging Science Subsystem Calibration Software
CODMAC	Committee On Data Management And Computation
DVD	Digital Video Disc
EDR	Experiment Data Record
GIF	Graphics Interchange Format
HTML	HyperText Markup Language
IDL	Interactive Data Language
IMG	Image
IO	Instrument Operations (Team)
ISO	International Standards Organization
ISS	Imaging Science Subsystem
JPEG	Joint Photographic Experts Group
JPL	Jet Propulsion Laboratory
MIPS	Multimission Image Processing Subsystem
NAC	Narrow Angle Camera
NASA	National Aeronautics and Space Administration
NSSDC	National Space Science Data Center
PDF	Adobe® Portable Document Format
PDS	Planetary Data System
SIS	Software Interface Specification
SOI	Saturn Orbit Insertion
TBD	To Be Determined
TDS	Telemetry Data System
WAC	Wide Angle Camera

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. A product label, which may be attached or detached, identifies, describes, and defines the structure of the data. An example of data is an image, a spectrum table, or a time series table. Together, a data file plus its accompanying label comprise a data product.

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

1. Introduction

1.1. Purpose and Scope

This Software Interface Specification (SIS) is intended to be used by those who wish to understand the contents and formats for the Cassini Project Imaging Science Subsystem (ISS) archive collection. Typically, these individuals would be planetary scientists, software engineers or data analysts using the ISS archive.

The specifications in this document apply to the ISS archive, which includes the ISS Experiment Data Record (EDR) data sets and ISS Calibration dataset, being generated on Digital Video Disk (DVD) volumes by the Cassini ISS team's Cassini Imaging Central Laboratory for Operations (ISS/CICLOPS).

1.2. Content Overview

This SIS describes the format, content and generation details of the ISS archive. Section 1 provides an introduction to the archive; Section 2 (Archive Volume Contents) describes the structure of the archive volumes and briefly describes the contents of each file; Section 3 (Archive Volume Format) describes the file formats types provided on these archive volumes; Section 4 (Archive Volume Generation) describes the volume assembly and generation process and the procedures for transferring the archive to the PDS, and Section 5 (Support Staff and Cognizant Persons) lists the individuals associated with the Cassini ISS archive volume generation.

1.3. Applicable Documents and Constraints

This Archive Volume SIS is intended to be consistent with the following documents:

1. Cassini Program Data Management Plan (PDMP), JPL D-12560, PD 699-061, Rev. B, April 1999.

2. Cassini / Huygens Program Archive Plan for Science Data, JPL D-159576, PD 699-068, Version 3, March 2004.

3. Cassini Imaging Science Subsystem (ISS) Tour VICAR Image Data File and Detached Planetary Data System (PDS) Label Software Interface Specification (SIS), Tour Version 1.0, JPL D-24724, DOIS-002, October 4, 2002, and the Cruise Version of this document (not numbered).

4. Planetary Data System Data Preparation Workbook, February 17, 1995, Version 3.1, JPL D-7669, Part 1.

5. Planetary Data System Standards Reference, August 1, 2003, Version 3.6, JPL D-7669, Part 2.

6. ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 15, 1988.

7. Universal Disk Format Specification, Revision 1.02, August 30, 1996, Optical Storage Technology Association (OSTA).

8. Planetary Data Dictionary Document, August 28, 2002, JPL D-7116, Rev E.

Produced by the Cassini ISS team, the reference below provides a comprehensive description of the team's science objectives, details on the ISS camera instrument, a discussion on the instrument calibration, and other valuable dataset information. This publication serves as excellent complement to the ISS archive volumes and should be referred to prior to any extensive usage of the datasets.

9. Cassini Imaging Science: Instrument Characteristics and Capabilities and Anticipated Science Investigations at Saturn, Space Science Review, submitted 2004.

1.4. Relationships with Other Documents

This SIS could be affected by any change in the design of the ISS standard data products produced by the Cassini Instrument Operations Team (Applicable Document #3). Additionally, this SIS could be impacted by higher-level requirement changes in any of the applicable documents (Numbered 1-8) above.

2. Archive Volume Contents

The ISS archive is comprised of a 2-volume scheme. The first volume is referred to as the 'DATA' volume and is considered to be mostly static. These volumes contain the raw (uncalibrated) ISS experiment data record image files (EDRs), attached and detached label files, helpful and required Planetary Data System (PDS) files and useful documentation related to the image datasets. Static refers to the fact that, once produced and validated, the contents of these volumes are less likely to be updated or modified. Exceptions are those cases where new information is made available or where images are reprocessed, due to previous errors, and are made available on later volumes. No calibration files are found on the DATA volumes, except in-flight calibration images found as sequenced in spacecraft clock (SCLK) order.

The second volume is referred to as the dynamic 'CALIBRATION' volume and contains all calibration-related files, except in-flight images as mentioned above. The contents of these volumes have the inherent property that they continue to evolve and improve as the knowledge of the mission parameters improves. As a result these volumes are updated periodically and released with the latest available calibration-related data and information.

The ISS team is not performing systematic processing with the imaging EDRs. However, to support future users of the ISS EDR datasets in performing their own calibration processing, the CALIBRATION volumes include the ISS calibration processing software and other related files to support calibration processing.

Included on the calibration volumes are the calibration data files, a set of sample calibrated images generated using the ISS team's calibration

processing software, the image files produced during ground calibration, calibration algorithms and documentation, along with the calibration processing software and related files.

The volume directory structure and contents differ slightly on the DATA and CALIBRATION volumes.

Briefly, the file contents of the 2-volume scheme are found in these directories/subdirectories:

DATA Volumes:

```
Root
  \Data
  \Index
  \Document
    \Report
  \Catalog
  \Label
```

CALIBRATION Volumes:

```
Root
  \Calib
  \Data
  \Document
    \Report
  \Catalog
  \Label
  \Extras
  \Index
```

GETTING STARTED

To begin using the ISS archive collection one should become familiar with the contents of the ROOT and DOCUMENT directories on both the DATA and CALIBRATION volumes. These directories include files that provide important detailed descriptive information on the ISS instrument, the archive files and formats, using the ISS team's calibration software, along with ISS team science objectives and rationale for image targeting. The Space Science Review publication released by the Imaging Team also provides important detail not found elsewhere in the archive and is a must read before embarking on analyzing the Cassini imaging data. You will find the most detailed information available on the instrument and the science objectives in this publication. This publication has not been approved for inclusion on these volumes. At the time of this writing it has been submitted, but not published (Section 1.3 Applicable Document #9).

The files contained in the ROOT and DOCUMENT directories are found in various formats. The .pdf files can be read using the latest version of Acrobat Reader. If you don't have a copy, downloads are available from the internet. Some documentation files have been provided in LaTeX format. These files have a .tex extension, and are simply ASCII files that can be viewed with any text editor. They are generally human-readable, with the exception of any tables they might contain, which will not appear properly typeset unless the LaTeX file is first compiled and converted to a different format. LaTeX is free, and is currently developed and maintained by the LaTeX3 Project. Information about the system and various conversion software can be found at their current website:
http://www.latex-project.org

Additionally, certain files are provided for use as human-readable files and some by home institution computer systems. For instance, the comprehensive INDEX.TAB file can be used to populate one's own image catalog for user search and query capabilities (eg., querying for specific target names or target list, lat/lon ranges, cameras (narrow or wide), filters or selecting based on phase, incidence and emission angles). More information on the INDEX.TAB file can be found in the indxinfo.txt file in the Index Directory.

For a brief tutorial on Cassini image calibration, see the theoretical_basis.ps document, as well as section 5 of the CISSCAL manual, which can be found in the document subdirectory on the Calibration archive volume.

Finally, the PDS Discipline Nodes are chartered to assist users with using the datasets they curate. Contact them for assistance if you find you have questions on getting started with using the Cassini image archive.

Further details on the contents of each directory and subdirectory are found in the following section 2 paragraphs below:

2.1. Root Directory Contents

Files in the Root Directory are found on both the DATA and CALIBRATION volumes. This directory includes an overview of the archive collection, a description of the data set volumes, including files for the PDS Catalog, and a list of errata or explanatory comments about the archive datasets. The contents of the ERRATA.TXT file may be updated to include important information regarding changes or modifications to the ISS datasets. Users should familiarize themselves with the contents of this file prior to accessing subsequent volumes in the archive.

The DATA and CALIBRATION volumes contain the following files in the ROOT Directory:

File Name	Source	File Contents
Aareadme.TXT	ISS/CICLOPS	Volume content and format information with attached PDS label
Errata.TXT	ISS/CICLOPS	A cumulative listing of comments and updates concerning all archive volumes published to date with attached PDS label
Voldesc.CAT	ISS/CICLOPS	A description of the contents of this volume in a PDS format readable by both humans and computers ISS/CICLOPS

2.2. Data Directory Contents and Naming

The Data Directory is on both the DATA and CALIBRATION volumes and contains files related to the image or calibration datasets. The EDR images are contained on the DATA volumes (including in-flight calibration images), while the sample calibrated images and the pre-flight ground calibration images are contained on the CALIBRATION volumes.

Both the DATA and CALIBRATION Volumes contain an introductory datainfo.txt file, in addition to the data files.

The DATA volumes contain the EDR image data files as they are generated by the Cassini Instrument Operations (IO) team [Applicable Document #3] and provided to the ISS/CICLOPS. The ISS/CICLOPS does not make any modifications to the image data files. Some modifications are made to the early mission phase PDS detached labels in order to comply with PDS standards. The EDRs

are stored within CICLOPS for use by the ISS team members and the archive volume assembly process.

Each EDR image data file is accompanied by its corresponding detached PDS label file. The files are organized on the archive volumes in subdirectories in SCLK order. Each subdirectory contains 128 image files & 128 image label files, for a maximum of 256 files per subdirectory (per PDS limitations). Given the fact that ISS EDR image size varies, the total number of images per volume varies. Approximately 3,000 to 5,000 images can be found on each DVD volume.

The image data files (.IMG files) are organized with both the narrow angle image and its corresponding wide-angle image in the same directory. The detached labels (.LBL files) are ordered the same as the image files.

