

DS-QMW-TN-0003

Date: 9 July 1999

Issue: 1

Rev. : 6

Page: i

Reference Document for CSDS CDF Implementation

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| Document Status Sheet | | | |
|---|-------------|---------------|---|
| 1. Document Title: CDF Reference | | | |
| 2. Document Reference Number: DS-QMW-TN-0003 | | | |
| 3. Issue | 4. Revision | 5. Date | 6. Reason for Change |
| 0 | 1 | 24 June 94 | For Stockholm IWG. |
| 1 | 0 | 8 Sept 94 | Modifications subject to Change sheets V1.4 to V1.5 for Toulouse IWG. Brings skeleton files to version 1.5. |
| 1 | 1 | 21 Oct 94 | Modifications subject to Change sheets V1.5 to V1.6. Last changes before placing under CSDS Configuration Control. |
| 1 | 2 | 3 May 1995 | Addition of EDI inputs and changes as per Change sheets V1.6 to 1.7 requested by instrument teams and CSDS UI project. |
| 1 | 3 | 1 Sept 1995 | Clarification of allowable characters in Inst_mode attribute. Clarification of Orbit_number attribute content and meaning of fill value in Status variable. |
| 1 | 4 | 29 Jan 1996 | Change to FGM parameters. Remove remaining TBDs. |
| 1 | 5 | 29 March 1999 | At change request V1.9 |
| 1 | 6 | 1 July 1999 | Remove Data products list. For Cluster II. |
| | | | |

Applicable Documents

1. CSDS skeleton files (.skt files)

Reference Documents

1. "CDF file Design for Cluster: Recommendations to CSDS", DS-QMW-TN-0001
2. "Report of the Data Products Task Group for the Cluster Science Data System", DS-MPA-TN-0001
3. "Report of the Parameter Naming Task Group", DS-RAL-TN-0002
4. "ISTP Standards and Conventions, Red Book"
5. "Structure of Generic CSDS Standard CDF Files", DS-QMW-TN-0008
6. "Definition of Spin for CSDS", DS-QMW-TN-0007
7. "Joining and Merging of CSDS Standard CDF Files", DS-QMW-TN-0009
8. "CSDS User's Guide", DS-MPA-TN-0015

Contents

| | | |
|----------|--|-----------|
| 1 | Introduction | 1 |
| 2 | The Cluster Mission | 1 |
| 2.1 | The Cluster Experiments | 1 |
| 2.2 | The Cluster Science Data Centres | 2 |
| 3 | The Interdependency Tables | 3 |
| 4 | Global Attributes | 5 |
| 5 | Variable Attributes | 42 |
| 6 | Variables | 74 |
| 7 | Standard Field Definitions | 78 |
| 7.1 | File Names | 78 |
| 7.2 | Instrument abbreviations | 78 |
| 7.3 | Time Fields | 78 |
| 7.4 | Date fields | 79 |
| 7.5 | Fill Values | 79 |
| 7.6 | Variable Names | 79 |
| 7.7 | Standards for Merging/Subsetting | 80 |
| 7.8 | Standards for non-CSDS Data Products | 80 |
| 7.9 | Definition of Spin | 80 |
| 7.10 | Definition of 'Minute' for SPDB | 80 |
| 7.11 | Empty Files | 80 |
| 7.11.1 | Catalogue Entries for Empty Files | 81 |
| 7.11.2 | Data Records | 81 |
| 7.11.3 | Global Attributes | 81 |
| 7.11.4 | Variable Attributes | 82 |

1 Introduction

This document is provided as a reference for construction of CSDS standard CDF files. It is complementary to the CSDS CDF skeleton files and should remain completely compatible with them as they evolve under configuration control.

It is based on the detailed recommendations in the task group report (applicable doc [1]) DS-QMW-TN-0001, "CDF file Design for Cluster: Recommendations to CSDS". It differs from that document in two important respects; firstly the material is presented in a format that is convenient for reference without any of the discussion of options or reasoning, and secondly it will be kept under configuration control along with the skeleton files. The discussion nature of the document DS-QMW-TN-0001 makes it difficult to keep that source up to date as the file designs evolve through the detailed design phase for CSDS, and only major changes will result in a reissue of the task group report.

This document will provide textural reference material sufficient to understand the skeleton files and the detailed requirements for populating the CSDS CDF files.

Cluster Prime and Summary Parameter data and JSOC catalogues are to be exchanged using CDF version 2.6 files.

2 The Cluster Mission

2.1 The Cluster Experiments

| Acronym | Experiment | Principle Investigator | PI Country |
|----------|---|------------------------|------------|
| ASPOC | Active Spacecraft Potential Control | W. Riedler | Austria |
| CIS | Cluster Ion Spectrometry | H. Rème | France |
| EDI | Electron Drift Experiment | G. Paschmann | Germany |
| FGM | Fluxgate Magnetometer | A. Balogh | U.K. |
| PEACE | Plasma Electrons and Currents Experiment | A. Fazakerly | U.K. |
| RAPID | Research with Adaptive Particle Imaging Detectors | P. Daly | Germany |
| DWP* | Digital Wave Processor | H. St.Alleyne | U.K. |
| EFW* | Electric Field and Waves | G. Gustafsson | Sweden |
| STAFF* | Spatio-Temporal Analysis of Magnetic Field Fluctuations | N. Cornilleau-Wehrlin | France |
| WBD* | Wide Band Data | D. A. Gurnett | U.S.A |
| WHISPER* | Waves of High Frequency and Sounder for Probing of the Electron Density by Relaxation | P. W. E. Décréau | France |

*These experiments are collectively referred to as WEC, the Wave Experiment Consortium

2.2 The Cluster Science Data Centres

| DC Name | Location | Experiments |
|---------|---|----------------------|
| UKCDC | Daresbury Rutherford Appleton Laboratory (DRAL) | DWP, FGM, PEACE |
| CFC | Centre National d'Études Spatiales (CNES) | CIS, STAFF, WHISPER |
| GDC | Max-Planck-Institut für Aeronomie, D-37191, Katlenburg-Lindau (MPAe) | EDI, RAPID |
| ACDC | Institut für Weltraumforschung (IWF) | ASPOC |
| SDC | Kungliga Tekniska Högskolan (KTH) | EFW |
| USCSDC | Goddard Space Flight Center (GSFC) | WBD |
| HDC | Central Research Institute for Physics (KFKI) | Auxiliary parameters |

3 The Interdependency Tables

The question of the interdependency between the various experiments can best be displayed by means of a matrix showing which other data sets are needed for the production of another one. There is no point distinguishing between PPDB and SPDB since the latter is essentially a subset of the former. The main question is what interchanges of data between data centres must take place.

It soon became apparent that there were a number of levels of requirements. In many cases, although a certain data set was not absolutely essential for the routine production of parameters, it was nevertheless required for overall checking and updating. Table 1 indicates these different levels by putting those requirements for the **continuous** production of the parameters in bold face, and the *occasional* requirements in a italic typeface.

Exactly what is needed also varies. Some experiments require detailed data, others want merely a flag that another experiment is operating and may therefore be interfering, while the rest are satisfied with software and calibration tables so that they may calculate the required parameters themselves. These different demands are indicated in Table 1.

Table 1: Cross-Experiment Requirements

For the routine production of PPDB and SPDB, the experiment at the top of each column needs continuous data from the experiments at the left for which a **bold** entry is given; the *slanted* entries indicate the requirements for occasional testing, cross-checking, and calibration.

| | ASPOC | CIS | EDI | FGM | PEACE | RAPID | DWP | EFW | STAFF | WBD | WHISPER |
|---------|------------------|---------------------------|------------------|-------------|---------------------------|-------------|-------------|---------------------------|-------------|-------------|-------------|
| ASPOC | — | | | | | | | <i>cal</i> | | | |
| CIS | | — | | <i>need</i> | <i>cal</i> | | | <i>cal</i> | | | <i>cal</i> |
| EDI | | | — | <i>need</i> | | | flag | flag <i>cal</i> | flag | flag | flag |
| FGM | | need | ct&sw | — | <i>cal</i> | <i>cal</i> | | ct&sw | <i>cal</i> | | need |
| PEACE | <i>ct&sw</i> | <i>cal</i> | | <i>need</i> | — | | | <i>cal</i> | | | <i>cal</i> |
| RAPID | | <i>cal</i> | | | | — | | | | | |
| DWP | | | | | | | — | wec | wec | wec | wec |
| EFW | <i>ct&sw</i> | <i>cal</i> | | | <i>cal</i> | | need | — | <i>cal</i> | need | |
| STAFF | | | | <i>need</i> | <i>cal</i> | | | | — | | |
| WBD | | | | | | | | | | — | |
| WHISPER | | flag <i>cal</i> | | | flag <i>cal</i> | flag | flag | flag <i>cal</i> | | flag | — |

Notes: **need** data are needed **continuously** or *occasionally* according to typeface
ct&sw calibration tables and software needed
flag software needed to determine on/off flag
Some experiments need WHISPER on/off only to flag possible interference.
WEC experiments need EDI status information for PPDB production.
EDI Status word will provide information on beam current, energy, and code-clock frequency, but not on the firing direction.
cal data are needed for the adjustment of the calibration tables but are not critical for the SPDB and PPDB production
wec decommutation of WEC data and WEC data products required

4 Global Attributes

This section lists all global attributes in alphabetical order. A standard format is used as an aid to easy reference, and one attribute per page is presented.

Acknowledgment

DATA TYPE

Global Attribute

Character string

Maximum length 80

Multiple Entries.

SYNTAX

Free form text string.

DEFINITION

Text string allowing for information on expected acknowledgment if data is citable. Since the citability and scientific quality is subject to change, this information should be held by CSDS and relevant documentation only referred to here.

USED IN

SP & PP

VALUE

“refer to CSDS for rules of acknowledgement”

SOURCE

Provided in .skt file.

WHEN USED

This is optional in ISTD standards, but has been adopted as required for CSDS.

COMMENTS

ISTP Standard

| | |
|--|--|
| <h1>ADID_ref</h1> | |
| <p>DATA TYPE Global Attribute Single 8 character string Single Entry.</p> | <p>SYNTAX "ECLUiiiim", where iii is the instrument 3 character acronym in upper case, and m is the modifier '1', '2', '3' '4' or 'S' for the four Prime Parameter files and Summary Parameters respectively.</p> |
| <p>DEFINITION The SFDU identifier. The SFDU contents are registered with the ESOC control authority.</p> | |
| <p>USED IN SP & PP</p> | <p>VALUE Provided by CSDS/ESOC</p> |
| <p>SOURCE Provided in .skt file.</p> | <p>WHEN USED Always required</p> |
| <p>COMMENTS ISTP Standard</p> | |

Caveats

DATA TYPE
Global Attribute
Character string
Maximum length 80
Multiple Entry.

SYNTAX
Free format text string.

DEFINITION
Text string at PI disposal. To provide warning messages to science users.

| | |
|--------------------|--|
| USED IN SP & PP | VALUE To be provided during validation. |
|--------------------|--|

| | |
|---|---|
| SOURCE Text inserted by the CSDS-UI validation software. | WHEN USED Optional at PI discretion. |
|---|---|

COMMENTS
CSDS Standard.

| | |
|---|-----------------------|
| <h2>Data_intervals</h2> | |
| DATA TYPE Global Attribute | SYNTAX |
| DEFINITION | |
| USED IN None | VALUE |
| SOURCE | WHEN USED Not Used |
| COMMENTS CSDS Standard Provided for Cluster I, has been dropped for Cluster II. | |

| | |
|--|--|
| <h1>Data_type</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Single Entry</p> | <p>SYNTAX</p> <p><i>“data type abbreviation>data type”</i></p> |
| <p>DEFINITION</p> <p>Identifies the type of data - essentially which data set/resolution.</p> | |
| <p>USED IN</p> <p>SP</p> <p>PP</p> | <p>VALUE</p> <p>“SP>Summary Parameter”</p> <p>“PP>Prime Parameter”</p> |
| <p>SOURCE</p> <p>Provided in .skt file.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>ISTP Standard</p> <p>Value fixed by CSDS in advance.</p> | |

Data_version

| | | |
|--|--|--|
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 10</p> <p>Single Entry</p> | | <p>SYNTAX</p> <p>“<i>nn</i>”</p> <p>where “<i>nn</i>” is a two digit number. The first release of each CDF file is “01”.</p> |
| <p>DEFINITION</p> <p>The version number of the data file. Any change in the data content of the file must be accompanied by incrementation of this attribute, and the version number in the ‘Logical_file_id’ (below) and file name.</p> | | |
| <p>USED IN</p> <p>unvalidated SP & PP</p> <p>first release SP & PP</p> | <p>VALUE</p> <p>Produced by pipeline software</p> <p>“00”</p> <p>On first release value is always</p> <p>“01”</p> <p>subsequent releases increment numerical value by one.</p> | |
| <p>SOURCE</p> <p>Set as “00” in .skt file.</p> <p>To be replaced by CSDS provided validation software with appropriate value.</p> | | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>ISTP Standard</p> <p>Note that only the generating NDC may issue a new version of the file, and responsibility lies with them to maintain correct sequence in numbering.</p> | | |

Descriptor

| | | |
|--|--|---|
| DATA TYPE Global Attribute Character string Maximum length 80 Single Entry | | SYNTAX “ <i>short_inst_name</i> > <i>inst_name</i> ” where “ <i>short_inst_name</i> ” is the three character abbreviation, and “ <i>inst_name</i> ” is the full instrument name. |
| DEFINITION The instrument name and description. | | |
| USED IN SP & PP | VALUE one of: “AUX>Auxiliary Data” “ASP>Active Spacecraft Potential Control” “PEA>Plasma Electron and Current Experiment” “FGM>Fluxgate Magnetometer” “EDI>Electron Drift Instrument” “EFW>Electric Fields and Waves” “DWP>Digital Wave Processor” “CIS>Cluster Ion Spectrometry” “RAP>Research with Adaptive Particle Imaging Detectors” “STA>Spatio-Temporal Analysis of Field Fluctuations” “WBD>Wide Band Data” “WHI>Waves of High Frequency and Sounder for Probing of Density by Relaxation” | |
| SOURCE Provided in .skt file. | | WHEN USED Always required |
| COMMENTS ISTP Standard Value fixed by CSDS in advance. | | |

| | |
|---|--|
| <h1>Discipline</h1> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Single Entry | SYNTAX <i>"discipline>sub-discipline"</i> where the substrings <i>"discipline"</i> and <i>"sub-discipline"</i> are fixed by CSDS. |
| DEFINITION The science discipline and sub-discipline. | |
| USED IN SP PP | VALUE "Space Physics> Magnetospheric Science" "Space Physics> Magnetospheric Science" |
| SOURCE Provided in .skt file. | WHEN USED Always required |
| COMMENTS ISTEP Standard Value fixed by CSDS in advance. | |

| | |
|---|--|
| <h1>Generated_by</h1> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Single Entry. | SYNTAX Free form text string. |
| DEFINITION This attribute allows for the generating data centre to be identified. | |
| USED IN SP & PP | VALUE to be provided by NDCs, <i>e.g.</i> "Austrian Data Centre, Graz. " |
| SOURCE To be generated during processing. | WHEN USED Always required |
| COMMENTS CSDS Standard | |

| | |
|---|---|
| <h2>Generation_date</h2> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Single Entry. | SYNTAX ISO standard text time field <i>yyyy-mm-ddTHH:MM:ss.wwwZ</i> it e.g. "1996-01-30T13:30:00.000Z" for January 30 1996 at 1.30 pm. |
| DEFINITION Date stamps the creation of the file. | |
| USED IN SP & PP | VALUE To be generated during processing. |
| SOURCE Written when file is populated. | WHEN USED Optional under ISTP standard. Required for CSDS standard. |
| COMMENTS ISTP Standard See section 7.3 | |

Inst_mode

DATA TYPE

Global Attribute
Character string
Maximum length 270
Multiple entries.

SYNTAX

“*Spacecraft*>*instrument*>*Rec number*>*UTC time*>*mode flag*>*text*”

where *Spacecraft* is one of C1, C2, C3, C4, *instrument* is the three character instrument abbreviation, *Rec number* is the number of the first record within the CDF file for which the new mode is applicable, the UTC time string is in ISO standard form (extended to milliseconds) of the start of the new mode, *mode flag* is an instrument specific mode code (to be allocated by the instrument teams) beginning with the instrument three-letter acronym followed by an underscore, and *text* is a text string providing human readable information on the mode. *e.g.*

“C1>PEA>0>1996-08-

23T14:01:55.000Z>PEA.SWM1> Solar wind mode”.

The *mode flag* acronym is limited to at most 30 characters, exceeding this limit will result in a fatal error on ingestion into the catalogues. The required text field is limited to at most 200 characters, exceeding this limit will result in truncation on ingestion into the catalogues. The *mode flag* may only contain alpha-numeric characters and the underscore and minus sign, while the *text* entry may contain any printable ascii character (20 to 7E in HEX) and the new-line character.

DEFINITION

Records mode switches and instrument down periods. Each time the instrument changes mode a new entry in this global attribute records the time of this mode switch and the new instrumental status. Mode flags to be decided by the instrument teams. The flag can be used to identify data gaps resulting from commanding. For new files the mode in operation at the start of the file must be supplied; in such a case the record number is zero and the time is appropriate to the first record in the file.

USED IN

SP & PP

VALUE

To be provided by NDCs and CSDS

SOURCE

To be generated during processing.

WHEN USED

Always required

COMMENTS

CSDS Standard

Note that the global attribute 'Data_intervals' will provide a complete list of continuous data intervals, and satisfies the ISTP 'Gap_flag' functionality. The purpose of 'Mode' for data gaps will be to identify the nature of the gap since it will be able to distinguish between 'instrument off', modes where the product cannot be produced and hardware or software problems.

Modes that involve switching between logical instruments (*e.g.* once per spin) are recorded as the commencement of this mode of operation, not each logical instrument switch. The modes must be defined elsewhere in detail. This differs from the Status flag in that it records the information pertaining to the instrument as commanding and operational changes, and is not kept for every record. It is information that could also be written into a data catalogue.

Any logical instrument switching that occurs on a short timescale (*e.g.* chopping between logical instruments on alternate spins) should have the instantaneous state recorded as part of the 'Status' variable.