The external filename of the image data file consists of a string that incorporates information about the instrument name, spacecraft clock and version number. The instrument name is required because the spacecraft clock is not unique for simultaneous exposures. The version number is required because the same image may be built multiple times due to multiple downlinks, or multiple Telemetry Data System (TDS) queries, etc. The following naming conventions are followed:

Image data filename convention:
<camera><SCLK time>_<version>.IMG

Where:
camera = 1-character instrument identifier (N=NAC, W=WAC)
SCLK time = 10-digit value of spacecraft clock at time of shutter close
version = version number of the file

Example:
W1832898283_4.IMG
(Wide Angle Camera image file taken at SCLK time 1832898283, version 4)

The corresponding detached label file follows the same naming convention above except with ".LBL" as the extension. Example: W1832898283_4.LBL

The Data Directory on the CALIBRATION volumes contains sample calibrated image data files and the ground calibration image data files. The first ten volumes contain the ground calibration images and the ISS Calibration Report, along with volume-specific directories and files. The tenth calibration volume contains the sample calibrated images, calibration processing software, documentation and other volume-specific directories and files. The PDS Imaging Node prepared the first ten volumes for inclusion in the ISS calibration dataset.

For the ground calibration files, the narrow-angle images (NAC) and the wide-angle (WAC) images have been placed in two separate subdirectories titled nacfm and wacfm.

Under each of these are sub-directories for each calibration test performed. Additionally, under these are further sub-directories identifying the time range of the image files included. The image file names are labeled by SCLK of the image event. A total of 26 NAC subdirectories exist and 21 WAC subdirectories exist. The following naming conventions are followed:

Ground calibration image data filename convention:
<SCLK time>.IMG

Where:
SCLK time = 6-digit value of spacecraft clock at time of shutter close

Example:
121811.IMG

The corresponding detached label file follows the same naming convention above except with ".LBL" as the extension. Example: 121811.LBL

The sample calibrated images have been processed using the Cassini Imaging Science Subsystem Calibration (CISSCAL) software included in this archive. These sample images represent what a future user of the archive should expect to achieve when performing their own calibration processing. There are ten sample calibrated images provided in the Data Directory: a wide- and narrow-angle image for each of the following target types: Saturn, Rings, Titan, Icy Satellite, and Star. The following naming conventions are followed:

Sample calibration image data filename convention:
<camera><SCLK time>_<version>_CAL.IMG

Where:
camera = 1-character instrument identifier (N=NAC, W=WAC)
SCLK time = 10-digit value of spacecraft clock at time of shutter close
version = version number of the file

Example:
W1369916235_1_CAL.IMG
(Wide Angle Camera image file taken at SCLK time 1369916235, version 1)

The corresponding detached label file follows the same naming convention above except with ".LBL" as the extension. Example: W1369916235_1_CAL.LBL

2.3. Index Directory Contents

The Index Directory is found on both the DATA and CALIBRATION volumes.

Files in the Index Directory on the DATA volumes are provided to help the user locate images, using a variety of keywords, found on the ISS archive volumes. [Appendix A in this document provides the complete list of keywords provided in the INDEX.TAB files contained on the DATA volumes.] Some of this keyword information comes directly from the detached PDS image EDR label; for example, keywords such as FILE_NAME, DATA_CONVERSION_TYPE, IMAGE_MID_TIME, FILTER_NAME, etc. The remaining keywords come from CICLOPS-delivered image data processing software which calculates many geometric quantities and target information (e.g., TARGET_DISTANCE, PIXEL_SCALE, PHASE_ANGLE, TWIST_ANGLE, etc.).

The index file consists of fixed-length records in ASCII character format. Each line is a record containing all the keywords for a particular image on the volume. Fields in a record are delimited by commas. Non-numeric fields

are enclosed in quotes and left-justified, whereas numeric fields are not enclosed by any characters and are right-justified. Multi-valued fields are enclosed in brackets and a comma separates each item in that field.

The accompanying label file, INDEX.LBL, details the keyword name, data type, start byte, number of bytes, and format so that keywords can be easily looked up and the file can be properly read into a database.

The DATA volumes contain the following files in the Index Directory:

File Name	Source	File Contents
Indxinfo.TXT	ISS/CICLOPS	A description of the contents of this directory with attached PDS label
Index.TAB	ISS/CICLOPS	A table listing related to data products and image geometry on this volume
Index.LBL	ISS/CICLOPS	A PDS detached label that describes INDEX.TAB

The CALIBRATION volumes containing the ground calibration image files also contain an Index Directory. Also, a comma-delimited ASCII file, this index file provides one record for each image file found on the DVD volume. These ground calibration image volumes also contain a CUMINDEX.TAB and .LBL file that provides of cumulative listing for the specific file contents for all volumes created.

The following files are contained in the Calibration volume Index Directory:

File Name	Source	File Contents
Indxinfo.TXT	PDS Imaging Node	A description of the contents of this directory, including notes on using the index files on these volumes
Index.TAB	PDS Imaging Node	A table listing related to data products and image geometry on this volume
Index.LBL	PDS Imaging Node	A PDS detached label that describes INDEX.TAB

2.4. Document Directory Contents

The Document Directory is found on both the DATA and CALIBRATION volumes. However, the contents differ between volumes. Both DOCUMENT Directories contain a Report(s) subdirectory, as well.

The Document Directory on the DATA volumes contains the SIS documents related to the EDR data products and the archive volumes. These documents generally describe the contents, formats and naming conventions for the data products.

DATA volumes contain following files in the Document Directories:

File Name	Source	File Contents

Docinfo.TXT	ISS/CICLOPS	A description of the contents of this directory
Archsis.TXT	ISS/CICLOPS	The Archive Volume SIS (this document) as text
Archsis.PDF	ISS/CICLOPS	The Archive Volume SIS as a PDF
Archsis.LBL	ISS/CICLOPS	A PDS detached label that describes both ARCHSIS.TXT and ARCHSIS.PDF
Edrsis.TXT	ISS/CICLOPS	The Experiment Data Record Tour Phase SIS as text
Edrsis.PDF	ISS/CICLOPS	The Experiment Data Record Tour Phase SIS as a PDF
Edrsis.LBL	ISS/CICLOPS	A PDS detached label that describes both EDRSIS.TXT and EDRSIS.PDF

A Report Subdirectory contains two different data outages and gap reports. As provided by IO, these reports detail the quality assessments and quantitative summaries for the image telemetry and subsequent image data product generation. They provide detail on the status of the downlink, noting any missing or incomplete data products and the reason for the discrepancy.

A preliminary version of these reports is generated for immediate analysis just after the first version of the products are generated, approximately 4-5 hours after the end of the downlink pass. Within 12 days, IO/MIPS reconciles the data through a process of identifying, explaining and tracking any missing data, where possible. Once this reconciliation process is complete, the final reports are generated, as well as the final EDR images.

NOTE: no product and quality reports were generated for images prior to SCLK 1431917000.

The quality report consists of one to three tables; depending on whether there are missing or incomplete products. The first table lists information about all the predicted products for the time range covered in the report. This information includes the following:

FILENAME: Filename of the product.
OBSERVATION_ID: Planned observation from which product originated.
SEQUENCE_NUMBER: The order the image appears in the observation.
COMMAND_FILE_NAME: Camera commanding file name for this product.
ORDER_NUMBER: The order the image appears in the IOI file.
SCETSTOP - The image stop time in UTC.

If there are partial/incomplete products, a second table is given describing those products. This table consists of the following:

FILENAME: Filename of the product.
DATA_POL: Images truncated due to data policing.
DSN_GAP: Images not received or partially received due to DSN issue.
TRUNC_RO: Images truncated due to a short readout cycle.
UNEXPLAINED: Incomplete images where the reason is unknown.

The following columns are used to explain incomplete images:

'PARTIAL' means that an image was received, but is incomplete due to the problem at the top of that column.
'NO' means that while the image is incomplete, it is not caused by the problem characterized by that column.
'NULL' means that either analysis is not complete for that column/image, or an explanation has been given but further reconciliation will not be performed.

If there are missing products, a third table is given describing those products. This table consists of the following:

SCLKSTOP: Spacecraft clock time of image stop time.
CAMERA: Camera taking this image, NAC or WAC.
TRIGGER: Trigger number issued to camera for this image.
TRIGGERTIME: Spacecraft clock of trigger execution time.
OFFSET: Offset of image time from trigger execution time.
PEF: Predicted Events File for this product.
IOI: Filename of camera commanding file (IOI) for this product..
REASON: Reason for missing product if known.

The Product Report contains statistical product generation information in paragraph form. The information includes the following:

Number of FINAL and COMPLETE products
Number of FINAL and INCOMPLETE products
Number of incomplete products due to TRUNCATED READOUT
Number of incomplete products due to DATA POLICING and DSN GAPS
Number of PRELIMINARY and COMPLETE products
Number of PRELIMINARY and INCOMPLETE products
Number of preliminary and incomplete products due to DATA POLICING and DSN GAPS
Number of MISSING products
Number of missing products due to DATA POLICING and due to DSN GAPS
Number of UNPREDICTED products

A Quality and a Product report are generated for the NAC and WAC each for a total of four reports covering the images on the volume. The Product and Quality reports are labeled as follows:

<VOLUME_ID>_<camera>_<report type>.rpt

Examples:
COISS_2001_nac_quality.rpt
COISS_2001_nac_product.rpt
COISS_2001_wac_quality.rpt
COISS_2001_wac_product.rpt

Found in the Document Directory on the CALIBRATION volumes is a Report subdirectory containing the ISS Calibration Report that provides detailed information regarding ISS calibration and the calibration algorithms used to produce the calibration data files. This is a 'must-read' document for any users wishing to thoroughly understand the ISS instrument calibration process and specifics.

Report Subdirectory files for the Calibration volumes include:

File Name	Source	File Contents
Isscalrpt.HTM	PDS Imaging Node	ISS Calibration Report as hypertext
Isscalrpt.LBL	PDS Imaging Node	A PDS detached label that describes the ISS Calibration Report PDS Imaging Node

The Document Directory on the remaining CALIBRATION volumes contains documentation related to using the ISS-produced calibration processing software (see EXTRAS section 2.8 for further discussion on the ISS calibration processing software). The following files are found in the CALIBRATION volumes beginning with Volume 10:

File Name	Source	File Contents
Cisscal_v3_manual.TEX	ISS/CICLOPS	ISS Calibration Software User Guide in LaTex
Cisscal_v3_manual.PDF	ISS/CICLOPS	(PDF version)
Cisscal_v3_manual.LBL	ISS/CICLOPS	(detached label)
In_flight_cal.TEX	ISS/CICLOPS	ISS In-Flight Calibration Guide in LaTex.
In_flight_cal.PDF	ISS/CICLOPS	(PDF version)
In_flight_cal.LBL	ISS/CICLOPS	(detached label)
Theoretical_basis.TEX	ISS/CICLOPS	ISS Calibration Theoretical Basis in LaTex
Theoretical_basis.PDF	ISS/CICLOPS	(PDF version)
Theoretical_basis.LBL	ISS/CICLOPS	(detached label)

NOTE: .pdf files are known to be problematic when using LINUX Acrobat Reader.

2.5. Catalog Directory Contents

The files in the Catalog Directory provide a top-level understanding of the mission, spacecraft, instruments, and data sets. This directory is found on both the DATA and CALIBRATION volumes. The Catalog Directory contains the following files:

File Name	Source	File Contents
Catinfo.TXT	ISS/CICLOPS	Description of the contents of this directory
Jupiterds.CAT	ISS/CICLOPS	Jupiter data set information for the PDS catalog, including science paper references (Jupiter data set volumes only)
Saturnds.CAT	ISS/CICLOPS	Saturn data set information for the PDS catalog, including science paper references (Saturn data set volumes only)
Calds.CAT	ISS/CICLOPS	Calibration data set information for the PDS catalog, including reference to the ISS Calibration Report (Calibration volume only)
Insthost.CAT	Cassini Engineer	Instrument host (i.e., spacecraft) information

		for the PDS catalog
Issna_inst.CAT	ISS/CICLOPS	Instrument description reference for Narrow Angle Camera for the PDS catalog
Isswa_inst.CAT	ISS/CICLOPS	Instrument description reference for Wide Angle Camera for the PDS catalog
Mission.CAT	Cassini Engineer	Mission information for the PDS catalog
Person.CAT	ISS/CICLOPS	Personnel information for the PDS catalog (Team and PDS personnel responsible for generating the archive)
Projref.CAT	Cassini Engineer	References mentioned in INSTHOST and MISSION .cat files
Issref.CAT	ISS/CICLOPS	References mentioned in other *.CAT files and/or pertinent to the ISS archive collection

2.6. Label Directory Contents

The Label Directory contains additional 'include' files that are not packaged with the data products or elsewhere in the volume directories. Include files are files referenced by a pointer in the EDR PDS label. They contain additional metadata or descriptive information regarding the datasets. The Label Directory is found on both the DATA and CALIBRATION volumes.

The following files can be found in the Label Directory:

File Name	Source	File Contents
Labinfo.TXT	ISS/CICLOPS	A description of the contents of this directory
Tlmtab.FMT	IO/MIPS	Binary Telemetry Header Format
Prefix.FMT	IO/MIPS	Binary Line Prefix Format
Prefix16.FMT	IO/MIPS	Binary Line Prefix Format
Prefix2.FMT	IO/MIPS	Binary Line Prefix Format
Prefix3.FMT	IO/MIPS	Binary Line Prefix Format
Vicar2.TXT	IO/MIPS	ASCII VICAR Label Format

2.7. CALIBRATION Directory Contents

The CALIB directory is found only on volume 11 of the CALIBRATION data set. This directory contains the calibration data files produced by the ISS team. These files range in format from text files (filter transmission functions, QE functions, etc.) to VICAR image files (blemish pixel maps, bright-dark pixel pair maps, flatfields, etc.), to Tagged Image File Format (TIFF) images and

assorted binary-format data files. The contents of the CALIB directory will be periodically updated throughout the life of the mission as knowledge of the instrument improves. As new files are provided, or old files are modified or deleted, explanations of changes will be added to the ERRATA.txt file.

The calibration data files are divided into subdirectories based on function. All .txt files contain an attached PDS label. VICAR-format calibration files are accompanied by detached PDS labels. The CALIB subdirectories and files, as of this writing, are as follows:

Subdirectory	Function Description (and files)
Antibloom	VICAR image files identifying anti-blooming pixel pairs for NAC and WAC. (abpair_mask.na, abpair_mask.wa)
Bitweight	Text files needed for performing bitweight correction. (wacg2m10.bwt, wacg3p25.bwt, nacg1p5.bwt, nacg3m10.bwt, wacg1m10.bwt, wacg2p25.bwt, wacg3p5.bwt, nacg2m10.bwt, nacg3p25.bwt, wacg1p25.bwt, wacg2p5.bwt)
Correction	Derived correction coefficients for NAC and WAC. (correctionfactors.1.old, correctionfactors_qecorr.1, wac_qe_correction.tab, nac_qe_correction.tab)
Darkcurrent	Dark current coefficient files and dark current VICAR image files derived from them. (Darkcurrent file names: TBD)
Efficiency	Various text files for calculating integrated system efficiencies. (ccdqe.dat, effic.db.old, solarflux.dat, effic.db, na_optics.dat, solarflux.dat.old, wa_optics.dat)
Efficiency/Systrans	Text files containing system transmissions for each filter combination, as well as a text file describing the column headings. (CAMERA-FW1-FW2.systrans, e.g. ISSNAIR2UV3.systrans)
Flatfield	VICAR image slope files, additional VICAR image dustring and mottle correction files, and a couple database text files. (Flatfield filenames: TBD)
Offset	VICAR image files for applying shutter offset, as well as explanatory text files. (nacshutter.txt, so.nacfm_plus25 so.wacfm_minus10, so.wacfm_plus5 so.nacfm_minus10, so.nacfm_plus5, so.wacfm_plus25, wacshutter.txt)

In addition, the CALIB directory will also feature a g-zipped TAR archive containing all the CALIB subdirectories and their contents listed above.

2.8. Extras Directory Contents

Found only on volume 11 of the CALIBRATION data set, this directory is reserved for elements that are beyond the scope of the PDS archive requirements and are not considered critical to understanding the dataset, but useful. The PDS places no restrictions on the contents and organization of this subdirectory other than conformance to ISO-9660/UDF standards.

The Extras Directory contains the source code for the Cassini Imaging Science Subsystem Calibration (CISSCAL) software. This software, developed by the Cassini Imaging team, allows the user to radiometrically and geometrically process the EDR-level images into higher level calibrated images. CISSCAL was developed using the Interactive Data Language (IDL); IDL Version 5.5 or later is required to compile and run the code. Both the CISSCAL software, and the calibration data files that are necessary to run it (found in the calib subdirectory of the 11th volume of the Calibration data set) will be updated throughout the mission, and the updates provided on subsequent Calibration volumes as they become available.

Note that, in the case that your computer system reads the ISO file system (instead of the UDF file system) of the calibration DVD volume, filenames may display as uppercase instead of the default lowercase. This will make the CISSCAL software unusable, as IDL requires lowercase filenames. To get around this issue, the entire contents of the CISSCAL subdirectory have also been provided as a g-zipped TAR archive. These archives can be decompressed using the standard 'tar' and 'gunzip' commands included with most LINUX and UNIX distributions, or with a program like WinZip for users running Windows.

The following files are contained in the Extras Directory:

File Name	Source	File Contents
Extrinfo.TXT	ISS/CICLOPS	A description of the contents of this directory with attached PDS label
cisscal.tar.gz	ISS/CICLOPS	Entire contents of CISSCAL subdirectory in a g-zipped TAR archive
cassimg__bitweightcorrect.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__brightdark.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__correctionfactors.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__debias.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__define.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__dividebyareapixel.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__dividebyefficiency.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__dividebyexpot.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__dividebyflats.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__dntoelectrons.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__dustringcorrect.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__geomcorr.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__linearise.pro	ISS/CICLOPS	CISSCAL source code written in IDL

cassimg__radiomcalib.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__readlabels.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__readvic.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__subtractdark.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__twelvebit.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__twohz.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cassimg__writevic.pro	ISS/CICLOPS	CISSCAL source code written in IDL
casslabels__define.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_common.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_delut.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_gui.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_log.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_readlist.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_readspec.pro	ISS/CICLOPS	CISSCAL source code written in IDL
linetime.pro	ISS/CICLOPS	CISSCAL source code written in IDL
cisscal_v3_manual.pdf	ISS/CICLOPS	CISSCAL manual in PDF format
readme.txt	ISS/CICLOPS	CISSCAL readme file in TXT format

3. Archive Volume Format

This section describes the format of the ISS archive volumes as assembled and written on archive media by ISS/CICLOPS and then transferred to the PDS Imaging Node. Data that comprise the archive are formatted in accordance with Planetary Data System specifications [Applicable Documents 4 and 5]. It should be noted that every attempt has been made to stay consistent in case sensitivity when naming directories, subdirectories and file names. Directory file names are found in uppercase, however, mixed cases are found in file names resulting from software-specific dependences.

3.1. File Formats

This section describes file formats for the types of files contained on the ISS archive volumes.

3.1.1. Document File Format

Document files with the .TXT suffix exist in the ROOT, INDEX, DOCUMNET, CALIB, CATALOG, LABEL, and SOFTWARE directories. They are flat ASCII text files, which may have embedded PDS labels. PDS recommends plain text files have line length restricted to 78 characters or fewer, to accommodate printing and display on standard devices. Each line is terminated by the two-character carriage-return/linefeed sequence, <CR><LF> (ASCII decimal character codes 13 and 10, respectively), for a maximum total line length of 80 characters.

Document .TXT files may be accompanied by corresponding document files with .HTM, .TEX or .PDF suffixes in the Root and Document directories. There may be documents that contain formatting and figures that cannot be rendered as ASCII text. Therefore each document may be available 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. Files may also be formatted in LaTeX, a TeX macro package. LaTeX is a high-quality typesetting system, with features designed for the production of technical and scientific documentation.