In the case of the AUX SPD files the mode information should contain spacecraft mode information such as telemetry mode for each spacecraft. The mode flag for AUX must also identify the spacecraft to which it applies. Since mode changes are independently time tagged they may be supplied for the full day even if data records are only available for a portion of the day.

| | |
|---|---|
| <h2>Inst_settings</h2> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Multiple entries.</p> | <p>SYNTAX</p> <p>Free form text string, it is suggested these could include pairs of the form "<i>parameter>value</i>"</p> |
| <p>DEFINITION</p> <p>An optional global attribute of text strings which are entirely at the PI's disposal to record instrumental parameter settings, software options or anything else.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>To be provided by NDCs and PIs</p> |
| <p>SOURCE</p> <p>To be generated during processing.</p> | <p>WHEN USED</p> <p>Optional</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> <p>This is provided for archival of actual values set on the instruments. It may not be required by all (or any) instruments, and the meanings would be described in published reports. They need not be self explanatory, and can keep information that does not obviously belong anywhere else. It could contain all information on options selected within the generation software.</p> | |

JSOC_EVENT_CODES

DATA TYPE

Global Attribute
Character string
Max length 80
Multiple entries

SYNTAX

Text string. The following form is suggested:
“*code>text description*”

DEFINITION

The text description identifies the meaning of the JSOC event Code.

USED IN

JP

VALUE

To be provided as part of JSOC Catalogue export software.

SOURCE

Provided by JSOC software

WHEN USED

Always required for JSOC PSE

COMMENTS

CSDS Standard

Logical_file_id

DATA TYPE

Global Attribute
Character string
Maximum length 50
Single Entry.

SYNTAX

“*Cn_tt_ins_yyyymmdd_Vmm*”
where ‘*Cn*’ takes the values ‘CL’ for SP data, and C1, C2, C3 or C4 for the PP data, ‘*tt*’ takes the values SP or PP for summary and prime data, ‘*ins*’ is the instrument three character abbreviation, ‘*yyymmdd*’ is an eight character date string, and *mm* is the two digit integer version number.
e.g. for prime parameter FGM data from satellite number 4 on 3 December 1995, as generated by the pipeline software, before validation:
“C4_PP_FGM_19951203_V00”

DEFINITION

This should be identical to the CDF file name. Note that for CSDS the first three fields in this attribute are the same as the attributes “Source_name”, “Data_type” and “Descriptor”. The date is an eight digit string of full year, month and day. The delimiter is the underscore character ‘_’.

USED IN

SP & PP

VALUE

To be generated during processing.

SOURCE

Written when file is populated.

WHEN USED

Always required

COMMENTS

ISTP Standard

The version number is incremented if file contents are altered. Only the NDC responsible for that instrument is allowed to issue an update to a file, or an instruction to reprocess (*e.g.* change an attribute entry), and the version number to apply.

| | |
|---|-------------------------------------|
| <h1>Logical_source</h1> | |
| DATA TYPE Global Attribute Character string Maximum length 50 Single Entry. | SYNTAX “ ” |
| DEFINITION | |
| USED IN SP & PP | VALUE |
| SOURCE Written when file is populated. | WHEN USED Always required |
| COMMENTS ISTP Standard | |

Logical_source_description

DATA TYPE
Global Attribute
Character string
Maximum length 50
Single Entry.

SYNTAX
“ ”

DEFINITION

USED IN
SP & PP

VALUE

SOURCE
Written when file is populated.

WHEN USED
Always required

COMMENTS
ISTP Standard

MODS

DATA TYPE

Global Attribute

Character string

Maximum length 80

Multiple Entries. Any number of entries may be used if more than 80 characters are needed.

SYNTAX

Free form text string.

DEFINITION

This text entry should record details of changes to the data set. It should contain text messages not readily recorded in the fixed format "Inst_settings" or the variable attributes "Calib_software" and "Calib_inputs".

USED IN

SP & PP

VALUE

To be generated during processing.

SOURCE

Written when file is populated.

WHEN USED

Always required

COMMENTS

ISTP Standard

Each change of version should include a *new* entry, while retaining all previous entries, thus CSDS validation software must add entries extracted from previous version of file when data is reprocessed to maintain a complete processing history.

| | |
|--|------------------------------|
| <h1>Mission_group</h1> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Single Entry. | SYNTAX |
| DEFINITION | |
| USED IN SP & PP | VALUE |
| SOURCE | WHEN USED Always required |
| COMMENTS ISTP Standard | |

Orbit_number

DATA TYPE

Global Attribute
Character string
Maximum length 80
Multiple entries.

SYNTAX

“Iso_time_at_perigee>orbit_number>period_in_minutes”
where *“Iso_time_at_perigee”* is the UTC time in ISO standard format. *“orbit_number”* is a three digit number recording the orbit number as specified on the RDM. *period_in_minutes* is the estimated period of the orbit in minutes provided on the RDM.
Perigee is at start of orbit. Orbits are measured perigee to perigee. The orbit number pertains only to the reference satellite.

DEFINITION

This attribute is provided on the assumption that CDF files will be based on days, whereas RDMs or other activities require knowledge of the orbit number.

USED IN

SP
AUX only.

VALUE

Derived from RDM.

SOURCE

To be generated during processing.

WHEN USED

Always required

COMMENTS

CSDS Standard

This is to be provided in the AUX files only. It will not appear in the instrument files. It is equivalent to the revolution number used in operations planning.

Entries must be chronological such that the earliest entry corresponds to the lowest orbit number.

Each AUX file shall contain in the Orbit_number at least one entry referring to the last perigee crossed by the reference satellite (the time of perigee will be \leq the start time of the file).

A second entry should be added if the reference satellite enters a new orbit during the day covered by the file.

Since CDF files will be produced on a one per day basis, this global attribute will require multiple entries for some CDF files. Pipeline software for generating CSDS data products must be capable of opening more than one orbit-based RDM in order to generate the CDF files for orbit crossings within one day.

| | |
|---|--|
| <h2>Parents</h2> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Multiple entries.</p> | <p>SYNTAX</p> <p>“RDM><i>rdm_id</i>”, where “<i>rdm_id</i>” is the identification string from the source RDM.</p> |
| <p>DEFINITION</p> <p>For PPDB and SPDB purposes this would be a text string containing the name of the parent RDM, including version number.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>Value derived from RDM label.</p> |
| <p>SOURCE</p> <p>To be generated during processing.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> <p>This, along with the version number in the CDF name, allows for identification of re-issues of RDMs, as well the actual RDM as a consistency check. If more than one RDM are used for a single CDF file, then each RDM should be named at subsequent entry numbers for this Global attribute.</p> | |

| | |
|---|---|
| <h2>PI_affiliation</h2> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Multiple entries. | SYNTAX "Institute of the Instrument team PI". |
| DEFINITION Name and address of the home Institute leading the instrument team. | |
| USED IN SP & PP | VALUE Institute as specified by PI. |
| SOURCE Provided in .skt file. | WHEN USED Always required |
| COMMENTS ISTP Standard. | |

| | |
|---|-------------------------------------|
| <h1>PI_name</h1> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Multiple entries. | SYNTAX "Name". |
| DEFINITION Name of the principal investigator leading the instrument team. | |
| USED IN SP & PP | VALUE PI Name. |
| SOURCE Provided in .skt file. | WHEN USED Always required |
| COMMENTS ISTP Standard. | |

| | |
|--|--|
| <h1>Project</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Single Entry</p> | <p>SYNTAX</p> <p><i>“short_name>long_name”</i></p> <p>where the substrings <i>“short_name”</i> and <i>“long_name”</i> are fixed by CSDS.</p> |
| <p>DEFINITION</p> <p>Name of the Project under which the mission is designated.</p> | |
| <p>USED IN</p> <p>SP</p> <p>PP</p> | <p>VALUE</p> <p>“STSP Cluster>Solar Terrestrial Science Programme, Cluster”</p> <p>“STSP Cluster>Solar Terrestrial Science Programme, Cluster”</p> |
| <p>SOURCE</p> <p>Provided in .skt file.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>ISTP Standard</p> <p>Value fixed by CSDS in advance.</p> | |

| | |
|--|---------------------------------------|
| <h1>Reference_SC</h1> | |
| DATA TYPE Global Attribute Character string Maximum length 80 Single Entry | SYNTAX Text digit, e.g. "1" |
| DEFINITION Spacecraft id of reference spacecraft. | |
| USED IN SP - AUX JP - PGP | VALUE "1" "1" |
| SOURCE Provided in .skt file. | WHEN USED Always required |
| COMMENTS CSDS Standard Value chosen by CSDS. | |

Rules_of_use

DATA TYPE

Global Attribute
Character string
Maximum length 80
Single Entry.

SYNTAX

Free form text string.

DEFINITION

Text containing information on, *e.g.* citability and PI access restrictions. Since these may change this attribute should refer to the CSDS for current status.

USED IN

SP & PP

VALUE

“refer to CSDS for rules of use”

SOURCE

Provided in .skt file.

WHEN USED

This is Optional in the ISTEP standards, but is adopted as required for CSDS.

COMMENTS

ISTP Standard

| | |
|---|--|
| <h2>Skeleton_version</h2> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Single Entry.</p> | <p>SYNTAX</p> <p>“CSDS_CDF_V<i>n.m</i>” where <i>n.m</i> is the numerical value identifying the skeleton file version.</p> |
| <p>DEFINITION</p> <p>This is a text attribute containing the skeleton file version number.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p><i>e.g.</i></p> <p>“CSDS_CDF_V1.9”</p> |
| <p>SOURCE</p> <p>Provided in .skt file.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> <p>The CSDS defined skeleton files will be under version control, and define the details of the CDF file structure. These will be distributed via the ESTEC server. The version number provides a check that all NDCs are using the same version of the skeleton files. Since the skeleton files are provided centrally, this attribute should be written into the CDF file from the skeleton file itself.</p> | |

| | |
|--|--|
| <h1>SC_Eng_id</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Multiple Entries.</p> | <p>SYNTAX</p> <p>“spacecraft;inst_module_id”</p> |
| <p>DEFINITION</p> <p>The string <i>spacecraft</i> is the Dornier spacecraft identification number, and permits mapping of the engineering spacecraft id to the operational designation 1 to 4. The string <i>inst_module_id</i> is specified by the instrument teams, and may identify the actual flight module(s) used.</p> | |
| <p>USED IN</p> <p>PP only</p> | <p>VALUE</p> <p>To be supplied by instrument teams for each spacecraft</p> |
| <p>SOURCE</p> <p>Provided in .skt file.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> | |

| | |
|--|---|
| Source_name | |
| <small>DATA TYPE</small> Global Attribute Character string Maximum length 80 Single Entry | <small>SYNTAX</small> “C <i>n</i> > Cluster Spacecraft <i>n</i> ” where ‘ <i>n</i> ’ takes the values 1,2,3 and 4 for the four spacecraft PP files respectively. For the SP data files the syntax is “CL> Cluster”. |
| <small>DEFINITION</small> The mission name, but for Cluster should also include which satellite. | |
| <small>USED IN</small> SP PP sat 1 PP sat 2 PP sat 3 PP sat 4 | <small>VALUE</small> “CL> Cluster” “C1> Cluster Spacecraft 1” “C2> Cluster Spacecraft 2” “C3> Cluster Spacecraft 3” “C4> Cluster Spacecraft 4” |
| <small>SOURCE</small> Provided in .skt file. | <small>WHEN USED</small> Always required |
| <small>COMMENTS</small> ISTP Standard Value fixed by CSDS in advance. | |

| | |
|---|---|
| <h2>State_wec_key</h2> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Text string</p> <p>Maximum length 80</p> <p>Multiple Entry</p> | <p>SYNTAX</p> <p>Free form, but suggested syntax is "State_wec[n]='mmm'= value", where <i>n</i> is the element in the array (in the range 0 - 4), <i>mmm</i> is a one byte integer (0 - 255) status code and <i>value</i> is the meaning of the status code (where appropriate it may also give the 8 bit binary code that it derived from).</p> |
| <p>DEFINITION</p> <p>A key defining the meanings of all possible status codes that may arise in the State_wec variable.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>To be provided</p> |
| <p>SOURCE</p> | <p>WHEN USED</p> <p>Always required for WEC instru- ments</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> | |

| | |
|---|---|
| <h1>Status_key</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Text string</p> <p>Maximum length 80</p> <p>Multiple Entry</p> | <p>SYNTAX</p> <p>Free form, but suggested syntax is “Status[<i>n</i>]=’<i>mmm</i>= <i>value</i>”, where <i>n</i> is the element in the character string (nominally in the range 0 - 3), <i>mmm</i> is a one byte integer (0 - 255) status code, and <i>value</i> is the meaning of the status code (where appropriate it may also give the 8 bit binary code that it derived from).</p> |
| <p>DEFINITION</p> <p>A key defining the meanings of all possible status codes that may arise in the Status word variable.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>“Status[0]=0= Bad data ”</p> <p>“Status[0]=1= Use with caution ”</p> <p>“Status[0]=2= OK ”</p> <p>“Status[0]=255= Not Supplied ”</p> |
| <p>SOURCE</p> <p>Entries for CSDS reserved first char provided in .skt file.</p> <p>Entries for other elements are generated during processing or are to be provided for inclusion in skeleton files.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>CSDS Standard .</p> | |

| | |
|---|--|
| <h1>TEXT</h1> | |
| <p>DATA TYPE Global Attribute Character string Maximum length 80 Multiple Entries</p> | <p>SYNTAX Free form text string.</p> |
| <p>DEFINITION A text description of the experiment. A reference to a journal or document is sufficient.</p> | |
| <p>USED IN SP & PP</p> | <p>VALUE To be provided by NDCs</p> |
| <p>SOURCE Provided in .skt file.</p> | <p>WHEN USED Always required</p> |
| <p>COMMENTS ISTP Standard Value fixed by generating NDCs in advance.</p> | |

| | |
|--|--|
| <h1>TITLE</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Single Entry</p> | <p>SYNTAX</p> <p><i>"Title>description"</i></p> <p>for example "Electron Moments > 1 min ave." for PEACE data in the SPDB.</p> |
| <p>DEFINITION</p> <p>The title of the data.</p> | |
| <p>USED IN</p> <p>SP</p> <p>PP</p> | <p>VALUE</p> <p>To be provided by NDCs</p> <p>To be provided by NDCs</p> |
| <p>SOURCE</p> <p>Provided in .skt file.</p> | <p>WHEN USED</p> <p>Always required</p> |
| <p>COMMENTS</p> <p>ISTP Standard</p> <p>Value fixed by generating NDCs in advance.</p> | |

| | |
|---|---|
| <h1>Validate</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Maximum length 80</p> <p>Single Entry.</p> | <p>SYNTAX</p> <p>The syntax is recommended to be of the form “<i>test>result>where-done>date</i>”.</p> |
| <p>DEFINITION</p> <p>Details to be specified. This attribute is written by software to validate the structure of the CDF file on a simple pass/fail criterion. The software should test that all expected attributes are present and, where possible, have reasonable values.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>To be specified</p> |
| <p>SOURCE</p> <p>To be generated after processing.</p> | <p>WHEN USED</p> <p>Optional</p> |
| <p>COMMENTS</p> <p>ISTP Standard</p> <p>It is not the same as data validation which, for Cluster, is performed by PI inspection, and covered by the global attributes “Validity” and “Validator”, see below.</p> | |

Validator

DATA TYPE

Global Attribute

Character string

Max length 80

Single entry

SYNTAX

Text string. The following form is suggested:

"name>institution>email"

DEFINITION

The Data Centres are responsible for pipeline production and distribution of PPD and SPD data, but responsibility for data validation lies with the PI teams. This attribute allows inclusion of a readable text string providing the name, institution and e-mail address for the team member responsible for validation of this file. It should be added to the file by the validation software.

USED IN

SP & PP

VALUE

To be provided as part of PI level authorised user registration at NDCs.

SOURCE

Provided by CSDS UI validation software

WHEN USED

Always required

COMMENTS

CSDS Standard

| | |
|---|---|
| <h1>Validity</h1> | |
| <p>DATA TYPE</p> <p>Global Attribute</p> <p>Character string</p> <p>Max length 30</p> <p>Single entry</p> | <p>SYNTAX</p> <p>Text string.</p> |
| <p>DEFINITION</p> <p>When the CDF file is first produced it contains the entry 'To be validated'. After PI, or designate, inspection it becomes validated and an entry written via the CSDS UI validation software.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>Initially this is set to "To Be Validated", but possible values once validated are</p> <p>"Validated - no caveats"</p> <p>"Validated - minor caveats"</p> <p>"Validated - major caveats".</p> |
| <p>SOURCE</p> <p>Written when file is validated.</p> | <p>WHEN USED</p> <p>Always required.</p> |
| <p>COMMENTS</p> <p>CSDS Standard.</p> <p>There is a difference between this validity flag which corresponds to the whole file and the 'Status' flag which is kept record by record.</p> <p>This validity is not a statement that each datum has a "science quality" of some level of confidence, but that this file is released to CSDS for distribution.</p> <p>In the case of the AUX SPD files the action of validating the files is to be performed by the generating data centre (HDC). Validation will ensure that values derived by routine processing are physically plausible, rather than detailed testing against the RDM input values. Caveats may be used as normal to provide users with warning information originating from either ESOC or HDC.</p> | |

5 Variable Attributes

This section lists all variable attributes in alphabetical order. A standard format is used as an aid to easy reference.

The list of variable attributes is intended to cover all meta-data that may need to be associated with the variable in a consistent manner. For each variable many of the attributes should not be required, and may be omitted.

There are two classes of variable attribute, regular and 'pointer' class. The regular attributes contain the meta-data themselves. Only one entry is allowed for a text string attribute, but multiple entries are allowed for other data types. The pointer class attributes contain the name of a non-record varying variable which in turn contains the meta-data. The pointer class attributes are useful when each element of an array requires its own distinct attribute, whence the pointer can refer to a variable of appropriate dimension and size to keep the meta-data. Either the regular attribute *or* the 'pointer' equivalent may be used, but they should normally be considered mutually exclusive.

AVG_TYPE

DATA TYPE

Variable Attribute

Character string.

Maximum length 30

Single entry

SYNTAX

A text string.

DEFINITION

The default averaging technique that should be performed on the data to reduce resolution.

USED IN

SP & PP

VALUE

One of:

'standard'

'angle_degrees'

'angle_radians'

'angle_hour'

'RMS'

'log'

'decibel'

'cosine'

'none'

SOURCE

Provided in skeleton files.

WHEN USED

Used for dependent data variables. It is 'optional' in the ISTP standards, but should be used for Cluster if the default averaging type is not 'standard'.