3.1.2. Tabular File Format

Tabular files (.TAB suffix) exist in the Index Directory. Tabular files are ASCII files formatted for direct reading into many database management systems on various computers. All fields are separated by commas, and character fields are enclosed in double quotation marks ("). (Character fields are padded with spaces to keep quotation marks in the same columns of successive records.) Character fields are left justified, and numeric fields are right justified. The "start byte" and "bytes" values listed in the labels do not include the commas between fields or the quotation marks surrounding character fields. The records are of fixed length, and the last two bytes of each record contain the ASCII carriage-return/line feed character sequence, <CR><LF>. 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 detached PDS labels. The PDS label file has the same name as the data file it describes, with the extension .LBL; for example, the file INDEX.TAB is accompanied by the detached label file INDEX.LBL in the same directory.

3.1.3. PDS Label Format

All image data files in the archive have detached PDS labels. These PDS labels are object-oriented. 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 that the object starts at the given location. For an object in the

same file as the label, the location is an integer representing the starting record number of the object (the first record in the file is record 1). For an object located outside the label file, the location denotes the name of the file containing the object, along with the starting record or byte number. For example:

```
^IMAGE = ("N1294562651_1.IMG",3)
```

indicates that the IMAGE object begins at record 3 of the file N1294562651_1.IMG, in the same directory as the detached label file.

Below is a list of the possible formats that use the ^object keyword.

```
^object = n
^object = n <BYTES>
^object = "filename.ext"
^object = ("filename.ext",n)
^object = ("filename.ext",n <BYTES>)
```

where:

n	starting record or byte number of the object, counting from beginning of the file (record 1, byte 1); default is record number.
<BYTES>	indicates that number given is in units of bytes.
filename	upper-case file name.
ext	upper-case file extension.

A combination of detached and attached PDS labels are found throughout the archive volumes.

For further explanation of the PDS labels for each type of data product, see the Data Product SIS, edrsis.txt, in the Document Directory [Applicable Document #3].

3.1.4. Software File Format

The Cassini ISS calibration software (CISSCAL) has been developed by the Cassini Imaging team using IDL software.

No compiled executables are supplied. Source code is written in IDL such that Version 5.5 or later is required to run CISSCAL. The source code is machine independent and will thus run on any machine for which an appropriate version of IDL is available.

3.1.5. Catalog File Format

Catalog files (suffix .CAT) exist in the Catalog and Root directories. They are text files formatted in an object-oriented structure consisting of sets of 'keyword=value' declarations. Each line must be terminated by the two-character carriage-return/linefeed sequence, <CR><LF> (ASCII decimal character codes 13 and 10, respectively). PDS recommends catalog files have line length restricted to 72 characters or fewer, including the <CR><LF>, to accommodate PDS data ingestion requirements set forth by their internal catalogs and databases.

3.1.6. Science Data File Formats

The image processing software used to create the EDR image data files is called VICAR (Video Image Communication And Retrieval). VICAR is an entire system of software, formats, and procedures for image storage and processing and was developed and is maintained by JPL's MIPS. A full explanation of VICAR, its standards, its software and reference information can be found at website: http://www-mipl.jpl.nasa.gov/vicar/.

Each image data file has a filename ending with the ".IMG" suffix, and contains several fixed-length data records. These are: the ASCII VICAR Label (or simply "image header"), the Binary Label Header (or "Binary Telemetry Header"), and the Image Line Records, which are comprised of the Binary Line Prefix plus the actual pixel data. All of these are briefly described in the paragraphs below. For more complete information about the format and content of the image data products, see the Cassini ISS Software Interface Specification (SIS) documents found in the Document Directory of these volumes. These image files are reconstructed from the best available telemetry data and line-filled where necessary to produce the most complete image records possible.

The ASCII VICAR Label is included to facilitate image processing and allow easy validation of products using existing VICAR software. These labels consist of a set of ASCII "keyword=value" pairs describing the important characteristics of the image. The VICAR Label is designed to be human-readable because it often is used to annotate products derived from the image, such as prints or plots. In addition, it is maintained through the various processed versions of the image to allow traceability. Also, the label items can be extracted by software modules in order to guide automated processing procedures. The VICAR Label contains required System items (such as image size information), History items (recording processing history for the file), and optional Property items (such as items describing gain states, etc.).

The Binary Label Header (also known as the Binary Telemetry Header) contains machine-readable information about the image as a whole and is populated directly from the telemetry available for the product. Many of these items are in the VICAR Label as well, but non-VICAR sites may ignore the VICAR Label and use the Binary Telemetry Header to construct their own human-readable label. This record contains 60 bytes of information and is padded with zeros to the image record length. Items in this header are copied directly from the Extended ISS Science header returned in telemetry.

There is one Line Record for each image line, comprised of a 24-byte Binary Prefix followed by the 8- or 16-bit pixel data for that line. The Prefix contains information about the image line derived from telemetry. This information may vary from line to line, so is not appropriate to include in the Binary Telemetry Header. Note that for lossy compressed images, the data are not associated with lines, so there is no way to associate a given record with a line number. In this case, the Binary Line Prefix contains information extracted from the lossy records received.

4. Archive Volume Generation

4.1. Data Transfer Methods and Archive Volume Creation

Once an image is transmitted back to the Deep Space Network (DSN) and sent to the Telemetry Data System (TDS) JPL, it is reformatted by the IO/MIPS from a series of data packets back into a two dimensional image. In the reformatting process, the upper 1s in 16-bit unconverted, uncompressed data

are converted to 0s. Images that had been compressed, either losslessly or lossily, are automatically decompressed in the reconstitution process before being sent to ISS/CICLOPS where they are ingested into the Archive Database, from which this archive is built.

Preliminary (quick-look) versions of images are generated immediately and distributed for instrument performance analysis. IO then performs reconciliation, if there is missing data in the preliminary versions, in an attempt to make more complete products. Once reconciliation is performed (within two weeks from downlink time), a final version of the image is produced. Only final image versions are archived on these volumes.

If images have been converted down to 8-bits by the LUT, a reverse LUT is applied to them to restore them to their approximate full 12-bit values. (This is an option in the Cassini ISS Calibration (CISSCAL) software that is supplied in this archive.) There is no way to restore an image previously converted to the 8 lowest bits back to 12-bits unless one is confident of smooth gradients throughout the image. Further modifications can take place to clean them and convert them to physical units in the process of calibration.

Images are put on the archive volumes exactly as they are received from IO/MIPS. The only processing that is done is to auto-navigate the images and assemble the archive volumes. Automated software is used to generate the archive disks by selecting the appropriate range of images, gathering the static documentation, and generating the INDEX.TAB file from the auto-navigation results. Auto-navigation software (Autonav) was developed to perform the large task of image pointing refinement (c-smithing) for the hundreds of thousands of images taken by the ISS cameras. Autonav uses an array of object detection algorithms in conjunction with the most recent spacecraft position and orientation kernels to navigate the images. The output of Autonav for any particular navigated image is a single, discrete c-kernel for the image mid time. These c-smithed c-kernels are packaged up in larger time periods and delivered to the Cassini project's database and JPL's NAIF node. Though the success rate of Autonav is high, it is not 100% successful. The code was structured to minimize the number of false-positive navigations. So, in many cases, some images that seem navigable, will fail to meet the success thresholds built into Autonav. In order to validate Autonav results, a tool was developed to allow a final reviewer to quickly visually scan through Autonav results and look for false-positive navigations and approve those that look correctly navigated. Also, a c-kernel compare tool is used to compare the auto-navigated c-kernels against the ACS reconstructed c-kernels and flag large discrepancies between the two for further investigation. However, all of these thresholds and verification steps do not absolutely prevent Autonav from producing false results, so future users are warned to exercise caution with respect to these results. Autonav results, when accurate, will greatly improve the accuracy of the geometric quantities calculated for the INDEX.TAB file.

One DVD copy is sent to the PDS Imaging Node, at JPL and one is retained within CICLOPS.

The PDS Imaging Node creates two additional DVD copies for dissemination, validation and retention by the PDS Central Node and the National Space Science Data Center (NSSDC). Archive volume submissions are recorded and tracked through the use of the Cassini Archive Tracking System (CATS).

4.2. Validation Methods

Validation is the method by which data sets and volumes are verified to be in accordance with the standards identified in the Planetary Data System Standards Reference document [Applicable Document #5]. Validation is considered to have 2 aspects: 1) quality scientific usability and 2) technical compliance to PDS standards.

In order to ensure PDS-compliant products, the archive volumes are validated by a collaborative effort between the ISS/CICLOPS team, the Imaging and Central Nodes of the PDS, and non-Cassini imaging scientists. The ISS/CICLOPS team is responsible for producing PDS-compliant archive volumes, while the PDS personnel are responsible for ensuring that the archive volume(s) meet PDS standards. Validation is performed on each volume by PDS using their validation tools. ISS/CICLOPS-developed operational volume verification tools and procedures are also utilized prior to delivery to PDS Imaging Node. Together these verification checks ensure PDS-compliant archive volumes.

Scientific usability is assessed through the ISS science team's normal and routine use of the mission imaging data sets in their science analysis. Additionally imaging scientists not associated with the Cassini project participate in the archive volume peer review process where they verify the "science" content of the data set, the completeness of the documentation, and the scientific validity (i.e., the integrity and usability) of the data.

A peer review of sample volumes is conducted by PDS. These reviews serve to validate the volume for proper structure, format, completeness, and science usability. Any deficiencies in the reviewed archive volume found are corrected and resolved. When all correctable errors have been resolved, production of the archive volumes proceeds and further validation is performed on a spot check basis by the both the PDS and the ISS/CICLOPS team. Non-correctable errors (eg., an error in the downlink data file) is described in the evolving errata file, ERRATA.TXT, included on each archive volume in the Root Directory

4.3. Data Product Sizes and Delivery Rates

All ISS standard product archive volumes will be delivered to the PDS Imaging Node consistent with the quarterly archive delivery schedule presented in the Cassini Huygens Program Archive Plan for Science Data (PD 699-069; JPL D-15976).