COMMENTS

ISTP Standard

If this attribute is not present then 'standard' (*i.e.* linear) is assumed. This attribute associated with the 'Status' variables should be set to 'none'. See ISTP Guidelines for more details.

| | |
|---|--|
| <h1>Calib_input</h1> | |
| <p>DATA TYPE</p> <p>Variable Attribute</p> <p>Character string.</p> <p>Maximum length 80</p> <p>Single Entry</p> | <p>SYNTAX</p> <p>Free format text string, but the suggested syntax is a character string of the form <i>calib file_date</i> where <i>calib file</i> is a sub-string identifying calibration data file(s) loaded by the software identified in "Calib_software", and <i>date</i> is the date stamp of these calibration files, see section (7.4).</p> |
| <p>DEFINITION</p> <p>This identifies calibration input files that contain constants (such as offsets and scaling that are kept distinct from the software) during PPDB and SPDB production. This information is under PI control.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>To be provided by NDC and PI</p> |
| <p>SOURCE</p> <p>Written when file is populated.</p> | <p>WHEN USED</p> <p>Required for all data variables.</p> |
| <p>COMMENTS</p> <p>CSDS standard.</p> | |

Calib_software

DATA TYPE

Variable Attribute

Character string.

Maximum length 80

Single Entry

SYNTAX

Free format text string, but the recommended syntax is a character string of the form *calib info_date* where *calib info* is a sub-string defining the software version information, and *date* is the date stamp of this calibration software, see section (7.4).

DEFINITION

This records calibration or general data reduction software version information during PPDB and SPDB production. This is particularly important if prime parameter data is subsequently recalculated with different software algorithms, internal calibration routines, *etc.* This information is under PI control.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Written when file is populated.

WHEN USED

Required for all data variables.

COMMENTS

CSDS standard.

| | |
|---|---|
| <h1>CATDESC</h1> | |
| <p>DATA TYPE Variable Attribute Character string. Maximum length 80 Single Entry</p> | <p>SYNTAX Free format text string. <i>e.g.</i> for Glassmeier Configuration parameter, 'sc_config_QG', it could be "(Vol/Ideal)+(Surface/Ideal)+1 for Tetrahedron" or for 'Epoch' in the PP it could be "Interval centred time tag rounded to nearest millisecond".</p> |
| <p>DEFINITION Extra text information on the variable if the FIELDNAM attribute is insufficient.</p> | |
| <p>USED IN SP & PP</p> | <p>VALUE To be provided by NDC and PI</p> |
| <p>SOURCE Provided in skeleton files.</p> | <p>WHEN USED Optional for all variables.</p> |
| <p>COMMENTS ISTEP standard.</p> | |

DEPEND_0

DATA TYPE
Variable Attribute
Character string.
Maximum length 30
Single Entry

SYNTAX
A text string.

DEFINITION
Identifies the time variable on which the associated variable depends.

USED IN
SP & PP

VALUE
Name of Epoch variable providing associated time line.

SOURCE
Provided in skeleton files.

WHEN USED
Required for all data variables.

COMMENTS
ISTP standard.

DEPEND_i

DATA TYPE

Variable Attribute

Character string.

Maximum length 30

Single Entry

SYNTAX

A text string.

DEFINITION

Identifies other variables on which the associated variable depends. It is used for variables of dimension greater than 0, and the identified metadata variables contain information on the measurement meaning in dimension i. For example, for a vector this identifies the elements with x, y and z coordinates in GSE. Similarly it could identify energy or frequency channels for arrays.

USED IN

SP & PP

VALUE

Name of variable providing associated dependency in dimension i.

SOURCE

Provided in skeleton files.

WHEN USED

Required for all data variables of dimension greater than 0.

COMMENTS

ISTP standard.

Note that the scalar DWP correlator variable 'correl_signif' is the peak value from an array in energy and frequency, and as such has Depend_1 and Depend_2 defined. Conceptually it corresponds to a sparse array.

DELTA_PLUS_VAR

| | |
|--|--|
| <p>DATA TYPE Variable Attribute See also DELTA_MINUS_VAR Character string. Maximum length 30 Single Entry</p> | <p>SYNTAX A text string.</p> |
| <p>DEFINITION Contains the name of other variables that store the uncertainty in the dependent variable to which the attribute pertains. DELTA_PLUS_VAR & DELTA_MINUS_VAR may 'point' to the same variable. The identified variable could be used either for uncertainty or range, and may refer to either a percentage or absolute fluctuation. The DICT_KEY attribute will be needed to specify which meaning is intended. For the Epoch variable DELTA_PLUS_VAR points to the variable recording the measurement half-period; this variable should usually be non-record varying and have value 30 seconds for SPD and either half the spin period averaged over the file, or 2 seconds for PPD.</p> | |
| <p>USED IN SP & PP</p> | <p>VALUE Name of variable providing associated uncertainty or range. For Epoch this is "Half_interval%<i>CX_RR_III</i>" for both DELTA_PLUS_VAR & DELTA_MINUS_VAR. See section(7.6) for values of <i>CX_RR_III</i>.</p> |
| <p>SOURCE Provided in .skt file.</p> | <p>WHEN USED Required for Epoch, optional for data variables.</p> |
| <p>COMMENTS ISTP standard.</p> | |

DELTA_MINUS_VAR

DATA TYPE
Variable Attribute
See also
DELTA_PLUS_VAR
Character string.
Maximum length 30
Single Entry

SYNTAX
A text string.

DEFINITION

Contains the name of other variables that store the uncertainty in the dependent variable to which the attribute pertains. DELTA_PLUS_VAR & DELTA_MINUS_VAR may 'point' to the same variable. The identified variable could be used either for uncertainty or range, and may refer to either a percentage or absolute fluctuation. The DICT_KEY attribute will be needed to specify which meaning is intended. For the Epoch variable DELTA_PLUS_VAR points to the variable recording the measurement half-period; this variable should usually be non-record varying and have value 30 seconds for SPD and either half the spin period averaged over the file, or 2 seconds for PPD.

USED IN
SP & PP

VALUE
Name of variable providing associated uncertainty or range. For Epoch this is "Half_interval%*CX_RR_III*" for both DELTA_PLUS_VAR & DELTA_MINUS_VAR. See section(7.6) for values of *CX_RR_III*.

SOURCE
Provided in .skt file.

WHEN USED
Required for Epoch, optional for data variables.

COMMENTS

ISTP standard.
At present this is only used for Epoch in CSDS CDF files.

DICT_KEY

DATA TYPE

Variable Attribute
Character string.
Maximum length 80
Single entry

SYNTAX

Text string.
Syntax "class>descriptor_descriptor_descriptor". Any
number of descriptor entries are permitted.

DEFINITION

It contains a pointer to an entry in the ISTP data dictionary that describes the data type.

USED IN

SP & PP

VALUE

Selected from ISTP list.

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.

COMMENTS

ISTP Standard

May change as the ISTP data dictionary is not complete.

DISPLAY_TYPE

DATA TYPE

Variable Attribute
Character string.
Maximum length 80
Single entry

SYNTAX

Text string.
Syntax “ ”.

DEFINITION

SP & PP

USED IN

Selected from
ISTP list.

VALUE

Provided in skeleton files.

SOURCE

For all variables.

WHEN USED

ISTP Standard.

COMMENTS

FIELDNAM

| | | |
|--|---------------------------------------|---|
| DATA TYPE Variable Attribute Character string Maximum length 30 Single entry | | SYNTAX Free format text. <i>e.g.</i> for the variable 'B_xyz_gse' this could be "DC Magnetic Field", whereas the inner labels from the LABLAXIS attribute would be "Bx (GSE)" <i>etc.</i> |
| DEFINITION Text identifying associated variable | | |
| USED IN SP & PP | VALUE To be provided by NDC and PI | |
| SOURCE Provided in skeleton files. | | WHEN USED For all variables |
| COMMENTS ISTEP Standard This attribute is used as a major or outer heading for plots. It can be longer than the entry in the 'LABEL' attribute, below. For vector quantities it can be used to label the whole variable, while the 'LABEL' attribute associates a short label with each element in the vector. | | |

FILLVAL

DATA TYPE
Variable Attribute
Same as variable.
Single entry

SYNTAX
Same as variable.

DEFINITION
The value to be expected by reading software if data were not written.

USED IN
SP & PP

VALUE
depends on variable data type. ISTP defaults will be used by CSDS as follows:

Epoch -1.0E31

REAL*8 -1.0E31

REAL*4 -1.0E31

INT*4 -2147483648

INT*2 -32768

CHAR space character, \x20 (hex) 32 (decimal)

Note that previously the ISTP FILLVAL for character type variables was the decimal value 255 (\xFF hex), but that this could not be set via the skeleton file as they will not accept non-printable characters. Cluster has character type data variables in the JSOC catalogue files. FILLVAL will not be supplied for the label variables.

SOURCE
Provided in skeleton files.

WHEN USED
For all data variables.

COMMENTS
ISTP Standard

Plot routines may know to ignore values that are equal to the fill value. In CDF version 2.4 and higher this attribute can be read by the utility CDFskeleton to set the pad values for the associated variable for the CDFlib software. This would be advisable for Cluster as the CDFskeleton utility will be used to generate the PPDB and SPDB. Thus the utility should be called with the appropriate flag (-fillval in UNIX) or (/FILLVAL in VMS).

FORMAT

DATA TYPE
Variable Attribute
See also FORMAT_PTR
Character string
FORMAT: Max length 8
FORMAT_PTR: Max
length 30
Single entry

SYNTAX
Text string giving either a C or Fortran format.

DEFINITION
FORMAT: Format to be used for output to a screen or file.
FORMAT_PTR: The name of a variable containing the formats for each entry in an array.

| | |
|--------------------|---------------------------------------|
| USED IN SP & PP | VALUE To be provided by NDC and PI |
|--------------------|---------------------------------------|

SOURCE
Provided in skeleton files.

WHEN USED
For all data variables.
FORMAT is to be used when the entry is the same for all elements, even for dimensioned variables.
FORMAT_PTR is to be used only when a different entry is required for some elements in a dimensioned variable.

COMMENTS
ISTP Standard
If not applicable a blank, “ ”, is preferable to “none” as this may be used by automatic plot software.

FORMAT_PTR

DATA TYPE

Variable Attribute

See also FORMAT

Character string

FORMAT: Max length 8

FORMAT_PTR: Max
length 30

Single entry

SYNTAX

Text string giving name of variable containing format.

DEFINITION

FORMAT: Format to be used for output to a screen or file.

FORMAT_PTR: The name of a variable containing the formats for each entry in an array.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.

FORMAT is to be used when the entry is the same for all elements, even for dimensioned variables.

FORMAT_PTR is to be used only when a different entry is required for some elements in a dimensioned variable.

COMMENTS

ISTP Standard

If not applicable a blank, “ ”, is preferable to “none” as this may be used by automatic plot software.

| | |
|---|--|
| <h1>Frame</h1> | |
| <p>DATA TYPE</p> <p>Variable Attribute</p> <p>Character string.</p> <p>Maximum length 80</p> <p>Single entry</p> | <p>SYNTAX</p> <p>Text string of the form <i>type>frame of reference</i> where <i>frame of reference</i> should be “na” if not applicable. For example, ‘Frame’ for ‘Epoch’ is always “scalar>na” while for ‘V_e_xyz_gse’ it is ‘vector>gse_xyz’.</p> |
| <p>DEFINITION</p> <p>Identifies the nature of the variable, and the frame of reference when applicable.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>The <i>type</i> of quantity may be one of the following:</p> <ul style="list-style-type: none"> scalar vector tensor array character <p>The <i>frame of reference</i> may be one of the following:</p> <ul style="list-style-type: none"> gse_xyz gsm_xyz na <i>other to be specified</i> |
| <p>SOURCE</p> <p>Provided in skeleton files.</p> | <p>WHEN USED</p> <p>Required for all data variables.</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> <p>A distinct type, vector, is defined because it occurs frequently, even though a vector is a tensor of rank one. ‘Tensor’ is used for rank two and higher.</p> <p>Most PP and SP will be scalars, but some will be vectors, and some 1-D arrays. Non-CSDS quantities may also require tensors and higher dimensional arrays. Only vectors and tensors may be rotated, so this attribute identifies which quantities may be rotated, and what frame they are in (usually GSE for PP and SP data). Note, software should not assume that a 3 element 1-D array may be rotated as a vector unless this attribute identifies it as such.</p> | |

LABLAXIS

DATA TYPE

Variable Attribute

See also LABL_PTR_1

Character string

Max length:-

LABLAXIS 10

LABL_PTR_1 30

Single entry

SYNTAX

Free format string. May include the coordinate frame information, *e.g.* "(GSE)". The units are provided elsewhere and should *not* be included here.

DEFINITION

LABLAXIS: Short text string to label the axis in a plot of the variable.

LABL_PTR_1: A pointer to a variable containing the array of axis labels for a dimensioned variable.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.

LABLAXIS is to be used for variables of dimension 0.

LABL_PTR_1 is to be used for all variables of dimension 1 or greater.

COMMENTS

ISTP Standard

Note that the attribute 'FIELDNAM' may be used to label plots where more than one component of an array is plotted in the same panel.

LABL_PTR_1

DATA TYPE

Variable Attribute

See also LABLAXIS

Character string

Max length:-

LABLAXIS 10

LABL_PTR_1 30

Single entry

SYNTAX

Free format string. May include the coordinate frame information, *e.g.* "(GSE)". The units are provided elsewhere and should *not* be included here.

DEFINITION

LABLAXIS: Short text string to label the axis in a plot of the variable.

LABL_PTR_1: A pointer to a variable containing the array of axis labels for a dimensioned variable.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.

LABLAXIS is to be used for variables of dimension 0.

LABL_PTR_1 is to be used for all variables of dimension 1 or greater.

COMMENTS

ISTP Standard

Note that the attribute 'FIELDNAM' may be used to label plots where more than one component of an array is plotted in the same panel.

MONOTON

DATA TYPE

Variable Attribute

Character string.

Maximum length 8

Single entry

SYNTAX

A text string.

DEFINITION

Indicates if variable is monotonic increasing (*e.g.* Epoch), decreasing or neither.

USED IN

SP & PP

VALUE

One of:

“INCREASE”

“DECREASE”

if the variable is not monotonic this attribute should be omitted.

SOURCE

Provided in skeleton files.

WHEN USED

Optional for dependent data variables. Required for ‘Epoch’ variables.

COMMENTS

ISTP Standard

It can be used by processing software to help search and analysis algorithms perform more efficiently.

SCALEMIN

DATA TYPE

Variable Attribute

Same as variable

Single entry

SYNTAX

Same as variable.

DEFINITION

This attributes provides the default minimum values for plot axes.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

For the 'Epoch' variable this is written when file is populated. It will be provided in the skeleton files for other data variables, but may be overridden by software when file is populated.

WHEN USED

For all data variables

COMMENTS

ISTP Standard

SCALEMAX

DATA TYPE

Variable Attribute

Same as variable

Single entry

SYNTAX

Same as variable.

DEFINITION

This attributes provide the default maximum values for plot axes.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

For the 'Epoch' variable this is written when file is populated. It will be provided in the skeleton files for other data variables, but may be overridden by software when file is populated.

WHEN USED

For all data variables

COMMENTS

ISTP Standard

SCALETYP

DATA TYPE

Variable Attribute

Character string.

Single entry

SYNTAX

A text string.

DEFINITION

Scale type for plotting variable.

USED IN

SP & PP

VALUE

Either "linear" or "log".

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.

It is an 'optional' ISTD attribute, but should be used for Cluster to aid plotting software.

COMMENTS

ISTD Standard

Other Cluster scaletypes could be defined, such as 'folding', TBD.

| | |
|--|---|
| <h2>SC_id</h2> | |
| DATA TYPE Variable Attribute Character string. Max length 10 Single entry | SYNTAX A text string containing spacecraft number. |
| DEFINITION This is the spacecraft identity number as a text string. This duplicates information in the variable name, but allows access to this information independently via attribute handling software. | |
| USED IN SP & PP | VALUE One of: “1”, “2”, “3” or “4”, or a combination such as “12” up to “1234” |
| SOURCE For SP this is written when file is populated. For PP this is provided in skeleton files. | WHEN USED For all data variables. |
| COMMENTS CSDS Standard. If more than one spacecraft are involved in production of the parameter (<i>e.g.</i> inter-spacecraft separations) then the numbers of all involved spacecraft are included. For example, for the separation between spacecraft 1 and 2 the entry is ‘12’. | |

SI_conversion

DATA TYPE

Variable Attribute

Character string.

Max length 80

Single entry

SYNTAX

Text string of the form

value>*SI unit*

where *value* is the conversion factor and the *SI unit* is the standard unit that it converts to. For example the magnetic field for FGM may be in **nT**, and to convert to Tesla the value of "SI_conversion" should be '1.0e-9>T'. For multi-dimensional units the grammar will be of a standard form. Distinct unit dimensions will be separated by space characters and powers (signed) will be preceded by the carat, \wedge . Non-dimensional qualifiers, which do not appear in the SI units list, are to be enclosed in braces '()' which may then be passed unaltered by parsing software. For example, 'm s \wedge -1' or '(number electrons) m \wedge -3'. Similarly '(percent)' and '(ratio)' would provide user information on dimensionless quantities. Non-integer powers are permitted, e.g. 'Hz \wedge -0.5'

DEFINITION

The conversion factor to SI units. This is the factor that the variable must be multiplied by in order to turn it to SI units. A table of recognised SI units is provided.

USED IN

SP & PP

VALUE

SI units should be one of:

s second

kg kilogram

m metre

Hz hertz

A ampere

K kelvin

J joule

V volt

T tesla

Pa pascal

C coulomb

henry [needed for mu_o]

farad [needed for eps_o]

W watt

N newton

ohm

mho

rad radian

sr steradian

degree [alternate angle measure, not SI, but avoids Pi].

SOURCE

Provided in skeleton.

WHEN USED

For all data variables.

COMMENTS

CSDS Standard.

This attribute makes multi-instrument quantities machine calculable without user intervention.

SI_conversion_ptr

DATA TYPE

Variable Attribute

Character string.

Max length 30

Single entry

SYNTAX

Text string containing the name of a character type variable with the same dimension as the variable to which this attribute belongs. The variable pointed to must contain the SI_conversion values (see above) for each element of the variable.

DEFINITION

Pointer to variable holding the conversion factors to SI units. These are the factors that the elements of the variable must be multiplied by in order to turn them to base SI units. A table of recognised base units is provided.

USED IN

Not needed for

SP or PP

VALUE

See SI_conversion.

SOURCE

written by software

WHEN USED

Only for inhomogeneous variables, such as vectors in polar coordinates.

COMMENTS

CSDS Standard.

This attribute makes multi-instrument quantities machine calculable without user intervention.

| | |
|---|---|
| <h2>Sig_digits</h2> | |
| DATA TYPE Variable Attribute Character string. Max length 10 Single entry | SYNTAX A text string containing the number of significant digits. |
| DEFINITION This attribute provides the number of significant digits. | |
| USED IN SP & PP | VALUE TBD |
| SOURCE Provided in skeleton files. | WHEN USED For all data variables. |
| COMMENTS CSDS Standard. It is to allow compression software to optimise the number of digits to retain, and users to assess the accuracy of products. This operation is subject to the deliberations of the 'network traffic report' Task Group, DS-CFC-TN-0001, on compression algorithms and implementation. Restrictions on data compression may also influence the format and choice of data type used by the CDF generation software. | |

UNITS

DATA TYPE

Variable Attribute

See also UNIT_PTR

Character string

Max length:-

UNITS 20

UNIT_PTR 30

Single entry

SYNTAX

Free format string.