Table 2 below summarizes expected sizes and production rates for the ISS Standard Products.

Table 2 - Standard Product Sizes and Delivery Rates

Data Set ID	Product Size*	Production Rate	Expected #products	Expected data vol
CO-CAL-ISSNA/ISSWA-2-CAL-V1.0	Varies	Quarterly rls	TBD	TBD
CO-E/V/J-ISSNA/ISSWA-2-EDR-V1.0	1.5 Mb	140 images/day	32,000	32 Gb
CO-S-ISSNA/ISSWA-2-EDR-V1.0	1.5 Mb	300 images/day	440,000	660 Gb

*average image size is used for calculation

For more information about the Cassini data products release schedule, see Appendix B of the Cassini/Huygens Program Archive Plan for Science Data [Applicable Document 2].

4.4. Archive Media Characteristics

All ISS standard product archive volumes have a Digital Versatile Disk (DVD-ROM or DVD-R) format that is produced in UDF-Bridge format (Universal Disc Format) with ISO 9660 level 2.

Backup and Duplicates

Following transfer of the assembled physical archive DVD volumes from the ISS/CICLOPS to the PDS Imaging Node, the virtual volumes are stored on magnetic media by the ISS/CICLOPS at least through the generation of the archive media.

4.5. Labeling and Identification

The Cassini ISS identification and labeling schemes are divided according to Jupiter (cruise), Saturn (tour) and Calibration.

Naming conventions and labeling schemes are:

- DATA_SET_ID:
  - CO_E/V/J_ISSNA/ISSWA_2_EDR_V1.0
  - CO_S_ISSNA/ISSWA_2_EDR_V1.0
  - CO_CAL_ISSNA/ISSWA_2_EDR_V1.0
- DATA_SET_NAME:
  - CASSINI ORBITER EARTH/VENUS/JUPITER ISSNA/ISSWA 2 EDR V1.0
  - CASSINI ORBITER SATURN ISSNA/ISSWA 2 EDR VERSION 1.0
  - CASSINI ORBITER CALIBRATION ISSNA/ISSWA 2 EDR VERSION 1.0
- STANDARD_DATA_PRODUCT_ID:
  - ISS_E/V/JEDR
  - ISS_SEDR
  - ISS_CAL
- VOLUME_SERIES_NAME:
  - MISSION TO SATURN
- VOLUME_ID:
  - COISS_xxxx
    - (where first x = 1 for Jupiter, 2 for Saturn, 0 for calibration)
    - (where next xxx = sequential numbering of volumes starting with 001)
- VOLUME_NAME:
  - CASSINI ISS EARTH/VENUS/JUPITER EDR SCLK 1294561143 to SCLK 1451040707
  - CASSINI ISS SATURN EDR SCLK 1454725799 to SCLKXXXXX
  - CASSINI ISS CALIBRATION FILES
- VOLUME_SET_ID:
  - USA_NASA_PDS_COISS_xxxx
    - (where first x = 1 for Jupiter, 2 for Saturn, 0 for calibration)

(where next xxx = sequential numbering of volumes)

VOLUME_SET_NAME:
CASSINI ISS EXPERIMENT DATA RECORDS AND CALIBRATION FILES

VOLUME_VERSION_ID:
VERSION x
(where x represents each volume version numbered sequentially starting with the original volume as 1)

VOLUMES:
XXX
(where xxx represents the total number of volumes in the Cassini ISS Experiment Data Records and Calibration Files volume set)

The following table provides examples of this scheme:

Mission Phase	Volume_Set_ID	Volume_ID	Volume_Name
All	USA_NASA_PDS_COISS_0nnn	COISS_0nnn	Cassini ISS Calibration Files
Jupiter	USA_NASA_PDS_COISS_1nnn	COISS_1nnn	Cassini ISS Earth/Venus/Jupiter Experiment Data Record
Saturn	USA_NASA_PDS_COISS_2nnn	COISS_2nnn	Cassini ISS Saturn Experiment Data Record

5. Support Staff and Cognizant Persons

Carolyn Porco	ISS Team Lead
Leslie Pieri	ISS Archive Lead
Josh Riley	ISS/CICLOPS Ops Team Deputy/Downlink Engineer
Ben Knowles	ISS/CICLOPS Calibration & Archiving Engineer
Charles Avis	ISS Instrument Operations Task Lead
Diane Conner	Cassini Project Archive Coordinator
Steve Adams	PDS Central Node Cassini Data Engineer
John Diehl	PDS Imaging Node Representative

6. Appendices

Appendix A provides a table listing all keywords found in the ISS archive volume INDEX.TAB files. Included in the table, in addition to the keyword, is the source of the value and the valid values as determined within the ISS archive generation process. Additionally, included are the PDS valid values as defined by PDS. Discrepancies may exist. In those cases, it should be noted that the PDS label, as generated by IO/MIPS, is not modified in the ISS archive generation process and, hence, these keywords are identified exactly as they are generated for the detached PDS label accompanying the EDR.

As a guideline, all valid values identified by "inf" and "-inf" can be replaced with corresponding max and min values allowed for corresponding data type. For example, if the DATA TYPE is "real", you can replace all "inf" values with "1e+32" and all "-inf" with "-1e32".

A bracket,"[" or "]", means that value is inclusive. A parenthesis, "(" or ")" means that value is excluded. For example, [-90, 90] is the equivalent of value >= -90 AND value <= -90. (-90, 90) is the equivalent of value > -90 AND value < -90.

APPENDIX A - ISS KEYWORDS TABLE

ARCHIVE KEYWORD	SOURCE	DESCRIPTION	DATA TYPE	UNITS	ISS VALID VALUES	PDS VALID VALUES
ANTIBLOOMING_STATE_FLAG	Label	Indicator of whether antiblooming was used for this image.	string		“ON”, "OFF"	“ON”, "OFF"
BIAS_STRIP_MEAN	Label	Mean value of the overclocked pixel values from all lines except the first and last. Not affected by light or dark current. Before C32, this uses one overclocked pixel value per line - during C32 (beginning at SCLK_START_COUNT_SECONDS = 1401927444) this uses six overclocked pixel values per line.	real		0.0 to UNK	0.0 to UNK
CALIBRATION_LAMP_STATE_FLAG	Label	Indicates whether calibration lamp was used for this image. (ISSNA has none, so it's always "N/A")	real		“ON”, "OFF"	“ON”, "OFF"
CENTER_LATITUDE	SPICE	Planetocentric latitude at aimpoint on target (or Ring_Aimpoint_Latitude if target is a ring).	real	deg	-90.0 to 90.0	-90.0 to 90.0
CENTER_LONGITUDE	SPICE	West longitude at aimpoint on target (or Ring_Aimpoint_Longitude if target is a ring).	real	deg	[0.,360.]	0.0 to 360.0

CENTRAL_BODY_DISTANCE	SPICE	Distance from spacecraft to center of primary body.	real	km	[0.,inf]	0.0 to UNK
COMMAND_FILE_NAME	Label	The name of the IOI file containing the observation description for this product - sent from the ISS Team Lead to IO.	string		CHAR(20)	CHAR(20)
COMMAND_SEQUENCE_NUMBER	Label	Numeric identifier for a sequence of commands sent to the spacecraft. Also known as "trigger number". (Comes from the TRIGGER_NUMBER keyword in the IOI file.) Note that 1-12 are reserved for IO use and 8 is reserved for OpNav.	integer		[1,65535]	1 to 65535
COORDINATE_SYSTEM_NAME	SPICE	The full name of the coordinate system to which the state vectors are referenced.	string		CHAR(30)	CHAR(30)
DARK_STRIP_MEAN	Label	Mean value of the extended pixel values from all lines except the first and last. Not affected by light, but by dark current and Dark Band problem.	real		[0.,inf]	0.0 to UNK
DATA_CONVERSION_TYPE	Label	The method of conversion used to convert image from 12 to 8 bits selected for this image. "12BIT" = no conversion "TABLE" = conversion by look-up table "8LSB" = keep only the 8 least significant bits	string		“12BIT”, "TABLE", "8LSB"	“12BIT”, "TABLE", "8LSB"
DATA_SET_ID	Label	PDS/Cassini-supplied name for this data set.	string		“CO-E/V/J-ISSNA/ISSWA-2-EDR-V1.0” "CO-S-ISSNA/ISSWA-2-EDR-V1.0" "CO-CAL-ISSNA/ISSWA-2-EDR-V1.0"	“CO-E/V/J-ISSNA/ISSWA-2-EDR-V1.0” "CO-S-ISSNA/ISSWA-2-EDR-V1.0" "CO-CAL-ISSNA/ISSWA-2-EDR-V1.0"
DATA_SET_NAME	Archive Gen	The name given to the Cassini ISS EDR image and CAL data sets.	string		“CASSINI ORBITER EARTH/VENUS/JUPITER ISSNA/ISSWA 2 EDR V 1.0" "CASSINI ORBITER SATURN ISSNA/ISSWA 2 EDR V 1.0" "CASSINI ORBITER CALIBRATION ISSNA/ISSWA 2 EDR V 1.0"	“CASSINI ORBITER EARTH/VENUS/JUPITER ISSNA/ISSWA 2 EDR V 1.0" "CASSINI ORBITER SATURN ISSNA/ISSWA 2 EDR V 1.0" "CASSINI ORBITER CALIBRATION ISSNA/ISSWA 2 EDR V 1.0"
DECLINATION	SPICE	Declination of camera optic axis.	real	deg	[-90.,90.]	-90.0 to 90.0
DELAYED_READOUT_FLAG	Label	Indicator of whether the image had to remain stored on the CCD while the other camera was performing a readout.	string		“YES”, "NO"	“YES”, "NO"