DEFINITION

UNITS: Text string with units to add to plots.

UNIT_PTR: The name of a variable containing the units for a dimensioned variable.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.

UNITS is to be used when the entry is the same for all elements, even for dimensioned variables.

UNIT_PTR is to be used only when a different entry is required for some elements in a dimensioned variable.

COMMENTS

ISTP Standard

If not applicable a blank, “ ”, is preferable to “none” as this may be used by automatic plot software.

UNIT_PTR

DATA TYPE

Variable Attribute

See also UNITS
Character string
Max length:-
UNITS 20
UNIT_PTR 30
Single entry

SYNTAX

Free format string.

DEFINITION

UNITS: Text string with units to add to plots.

UNIT_PTR: The name of a variable containing the units for a dimensioned variable.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Provided in skeleton files.

WHEN USED

For all data variables.
UNITS is to be used when the entry is the same for all elements, even for dimensioned variables.
UNIT_PTR is to be used only when a different entry is required for some elements in a dimensioned variable.

COMMENTS

ISTP Standard

If not applicable a blank, “ ”, is preferable to “none” as this may be used by automatic plot software.

VALIDMIN

DATA TYPE

Variable Attribute

See also VALIDMAX

Same as variable

Single entry

SYNTAX

Same as variable.

DEFINITION

This attribute provides a minimum below which the values of the variable are considered unreliable due to instrument constraints.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Default may be provided in the skeleton files, but the valid range may be mode dependent and for some instruments must be written from software when the file is populated.

WHEN USED

For all data variables

COMMENTS

ISTP Standard

VALIDMAX

DATA TYPE

Variable Attribute

See also VALIDMIN

Same as variable

Single entry

SYNTAX

Same as variable.

DEFINITION

This attribute provides a maximum above which the values of the variable are considered unreliable due to instrument constraints.

USED IN

SP & PP

VALUE

To be provided by NDC and PI

SOURCE

Default may be provided in the skeleton files, but the valid range may be mode dependent and for some instruments must be written from software when the file is populated.

WHEN USED

For all data variables

COMMENTS

ISTP Standard

VAR_TYPE

DATA TYPE

Variable Attribute
Character string.
Maximum length 10
Single entry

SYNTAX

A text string that has value of either “data” or “meta-
data”.

DEFINITION

This identifies whether the associated variable is true data or metadata which de-
scribes the data.

USED IN

SP & PP

VALUE

Either “data” or “metadata”

SOURCE

Provided in .skt files.

WHEN USED

For all variables.

COMMENTS

ISTP Standard

6 Variables

Variables are divided into data variables, such as ‘Epoch’ and instrument data products, and metadata that describes the data, such as ‘Half_interval’ and labels for vector data. A further distinction of ‘record-varying’ and ‘non-record-varying’ may be made, depending upon whether the variable has distinct entries in each data record or a single value is supplied for all data records in the file. Variables of type ‘data’ are always record-varying, while ‘metadata’ are usually non-record-varying.

All variables take the extension *CX_RR_III* which identifies the spacecraft, resolution and instrument. See section(7.6) for details and syntax of this postfix.

| | |
|--|------------------------------------|
| Epoch%<i>CX_RR_III</i> | |
| <small>DATA TYPE</small> CSDS Data Product real*8 Scalar FILLVAL = -1.e31 record-varying | <small>SYNTAX</small> |
| <small>DEFINITION</small> This is a 64 bit real containing the number of milliseconds since time 01-Jan-0000 00:00:00.000 and stores time to millisecond accuracy. Standard CDF functions allow conversion between text strings (as above) and Epoch values. | |
| <small>USED IN</small> SP & PP | <small>VALUE</small> |
| <small>SOURCE</small> Written when file is populated. | <small>WHEN USED</small> Always |
| <small>COMMENTS</small> ISTP Standard Epoch variables should always be monotonic increasing within a CDF file and the attribute “MONOTON” should be set to “INCREASE” for Epoch variables. Epoch does not allow for leap seconds, but since these may occur only four times during a nominal two year operations phase, CSDS has chosen to merely mark affected records as bad data. Although leap seconds are cumulative, the error resulting from conversion to and from Epoch is only affected where the leap second occurs, and is not cumulative. This should be the first record varying variable in the CDF file, and this is set by the skeleton files. | |

Status%*CX_RR_III*

DATA TYPE

CSDS Data Product

uint1[*n*]
array of 1-byte unsigned integers
FILLVAL = 255
record-varying

SYNTAX

array of size *n*.
First element is CSDS Status byte. Other elements are also unsigned 1-byte integers with value in [0,255], at PI disposal. The value 255 is reserved as the FILLVAL and is used to indicate that the Status value is not available. The array size, *n*, is prescribed by the skeleton file and is under configuration control. The baseline is 4 characters.

DEFINITION

Status flag for each instrument on each spacecraft.

The first element is reserved for CSDS wide standard status messages and the others are to be used according to instrument team designation.

Status is not to be provided for the AUX data at PP resolution, and hence no AUX PP files will be produced. Only SP resolution Status will be written for AUX parameters. The AUX Status variable should have 5 elements in total. In the AUX SPD files the Status[0] element is to be written as for other files, but nominally should be '2', that is, "OK".

The other AUX Status, Status[1] to Status[4] are to be allocated one to each spacecraft with the array index being the same as the appropriate SC.id. These elements may be used by HDC at their own discretion to identify any status information arising during processing. They may also identify status flags such as the identity of the receiving ground station.

Note that the auxilliary data may be available (and desirable) even when the scientific instruments are not operating. Since the SPD files are small the AUX parameters should be supplied whenever available.

The CDF files for WEC instruments will also include the WEC Status word which will be called, 'State_wec%*CX_RR_III*', e.g., 'State_wec%*C2_PP_STA*' for spacecraft 2 for STAFF Prime Parameter files.

USED IN

SP & PP

VALUE

Values are restricted to being distinct unsigned 1-byte integers, *i.e.* values between 0 and 255 inclusive.

SOURCE

Written when file is populated.

WHEN USED

Always

COMMENTS

CSDS Standard

State_wec is a 5 element array of 1-byte unsigned integers to allow a distinct element for each of the WEC instruments. For State_wec alone the first element is not reserved for CSDS wide status values.

Half_interval%*CX_RR_III*

| | | | |
|---|--|--|--|
| DATA TYPE Metadata real*8 Scalar FILLVAL = -1.e31 normally non-record-varying | | SYNTAX | |
| DEFINITION Half of average measurement interval in milliseconds (as a real*8) . | | | |
| USED IN SP PP | | VALUE 3.e4 (half a minute) half average sample period in file. | |
| SOURCE Written when file is populated. | | WHEN USED Always | |
| COMMENTS CSDS Standard Note that the Epoch value measures the centre of the interval. Since the spin period should vary only very slowly it is recommended that this variable be non-record-varying. The average over the half intervals excluding data gaps for the whole file should be used. It is pointed to by the “DELTA_PLUS_VAR” attribute for the “Epoch” variable in order to be consistent with the ISTP implementation. In exceptional circumstances it may be necessary to redefine this to record varying (in the pipeline software before entering any values), for example, for prime parameter data collected during a day that involved a spacecraft manoeuvre. Otherwise spin periods are stable enough for PPD purposes, while the SPD is a fixed minute sample time and always non-record-varying. If a more accurate measure of sample interval is required, the time separation between time tags gives the average of the two neighbouring intervals. The exact interval cannot be extracted for time centred measurements, but the PPDB does not require this level of accuracy. | | | |

| | |
|---|--|
| <h2 style="margin: 0;">L_gse_xyz</h2> | |
| <p>DATA TYPE</p> <p>Metadata</p> <p>char[7]</p> <p>array dimension 1 size 3</p> <p>non-record-varying</p> <p>This does not take the % extension as it is file invariant and identical in all files containing gse cartesian vectors.</p> | <p>SYNTAX</p> <p>Array of three quantities, each a seven element string (char[7]).</p> |
| <p>DEFINITION</p> <p>Identifies elements for GSE vector quantities. Pointed to by 'Depend_1' variable attribute for gse vectors.</p> | |
| <p>USED IN</p> <p>SP & PP</p> | <p>VALUE</p> <p>[1] = "x (GSE)"</p> <p>[2] = "y (GSE)"</p> <p>[3] = "z (GSE)"</p> |
| <p>SOURCE</p> <p>Provided in skeleton file.</p> | <p>WHEN USED</p> <p>Always</p> |
| <p>COMMENTS</p> <p>CSDS Standard</p> | |

7 Standard Field Definitions

7.1 File Names

For operating systems with case sensitive file system naming schemes the CDF file names will be in upper case with the extension .cdf in lower case. On case insensitive operating systems it is immaterial what case is used for file names.

For non-CSDS files with the optional extension ‘_extn’ the use of upper or lower case is at the discretion of the person generating the file, but care should be taken to ensure that names remain unique if they are to be transferred to case insensitive environments.

7.2 Instrument abbreviations

ASP ASPOC, Active Spacecraft Potential Control

AUX AUX, Auxiliary Data

PEA PEACE, Plasma Electron and Current Experiment

FGM FGM, Fluxgate Magnetometer

EDI EDI, Electron Drift Instrument

EFW EFW, Electric Fields and Waves

DWP DWP, Digital Wave Processor

CIS CIS, Cluster Ion Spectrometry

RAP RAPID, Research with Adaptive Particle Imaging Detectors

STA STAFF, Spatio-Temporal Analysis of Field Fluctuations

WBD WBD, Wide Band Data

WHI WHISPER, Waves of High Frequency and Sounder for Probing of Density by Relaxation

7.3 Time Fields

The standard time fields used as attribute entries will be in ISO standard UTC extended to accommodate millisecond accuracy. This will be of the form:

yyyy-mm-ddT $HH:MM:ss$.wwwZ

where *yyyy* is a four character year field, *mm* is a two character month, *dd* is a two character day, *HH* is a two character hour (00-23), *MM* is two character minutes, *ss* is two character seconds and *www* is three characters for milliseconds. For example, noon on 5 November 1996 would be: 1996-11-05T12:00:00.000Z

while midnight of the same day (12 hours later) would be: 1996-11-06T00:00:00.000Z

7.4 Date fields

Date fields, when not part of a time field, take the format:

yyyymmdd

where *yyyy* is a four character year field, *mm* is a two character month and *dd* is a two character day. For example, the 5 November 1996 would be, 19961105

7.5 Fill Values

Fill values for CDF variables:-

| Type | Fill Value | CDF_type | Comments |
|----------------|-------------|--------------------------------------|---|
| 4 byte real | -1.0e31 | CDF_FLOAT CDF_REAL4 | |
| 8 byte real | -1.0e31 | CDF_REAL8 CDF_DOUBLE CDF_EPOCH | Including Epoch, but some CDFs use 01-Jan-1994 00:00:00.000 for Epoch |
| byte | -128 | CDF_BYTE CDF_INT1 | numeric value of char in C |
| unsigned byte | 255 | CDF_UINT1 | Not ISTP, numeric value of uchar in C |
| 2 byte int | -32768 | CDF_INT2 | |
| Uns 2 byte int | 65535 | CDF_UINT2 | Not ISTP |
| 4 byte int | -2147483648 | CDF_INT4 | |
| Uns 4 byte int | 4294967295 | CDF_UINT4 | Not ISTP |
| char | " " | CDF_CHAR CDF_UCHAR | Hexadecimal '\x20' or decimal 32 The space character |

7.6 Variable Names

All variable names (both data and metadata) will contain a postfix that identifies the CDF file it is held in. Thus variable names will be of the form:

variable%CX_RR_III

where *CX* is one of C1, C2, C3, C4 or CL (the last for the Summary Parameter files), *RR* is the resolution of the file, *i.e.* either SP or PP for the Summary and Prime Parameters respectively, and *III* is the three character instrument abbreviation.

For example, the Epoch variable will be
Epoch%C2_PP_WHI

for WHISPER in the Prime Parameter file for spacecraft 2.

7.7 Standards for Merging/Subsetting

Standards for merging, joining and subsetting files are not specified completely for CSDS and have not been placed under configuration control. Recommendations for handling standard attribute and variable fields on file processing are provided in the document DS-QMW-TN-0009 (see reference document list).

7.8 Standards for non-CSDS Data Products

Separate recommendations are provided in DS-QMW-TN-0008, for syntax and definition of the contents of generic data files containing data other than CSDS database products (SPD and PPD). Those recommendations are provided in order to facilitate the access of other data products by Cluster science analysis software and for writing of processed data from such software systems. They provide guidelines only and are not under CSDS configuration control.

7.9 Definition of Spin

This section is now covered by the CSDS configuration controlled document, "Definition of Spin for CSDS", DS-QMW-TN-0007.

7.10 Definition of 'Minute' for SPDB

The summary parameters are to be averages over a minute, but we have yet to define what that really means. Some instruments are spin synchronized, others are clock oriented. However, since the SPDB is essentially a sub-set of the spin-averaged PPDB, and since the time of a spin is taken as its middle time (Section 7.9) it is reasonable to define a minute average as

the average of all those measurements made during spins whose middle times lie within the minute boundaries

and to define the time stamp of the minute average as *the initial minute boundary plus 30 sec.*

Those experiments that are clock-oriented, and which calculate the SPDB directly from the raw data *and not from the PPDB*, might find it more convenient to take only those measurements into the average that lie between the minute boundaries. This could add a slight bias to the timing, but this should be unimportant given the 60-s resolution of the SPDB.

7.11 Empty Files

This subsection defines the content of CSDS CDF files for days with no science data appropriate to the PPD or SPD.

This file definition applies to files for which it is not possible to generate any CSDS data products for a given spacecraft/instrument/day combination. It is not intended

for use when data processing is merely delayed by instrumental or calibration problems whatever the delay. If at a later stage it becomes apparent that the relevant data cannot be processed, then empty files as described here may then be generated.

7.11.1 Catalogue Entries for Empty Files

Reference to the existence of an empty data file must be possible within the CSDS UI catalogues. This is to enable a user may ascertain that telemetry has been processed for a specified day, but that no data resulted.

The instrument mode provides the science user with information on non-existence of science data, such as instrument off or engineering mode etc.

It will be necessary for the UI project to ensure that a search on data availability will be possible using the instrument mode bearing in mind that no valid science data intervals will be recorded in the catalogues. Since the operation of confirming the absence of science data may not be intuitively obvious within the normal operation of the query interface it must be explicitly documented.

In view of the need for the CSDS UI to ingest files with no science data, the following must be provided within such 'empty' files.

7.11.2 Data Records

In the absence of any valid science data a single record of fill values will be written. This avoids CDFlib read errors that result from a NULL file, and provides a record number to associate with the mode attribute.

- The Epoch variable should contain the epoch for the start of the day being processed.
- The first byte of the Status variable should be 0, that is bad data. The value 255 is reserved for 'Status not provided'.

7.11.3 Global Attributes

Most attributes are provided through the skeleton files and are to be kept. Attributes written by pipeline processing should be provided where possible, but the following specific attributes must be present:

Logical_file_id based on the instrument, spacecraft and day for which the science data is not available.

Data_intervals although no data is available a single 'data record' of fill values has been written, and this should result in an entry 0, 0 to enable software to access the record of FILLVALs.

Instr_mode a single entry with record number 0 and time corresponding to the start of the day being processed with an instrument mode that is distinct from modes that produce science data, that is an instrument off mode or similar.

Orbit_number this should always be provided in the AUX SP files.

7.11.4 Variable Attributes

No special action is needed on variable attributes.

Index

| | page |
|--|------|
| 4 Acknowledgment | 6 |
| 4 ADID_ref | 7 |
| 4 Caveats | 8 |
| 4 Data_intervals | 9 |
| 4 Data_type | 10 |
| 4 Data_version | 11 |
| 4 Descriptor | 12 |
| 4 Discipline | 13 |
| 4 Generated_by | 14 |
| 4 Generation_date | 15 |
| 4 Inst_mode | 16 |
| 4 Inst_settings | 18 |
| 4 JSOC_EVENT_CODES | 19 |
| 4 Logical_file_id | 20 |
| 4 Logical_source | 21 |
| 4 Logical_source_description | 22 |
| 4 MODS | 23 |
| 4 Mission_group | 24 |
| 4 Orbit_number | 25 |
| 4 Parents | 26 |
| 4 PI_affiliation | 27 |
| 4 PI_name | 28 |
| 4 Project | 29 |
| 4 Reference_SC | 30 |
| 4 Rules_of_use | 31 |
| 4 Skeleton_version | 32 |
| 4 SC_Eng_id | 33 |
| 4 Source_name | 34 |
| 4 State_wec_key | 35 |
| 4 Status_key | 36 |
| 4 TEXT | 37 |
| 4 TITLE | 38 |
| 4 Validate | 39 |
| 4 Validator | 40 |
| 4 Validity | 41 |
| 5 AVG_TYPE | 43 |
| 5 Calib_input | 44 |
| 5 Calib_software | 45 |
| 5 CATDESC | 46 |
| 5 DEPEND_0 | 47 |
| 5 DEPEND_i | 48 |
| 5 DELTA_PLUS_VAR | 49 |
| 5 DELTA_MINUS_VAR | 50 |
| 5 DICT_KEY | 51 |

| | | |
|---|---|----|
| 5 | DISPLAY_TYPE | 52 |
| 5 | FIELDNAM | 53 |
| 5 | FILLVAL | 54 |
| 5 | FORMAT | 55 |
| 5 | FORMAT_PTR | 56 |
| 5 | Frame | 57 |
| 5 | LABLAXIS | 58 |
| 5 | LABL_PTR_1 | 59 |
| 5 | MONOTON | 60 |
| 5 | SCALEMIN | 61 |
| 5 | SCALEMAX | 62 |
| 5 | SCALETYP | 63 |
| 5 | SC_id | 64 |
| 5 | SI_conversion | 65 |
| 5 | SI_conversion_ptr | 67 |
| 5 | Sig_digits | 68 |
| 5 | UNITS | 69 |
| 5 | UNIT_PTR | 70 |
| 5 | VALIDMIN | 71 |
| 5 | VALIDMAX | 72 |
| 5 | VAR_TYPE | 73 |
| 6 | Epoch% <i>CX_RR_III</i> | 74 |
| 6 | Status% <i>CX_RR_III</i> | 75 |
| 6 | Half_interval% <i>CX_RR_III</i> | 76 |
| 6 | L_gse_xyz | 77 |