DESCRIPTION	Label	Descriptive comment up to 255 characters. Populated by IO telemetry processing, validation and reconciliation software to describe known limitations of this product.	string		CHAR(75)	CHAR(75)
DETECTOR_TEMPERATURE	Label	Temperature of CCD in Celsius degrees. (Note: Celsius does not conform to PDS standards of Kelvin.) PDS Imaging Node will convert Celsius to Kelvin for ingestion into the PDS.	real	deg C	-999.0, [-273.15,inf]	-999.0 to UNK <degC> Value range outside of current PDS keyword definition for DETECTOR_TEMPERATURE. Reason: Default unit is degree Kelvin.
EARTH_RECEIVED_START_TIME	Label	Earth Received time of the earliest record containing valid data for this image (UTC). ASCII CCSDS format: yyy-dddThh:mm:ss.fffZ	date		Ex: 1996-158T05:53:34.000Z	YYYY-MM-DDThh:mm:ss[.fff]
EARTH_RECEIVED_STOP_TIME	Label	Earth Received time of the latest record containing valid data for this image (UTC). ASCII CCSDS format: yyy-dddThh:mm:ss.fffZ	date		Ex: 1996-158T05:53:34.000Z	YYYY-MM-DDThh:mm:ss[.fff]
ELECTRONICS_BIAS	Label	Commanded electronics bias to ensure that all DN values are greater than zero. (Comes from the VIDEO_OFFSET keyword in the IOI file.)	integer		[0,255]	0 to 255
EMISSION_ANGLE	SPICE	Emission angle at aimpoint on target.	real	deg	[0.,90.]	0.0 to 180.0
EXPECTED_MAXIMUM	Label	2-valued array. First, represents the ratio of the expected maximum DN in the image to the VALID_MAXIMUM (full well DN). Second, represents the ratio of the expected maximum DN in the image to the VALID_MAXIMUM (maxDN).	real real		(0.,inf) (0.,inf]	(0.0 to UNK, 0.0 to UNK)
EXPECTED_PACKETS	Label	This keyword provides the total number of packets expected to be stored on the SSR for this image. To convert to volume in bits, multiply this value by 7616 bits/packet. (Comes from the EXPECTED_PACKETS keyword in the IOI file.)	integer		[1,2277]	0.0 to UNK
EXPOSURE_DURATION	Label	Exposure duration for the image in milliseconds. 63 distinct values from 0 to 1200000. (See table in AppendixA.) -999.0 if extended header is unavailable	real	milliseconds	-999.0, [0,1200000]	0.0 to UNK
FILE_SPECIFICATION_NAME	Archive Gen	Path name locating images in Data Directory on data set volumes	string			CHAR(255)

FILTER_NAME	Label	2-valued array. First, filters used on filter wheel 1. Second, filters used on filter wheel 2.	string string		"CL1","RED","BL1","UV 2","UV1","IRP0","P120", "P60","P0","HAL","IR4","IR2","CL1","IR3","IR4","IR5","CB3","MT3","CB2", "MT2","IR2" "CL2","GRN","UV3","BL 2","MT2","CB2","MT3","CB3","MT1","CB1","IR3",","IR1","CL2","RED","GRN","BL1","VIO","HAL","IRP90","IRP0","IR1"	(CHAR(20),CHAR(20))
FILTER_TEMPERATURE	Label	Temperature of the filter wheels.	real	deg C	-999.0, [-273.15,inf]	-999.0 to UNK
FLIGHT_SOFTWARE_VERSION_ID	Label	Indicates version of instrument flight software used to acquire image.	string		CHAR(20)	CHAR(20)
GAIN_MODE_ID	Label	The electronics gain setting selected for this image, given in units of electrons per DN. (This is an approximate value so both cameras can use the same set of values.)	string		“12 ELECTRONS PER DN”, "29 ELECTRONS PER DN", "95 ELECTRONS PER DN", "215 ELECTRONS PER DN"	“12 ELECTRONS PER DN”, "29 ELECTRONS PER DN", "95 ELECTRONS PER DN", "215 ELECTRONS PER DN"
IMAGE_MID_TIME	Label	Exposure mid-time calculated from spacecraft clock using both the coarse (seconds) and fine (subRTI) counters (UTC). (A subRTI is approximately 4 msec (1/256 second)). This value is calculated from the SPACECRAFT_CLOCK_ STOP_COUNT - (EXPOSURE_DURATION/2) then converted to UTC. When the shutter was inhibited (ie SHUTTER_STATE_ID="DISABLED"), the IMAGE_MID_TIME = START_TIME = STOP_TIME, and all three represent the start of the exposure window during the prepare cycle of the image. ASCII CCSDS format: yyyy-dddThh:mm:ss.fffZ	date		Ex: 1996-158T05:53:34.000Z	YYYY-DDDThh:mm:ss[.fff]
IMAGE_NUMBER	Label	The seconds portion of the spacecraft clock at shutter close.	string	seconds	CHAR(30)	CHAR(30) <s>

IMAGE_OBSERVATION_TYPE	Label	A multi-valued list describing the purpose(s) of this image, for example, OPNAV, science, calibration, engineering and/or support imaging. (Comes from the IMAGE_OBSERVATION_TYPE_* keywords in the IOI file parameter set description.) This list can contain up to five values where the purposes of the image are identified. More than one value may be specified.	string		{"CALIBRATION", "ENGINEERING", "OPNAV", "SCIENCE", "SUPPORT"}	{"CALIBRATION", "ENGINEERING", "OPNAV", "SCIENCE", "SUPPORT"}
IMAGE_TIME	Label	Time of shutter close calculated from spacecraft clock using both the coarse (seconds) and fine (subRTI) counters (UTC). (A subRTI is approximately 4 msec (1/256 second)). When the shutter was inhibited (ie SHUTTER_STATE_ID="DISABLED"), the IMAGE_TIME = START_TIME = STOP_TIME, and all three represent the start of the exposure window during the prepare cycle of the image. ASCII CCSDS format: yyyy-dddThh:mm:ss.fffZ	date		Ex: 1996-158T05:53:34.000Z	YYYY-MM-DDThh:mm:ss[.fff]
INCIDENCE_ANGLE	SPICE	Incidence angle at aimpoint on target.	real	deg	[0.,180.]	0.0 to 180.0
INST_CMPRS_PARAM	Label	4-valued array. First, the lossy compression MALGO (algorithm) parameter. MALGO. Second, the lossy compression TB (block type) parameter. TB. Third, the lossy compression group-of-blocks (number of blocks per group) parameter. GOB. Fouth, the lossy compression the compression rate parameter (quantization factor). QF.	integer integer integer integer		[0,1] [0,1] [1,255] [0,15]	(INT,INT,INT,INT)
INST_CMPRS_RATE	Label	2-valued array. First, the expected average number of bits and comes from the BITS_PER_PIXEL keyword in the IOI file. Second, the actual average number of bits and is calculated during telemetry processing.	real real	bits/pixel	[0.,16.] [0.,16.]	(REAL,REAL)
INST_CMPRS_RATIO	Label	Ratio of expected image size to size of image received. (Doesn't account for missing data.)	real		[0.,inf]	0.0 to UNK
INST_CMPRS_TYPE	Label	Compression type used for the image.	string		“NOTCOMP”, "LOSSLESS", "LOSSY"	“NOTCOMP”, "LOSSLESS", "LOSSY"
INSTRUMENT_DATA_RATE	Label	The rate at which data was transferred out of instrument. -999.0 if channelized data and extended header are unavailable.	real	kilobits/second	-999.0, 60.9, 121.9, 182.8, 243.7, 365.6	-999.0 to 365.6
INSTRUMENT_HOST_ID	PDS/Cassini	Unique identifier for the host where the instrument is located.	string		"CO"	"CO"

INSTRUMENT_HOST_NAME	Label	Name of the spacecraft upon which this instrument resides.	string		"CASSINI ORBITER"	"CASSINI ORBITER"
INSTRUMENT_ID	Label	Indicator of which camera took this image.	string		“ISSNA”, "ISSWA"	“ISSNA”, "ISSWA"
INSTRUMENT_MODE_ID	Label	The summation mode used for this image.	string		“FULL”,"SUM2","SUM4"	“FULL”,"SUM2","SUM4"
INSTRUMENT_NAME	Label	Name of the CASSINI Instrument which acquired the image data.	string		“IMAGING SCIENCE SUBSYSTEM NARROW ANGLE”, "IMAGING SCIENCE SUBSYSTEM WIDE ANGLE"	“IMAGING SCIENCE SUBSYSTEM NARROW ANGLE CAMERA”, "IMAGING SCIENCE SUBSYSTEM WIDE ANGLE CAMERA"
LIGHT_FLOOD_STATE_FLAG	Label	Indicator of whether Light Flood was used just prior to taking this image.	string		“ON”, "OFF"	“ON”, "OFF"
LOWER_LEFT_LATITUDE	SPICE	Planetocentric latitude of lower-left pixel.	real	deg	[-90.,90.]	-90.0 to 90.0
LOWER_LEFT_LONGITUDE	SPICE	West longitude of lower-left pixel.	real	deg	[0.,360.)	0.0 to 360.0
LOWER_RIGHT_LATITUDE	SPICE	Planetocentric latitude of lower-right pixel.	real	deg	[-90.,90.]	-90.0 to 90.0
LOWER_RIGHT_LONGITUDE	SPICE	West longitude of lower-right pixel.	real	deg	[0.,360.)	0.0 to 360.0
MAXIMUM_RING_RADIUS	SPICE	Maximum ringplane radius in image.	real	km	[0.,inf]	[0.,inf]
METHOD_DESC	Label	This keyword describes the information and/or algorithm used to calculate the I/F value used by the ISS team to determine the EXPOSURE_DURATION. (Limited to char(75)). (Comes from the METHOD_DESC keyword in the IOI file.)	string		CHAR (75)	
MINIMUM_RING_RADIUS	SPICE	Minimum ringplane radius in image.	real	km	[0.,inf]	0.0 to UNK
MISSING_LINES	Label	For non-lossy compressed data only, number of missing or incomplete image lines. For all data, including lossy compressed images, when data is missing, the missing pixel values are replaced by 0. “N/A” for lossy compressed data.	integer		[0,1024]	0 to UNK
MISSING_PACKET_FLAG	Label	Indicator of whether consecutive packets were received. If set to "YES", this flag indicates that packets needed to construct a complete image were missing. If set to "NO", all consecutive packets were received. However, data may be missing at the beginning or end of the image. In this case, missing data would be reflected in the MISSING_LINES keyword for non-lossy data, and through visual inspection for lossy compressed data.	string		“YES”, "NO"	“YES”, "NO"

MISSION_NAME	Label	Mission name associated with this image.	string		“CASSINI-HUYGENS “	“CASSINI-HUYGENS “
MISSION_PHASE_NAME	Label	Mission phase of which this image is a part.	string		“SATURN ORBIT INSERTION”, "SCIENCE_CRUISE", "SPACE_SCIENCE", "APPROACH_SCIENCE", "TOUR PRE-HUYGENS", "PHOEBE ENCOUNTER", "TITAN A ENCOUNTER", "TITAN B ENCOUNTER", "HUYGENS DESCENT", "HUYGENS PROBE SEPARATION", "TITAN C HUYGENS", "TOUR"	“SATURN ORBIT INSERTION”, "SCIENCE_CRUISE", "SPACE_SCIENCE", "APPROACH_SCIENCE", "TOUR PRE-HUYGENS", "PHOEBE ENCOUNTER", "TITAN A ENCOUNTER", "TITAN B ENCOUNTER", "HUYGENS DESCENT", "HUYGENS PROBE SEPARATION", "TITAN C HUYGENS", "TOUR"
NORTH_AZIMUTH_CLOCK_ANGLE	SPICE	Direction of the northward-pointing azimuth at the aimpoint on the target body.	real	deg	[0.,360.)	0.0 to 360.0
OBSERVATION_ID	Label	Name of observation of which this image is a part. (Note: source is REQUEST name (up to any "$" delimiter) from the predicted events file; no checks performed to ensure conformance to PDS standards)	string			CHAR(30)
OPTICS_TEMPERATURE	Label	2-valued array. First, temperature of front optics in Celsius degrees. Note that there is no rear optics temperature for the WAC camera, so when INSTRUMENT_ID = ISSWA, the second element of the array will always be -999.0. (-999.0, -999.0) if the extended header is unavailable. Second, temperature of rear optics in Celsius degrees. Note that there is no rear optics temperature for the WAC camera, so when INSTRUMENT_ID = ISSWA, the second element of the array will always be -999.0. (-999.0, -999.0) if the extended header is unavailable.	real real	deg C	-999.0, [-273.15,inf], -999.0, [-273.15,inf]	(-999.0 to UNK,-999.0 to UNK)
ORDER_NUMBER	Label	Identifier provided by Team Lead for this image which is unique within the IOI file. This value will not be unique for parameter sets described in the IOI file with ITERATION_COUNT > 1 or with LOOP_COUNT > 1	integer		[0,inf]	0 to UNK
PARALLEL_CLOCK_VOLTAGE_INDEX	Label	Commanded parallel clock voltage index. Controls clocking frequency. (Comes from the PC_VOLTAGE keyword in the IOI file.)	integer		[0,15]	0 to 15

PHASE_ANGLE	SPICE	Phase angle at subspacecraft point on target.	real	deg	[0.,180.]	0.0 to 180.0
PIXEL_SCALE	SPICE	Size of one pixel at sub-spacecraft point on target body.	real	km/pixel	all real non-negative numbers	0.0 to UNK
PLANET_CENTER	SPICE	2-valued array. First, Line of target body center. Second, Sample of target body center.	integer integer		[0,1024] [0,1024]	(INT,INT)
PREPARE_CYCLE_INDEX	Label	The element number within the Prepare Cycle table selected for this image. (see Appendix B tables)	integer		[0,15]	0 to 15
PRODUCT_CREATION_TIME	Label	Time of creation of this image on the ground (UTC). ASCII CCSDS format: yyyy-dddTHH:mm:ss.fffZ	date		Ex: 1996-158T05:53:34.000Z	YYYY-MM-DDThh:mm:ss[.fff]
PRODUCT_ID	Label	Unique identifier for each image commanded. Required by PDS/Cassini. The PRODUCT_ID will be constructed: SPACECRAFT_CLOCK_CNT_PARTITION"_"ISPACECRAFT_CLOCK_STOP_COUNT, where I is "N" if the INSTRUMENT_ID is "ISSNA", and I is "W" if the INSTRUMENT_ID is "ISSWA".	string		Ex: 1N832898284.123	CHAR(40)
PRODUCT_VERSION_TYPE	Label	Identifies the version of an individual data product. Always "FINAL" for products archived with PDS/Cassini. "PRELIMINARY" indicates additional processing is underway at IO/MIPL, for instance, to recover additional telemetry if possible.	string		"PRELIMINARY", "FINAL"	"PRELIMINARY", "FINAL"
PRODUCT_TYPE	PDS/Cassini	Identifies the type of a data product within the data set	string		"EDR"	"EDR"
READOUT_CYCLE_INDEX	Label	The element number within the Readout Cycle table selected for this image. (see Appendix B tables)	integer		[0,15]	0 to 15
RECEIVED_PACKETS	Label	This keyword provides the actual number of packets received from the SSR for this image. To convert to volume in bits, multiply this value by 7616 bits/packet. This value reflects data received. In the event the image is incomplete due to an outage in the transmission, this field will not be an accurate indicator of actual volume on the SSR.	integer		[1,2277]	0 to UNK
RIGHT_ASCENSION	SPICE	Right ascension of camera optic axis.	real	deg	[0.,360.)	0.0 to 360.0
RING_CENTER_LATITUDE	SPICE	Planetocentric latitude at aimpoint on ring	real	deg	[-90.,90.]	-90.0 to 90.0

RING_CENTER_LONGITUDE	SPICE	West longitude at aimpoint on ring	real	deg	[0.,360.)	0.0 to 360.0
RING_EMISSION_ANGLE	SPICE	Emission angle relative to target ring at aimpoint.	real	deg	[0.,90.]	0.0 to 90.0
RING_INCIDENCE_ANGLE	SPICE	Incidence angle relative to target ring at aimpoint.	real	deg	[0.,180.]	0.0 to 180.0
RINGS_FLAG	SPICE	If the target is a ring, then this quantity is "YES" if any part of that ring is visible in the image; "NO" otherwise. If the target is not a ring, then this quantity tests whether any part of the A, B, C, or D are visible in the image.	string		"YES","NO"	"YES","NO"
SC_PLANET_POSITION_VECTOR	SPICE	3-valued array. X, Y, Z components of the position vector from spacecraft to primary planet center, corrected for light-travel time and stellar aberration.	real real real	km	[0.,inf], [0.,inf], [0.,inf]	(0.0 to UNK, 0.0 to UNK, 0.0 to UNK)
SC_PLANET_VELOCITY_VECTOR	SPICE	3-valued array. X, Y, Z components of the velocity vector of primary planet relative to spacecraft, corrected for light-travel time.	real real real	km/s	[0.,inf], [0.,inf], [0.,inf]	(0.0 to UNK, 0.0 to UNK, 0.0 to UNK)
SC_SUN_POSITION_VECTOR	SPICE	3-valued array. X, Y, Z components of the position vector from spacecraft to sun center, corrected for light-travel time and stellar aberration.	real real real	km	[0.,inf], [0.,inf], [0.,inf]	(0.0 to UNK, 0.0 to UNK, 0.0 to UNK)
SC_SUN_VELOCITY_VECTOR	SPICE	3-valued array. X, Y, Z components of the velocity vector of sun relative to spacecraft, corrected for light-travel time.	real real real	km/s	[0.,inf], [0.,inf], [0.,inf]	(0.0 to UNK, 0.0 to UNK, 0.0 to UNK)
SC_TARGET_POSITION_VECTOR	SPICE	3-valued array. X, Y, Z components of the position vector from spacecraft to target center, corrected for light-travel time and stellar aberration.	real real real	km	[0.,inf], [0.,inf], [0.,inf]	(0.0 to UNK, 0.0 to UNK, 0.0 to UNK)
SC_TARGET_VELOCITY_VECTOR	SPICE	3-valued array. X, Y, Z components of the velocity vector of the target relative to spacecraft, corrected for light-travel time.	real real real	km/s	[0.,inf], [0.,inf], [0.,inf]	(0.0 to UNK, 0.0 to UNK, 0.0 to UNK)
SENSOR_HEAD_ELEC_TEMPERATURE	Label	Temperature of the sensor head electronics.	real	deg C	-999.0, [-273.15,inf]	-999.0 to UNK
SEQUENCE_ID	Label	Identifies the segment associated with this image. Note that this keyword does not come from the IOI file. Ex: “C22”, “S19”	string			CHAR(20)

SEQUENCE_NUMBER	Label	Indicates the order in which this image was expected to be taken within the given observation (OBSERVATION_ID).	integer		[1,inf]	1 to UNK
SEQUENCE_TITLE	Label	The name assigned by the Team Lead for the activity of which this image is a part. Comes from the SEQUENCE_TITLE keyword in the IOI file. Limited to 30 characters. Example = ???.	string		Ex: C22	CHAR(60)
SHUTTER_MODE_ID	Label	Indicator of whether this exposure was part of a joint observation with the other ISS camera.	string		“BOTSIM”,"NACONLY", "WACONLY"	“BOTSIM”,"NACONLY", "WACONLY"
SHUTTER_STATE_ID	Label	Indicator of whether the shutter was enabled during the exposure.	string		“ENABLED”, "DISABLED"	“ENABLED”, "DISABLED"
SOFTWARE_VERSION_ID	Label	Ground software version used to generate this image.	string			CHAR(20)
SPACECRAFT_CLOCK_CNT_PARTITION	Label	Indicates the clock partition active for the SPACECRAFT_CLOCK_START_ COUNT and SPACECRAFT_CLOCK STOP_COUNT elements. Remains at "1" unless the spacecraft clock rolls over or is reset.	integer		[1,inf]	1 to UNK
SPACECRAFT_CLOCK_START_COUNT	Label	The seconds and subRTI portions of the spacecraft clock at shutter open. Calculated from spacecraft clock of shutter close less the exposure duration. When the shutter was inhibited (ie SHUTTER_STATE_ID="DISABLED"), the SPACECRAFT_CLOCK_START_COUNT = SPACECRAFT_CLOCK_STOP_COUNT, and both represent the start of the exposure window during the prepare cycle of the image. EX: “832898283.123”	string		Ex: 832898283.123	CHAR(30)
SPACECRAFT_CLOCK_STOP_COUNT	Label	The seconds and subRTI portions of the spacecraft clock at shutter close. (A subRTI is approximately 4 msec (1/256 second)). When the shutter was inhibited (ie SHUTTER_STATE_ID="DISABLED"), the SPACECRAFT_CLOCK_START_COUNT = SPACECRAFT_CLOCK_STOP_COUNT, and both represent the start of the exposure window during the prepare cycle of the image. EX: “832898284.456”	string		Ex: 832898284.456	CHAR(30)
SPICE_PRODUCT_ID	SPICE	The names of the SPICE files used in processing the data.	string		CHAR(512)	
STANDARD_DATA_PRODUCT_ID	Archive Gen	Data product type identifier	string		"ISS_EDR"	"ISS_EDR"

START_TIME	Label	Time of shutter open. Calculated from spacecraft clock of shutter close less the exposure duration. Expressed in UTC format, and includes subRTI resolution. (A subRTI is approximately 4 msec (1/256 second)). When the shutter was inhibited (ie SHUTTER_STATE_ID="DISABLED"), the START_TIME = STOP_TIME, and both represent the start of the exposure window during the prepare cycle of the image. EX: 1996-158T05:53:34.000Z	date		Ex: 1996-158T05:53:34.000Z	YYYY-MM-DDThh:mm:ss[.fff]
STOP_TIME	Label	Time of shutter close from spacecraft clock (UTC). Identical to IMAGE_TIME. Includes subRTI resolution. (A subRTI is approximately 4 msec (1/256 second)). When the shutter was inhibited (ie SHUTTER_STATE_ID="DISABLED"), the START_TIME = STOP_TIME, and both represent the start of the exposure window during the prepare cycle of the image. EX: 1996-158T05:53:34.000Z	date		Ex: 1996-158T05:53:34.000Z	YYYY-MM-DDThh:mm:ss[.fff]
SUB_SOLAR_LATITUDE	SPICE	Planetocentric latitude of subsolar point on target; Ring_Subsolar_Latitude if target is a ring.	real	deg	[-90.,90.]	-90.0 to 90.0
SUB_SOLAR_LONGITUDE	SPICE	West longitude of subsolar point on target; Ring_Subsolar_Longitude if target is a ring.	real	deg	[0.,360.)	0.0 to 360.0
SUB_SPACECRAFT_LATITUDE	SPICE	Planetocentric latitude of subspacecraft point on target; Ring_Subspacecraft_Latitude if target is a ring.	real	deg	[-90.,90.]	-90.0 to 90.0
SUB_SPACECRAFT_LONGITUDE	SPICE	West longitude of subspacecraft point on target; Ring_Subspacecraft_Longitude if target is a ring.	real	deg	[0.,360.)	0.0 to 360.0

TARGET_DESC	Label	The name of the intended target for which the exposure was calculated/selected in the given image. May include calibration type information. Limited to 75 characters. (Comes from the TARGET_DESC keyword in the IOI file.)	string		MERCURY, “VENUS”, “EARTH”, “MARS”, “JUPITER”, “SATURN”, “URANUS”, “NEPTUNE”, “PLUTO”, “SUN”, “MOON”, “EARTH”, “MIMAS”, “ENCELADUS”, “TETHYS”, “DIONE”, “RHEA”, “TITAN”, “HYPERION”, “IAPETUS”, “PHOEBE”, “JANUS”, “EPIMETHEUS”, “HELENE”, “TELESTO”, “CALYPSO”, “ATLAS”, “PROMETHEUS”, “PANDORA”, “PAN”, “IO”, “EUROPA”, “GANYMEDE”,, “CALLISTO”, “AMALTHEA”, “HIMALIA”, “ELARA”, “PASIPHAE”, “SINOPE”, “LYSITHEA”, “CARME”, “ANANKE”, “LEDA”, “THEBE”, “ADRASTEA”, “METIS”, “SKY”, “MASURSKY”, “FOMALHAUT”, “SPICA”, “DARK SKY”, “NULL”	MERCURY, “VENUS”, “EARTH”, “MARS”, “JUPITER”, “SATURN”, “URANUS”, “NEPTUNE”, “PLUTO”, “SUN”, “MOON”, “EARTH”, “MIMAS”, “ENCELADUS”, “TETHYS”, “DIONE”, “RHEA”, “TITAN”, “HYPERION”, “IAPETUS”, “PHOEBE”, “JANUS”, “EPIMETHEUS”, “HELENE”, “TELESTO”, “CALYPSO”, “ATLAS”, “PROMETHEUS”, “PANDORA”, “PAN”, “IO”, “EUROPA”, “GANYMEDE”,, “CALLISTO”, “AMALTHEA”, “HIMALIA”, “ELARA”, “PASIPHAE”, “SINOPE”, “LYSITHEA”, “CARME”, “ANANKE”, “LEDA”, “THEBE”, “ADRASTEA”, “METIS”, “SKY”, “MASURSKY”, “FOMALHAUT”, “SPICA”, “DARK SKY”, “NULL”
TARGET_DISTANCE	SPICE	Distance from the spacecraft to the center of the target.	real	km	[0.,inf]	0.0 to UNK <km>
TARGET_EASTERNMOST_LONGITUDE	SPICE	Easternmost longitude visible on target body.	real	deg	[0.,360.)	0.0 to 360.0

TARGET_LIST	SPICE	Name of each body visible in the image. A body is included if any part of its limb is not hidden by another body. Bodies may be obscured by rings.	string	N/A	MERCURY, “VENUS”, “EARTH”, “MARS”, “JUPITER”, “SATURN”, “URANUS”, “NEPTUNE”, “PLUTO”, “SUN”, “MOON”, “EARTH”, “MIMAS”, “ENCELADUS”, “TETHYS”, “DIONE”, “RHEA”, “TITAN”, “HYPERION”, “IAPETUS”, “PHOEBE”, “JANUS”, “EPIMETHEUS”, “HELENE”, “TELESTO”, “CALYPSO”, “ATLAS”, “PROMETHEUS”, “PANDORA”, “PAN”, “IO”, “EUROPA”, “GANYMEDE”,, “CALLISTO”, “AMALTHEA”, “HIMALIA”, “ELARA”, “PASIPHAE”, “SINOPE”, “LYSITHEA”, “CARME”, “ANANKE”, “LEDA”, “THEBE”, “ADRASTEA”, “METIS”, “SKY”, “MASURSKY”, “FOMALHAUT”, “SPICA”, “DARK SKY”, “NULL”	MERCURY, “VENUS”, “EARTH”, “MARS”, “JUPITER”, “SATURN”, “URANUS”, “NEPTUNE”, “PLUTO”, “SUN”, “MOON”, “EARTH”, “MIMAS”, “ENCELADUS”, “TETHYS”, “DIONE”, “RHEA”, “TITAN”, “HYPERION”, “IAPETUS”, “PHOEBE”, “JANUS”, “EPIMETHEUS”, “HELENE”, “TELESTO”, “CALYPSO”, “ATLAS”, “PROMETHEUS”, “PANDORA”, “PAN”, “IO”, “EUROPA”, “GANYMEDE”,, “CALLISTO”, “AMALTHEA”, “HIMALIA”, “ELARA”, “PASIPHAE”, “SINOPE”, “LYSITHEA”, “CARME”, “ANANKE”, “LEDA”, “THEBE”, “ADRASTEA”, “METIS”, “SKY”, “MASURSKY”, “FOMALHAUT”, “SPICA”, “DARK SKY”, “NULL”
TARGET_NAME	Label	Identifies a target. The target may be a planet, satellite, ring, region, feature, asteroid or comet.	string	N/A	all valid solar system bodies and features	CHAR(20)
TARGET_NORTHERNMOST_LATITUDE	SPICE	Northernmost latitude visible on target body.	real	deg	[-90.,90.]	-90.0 to 90.0
TARGET_SOUTHERNMOST_LATITUDE	SPICE	Southernmost latitude visible on target body.	real	deg	[-90.,90.]	-90.0 to 90.0
TARGET_WESTERNMOST_LONGITUDE	SPICE	Westernmost longitude visible on target body.	real	deg	[0.,360.)	0.0 to 360.0

TELEMETRY_FORMAT_ID	Label	The telemetry mode in effect when sending data from the instrument to the spacecraft computer.	string		“S_N_ER_1”, "S_N_ER_2", "S_N_ER_3", "S_N_ER_4", "S_N_ER_5", "S_N_ER_5A", "S_N_ER_6", "SAF_142200", "UNK	Values do not conform to the current definition of TELEMETRY_FORMAT_ID. Recommend that PDS update the current definition.
TWIST_ANGLE	SPICE	Twist angle of optic axis.	real	deg	[0.,360.)	0.0 to 360.0
UPPER_LEFT_LATITUDE	SPICE	Planetocentric latitude of upper-left pixel.	real	deg	[-90.,90.]	-90.0 to 90.0
UPPER_LEFT_LONGITUDE	SPICE	West longitude of upper-left pixel.	real	deg	[0.,360.)	0.0 to 360.0
UPPER_RIGHT_LATITUDE	SPICE	Planetocentric latitude of upper-right pixel.	real	deg	[-90.,90.]	-90.0 to 90.0
UPPER_RIGHT_LONGITUDE	SPICE	West longitude of upper-right pixel.	real	deg	[0.,360.)	0.0 to 360.0
VALID_MAXIMUM	Label	2-valued array. First, indicates the minimum full well saturation level of the instrument, which is a function of INSTRUMENT_MODE_ID, INSTRUMENT_ID, and GAIN_MODE_ID, expressed as a DN value. This may exceed 4095. Second, indicates the maximum DN saturation level for the signal returned by the A/D converter. Valid values are 255 and 4095. See Appendix B tables	integer integer		255,4095 255,4095	(INT,INT)