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Rosetta-SD2

To Planetary Science Archive Interface Control Document

RLGS-SPEC-SONC_DPS-SCIE-9032-CNES
SOP-RSSD-TPL-001

Issue 1.0

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Distribution List

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Change Log

Date	Sections Changed	Reasons for Change
23/12/2010	Creation of Issue 1 Revision 0	Delivery of Issue 1.0 to PSA after peer review

TBD ITEMS

Section	Description
3.4.3.6	Geometry Directory

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1 Introduction

1.1 Purpose and Scope

The purpose of this EAICD (Experimenter to (Science) Archive Interface Control Document) is two fold. First it provides users of the SD2 instrument with detailed description of the product and a description of how it was generated, including data sources and destinations. Secondly, it is the official interface SD2 experiment and the archiving authority.

1.2 Archiving Authorities

The Planetary Data System Standard is used as archiving standard by

- NASA for U.S. planetary missions, implemented by PDS
- ESA for European planetary missions, implemented by the Research and Scientific Support Department (RSSD) of ESA

ESA's Planetary Science Archive (PSA)

ESA implements an online science archive, the PSA,

- to support and ease data ingestion
- to offer additional services to the scientific user community and science operations teams as e.g.
    - search queries that allow searches across instruments, missions and scientific disciplines
    - several data delivery options as
        - direct download of data products, linked files and data sets
        - ftp download of data products, linked files and data sets

The PSA aims for online ingestion of logical archive volumes and offers the creation of physical archive volumes on request.

1.3 Contents

This document describes the data flow of the SD2 instrument on Rosetta from the s/c until the insertion into PSA. It includes information on how data were processed, formatted, labelled and uniquely identified. The document discusses general naming schemes for data volumes, data sets, data and label files. Standards used to generate the product are explained. Software that may be used to access the product is explained. The design of the data set structure and the data product is given.

1.4 Intended Readership

The staff of archiving authority (Planetary Data System for NASA, Planetary Science Archive for ESA) design team and any potential user of the SD2 data.

1.5 Applicable Documents

AD 1. Planetary Data System Data Preparation Workbook, February 17, 1995, Version 3.1, JPL, D-7669, Part1
AD 2. Planetary Data System Standards Reference, August 1, 2003, Version 3.6, JPL, D-7669, Part2
AD 3. "CDMS – SD2 Data Interface Control Document", SHARK-ICD-TS-043, October 2002, Revision G
AD 4. CDMS Subsystem &Instruments Electrical Interface Definition (Extract from REID-A) and Generic Payload Control.
AD 5. CDMS Command and Data Management System - Subsystem Specification RO-LCD-SP-3101 29/08/2001, Issue 3, Rev. 5
AD 6. CDMS Command and Data Management System - Operation Manual RO-LCD-SW-3402 12/02/2001, Issue 1, Rev. 2
AD 7. Rosetta Time handling RO-EST-TN-3165, issue 1 rev 0, February 9, 2004
AD 8. "SD2 Subsystem User Manual", SD2-SUM-TS-011, October 2002, Revision E
AD 9. "Rosetta Lander SD2 Subsystem Specification", SHARK-AB-TS-003, May 2001, Revision E
AD 10. "SD2 Software User Requirement Document", SHARK-URD-TS-067, June 2001, Revision E
AD 11. RO-EST-RS-3001/EID A, Rosetta Experiment Interface Document, Part A
AD 12. RO-LAN-RD-3111, Rosetta Lander Experiment Interface Document, REID-A
AD 13. DDID- Data Delivery Interface Document RO-ESC-IF-5003 Issue B6 23/10/2003
AD 14. ROSETTA Archive Generation, Validation and Transfer Plan, January 10, 2006, Issue 2, Rev. 3, RO-EST-PL-5011
AD 15. ROSETTA Archive Conventions RO-EST-TN-3372 Issue 5, Rev. 6, 25 March 2010
AD 16. CDMS DDD, RO-LCD-SW-3610, Issue 6 and above

1.6 Relationships to Other Interfaces

No products, software and documents would be affected by a change in this EAICD.

1.7 Acronyms and Abbreviations

CDMS	Command and Data Management System
CODMAC	Committee On Data Management, Archiving, and Computation
COSAC	Cometary Sampling And Composition
DDS	Data Disposition System
DECW	Data Error Control Word
EGSE	Electrical & Electronic Ground Support Equipment

ESS	Electrical Support System
FM	Flight Model
FS	Flight Spare
GRM	Ground Reference Model
HK	Housekeeping
HTO	High Temperature Oven
LOBT	Lander On Board Time
MPAe	Max Plank Institute for Aeronomy
MTO	Medium Temperature Oven
OBT	On Board Time
OBDH	On Board Data Handling
OOBT	Orbiter On Board Time
PDS	Planetary Data System
PECW	Packet Error Control Word
PID	Process Identifier
PSA	Planetary Science Archive
QM	Qualification Model
RF	Radio frequency
SC	Science
SCET	Spacecraft Event Time
SD2	Sample Drill & Distribution System
SFDU	Standard Formatted Data Unit
SONC	Science Operations and Navigation Center (CNES-Toulouse)
TBC	To Be Confirmed
UTC	Universal Time Coordinated

1.8 Contact Names and Addresses

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2 Overview of Instrument Design, Data Handling Process and Product Generation

The SD2 experiment provides samples collected at different depths to microscopes and evolved gas analysers.
The primary characteristics of SD2 are here below summarised:

- capable to drill the surface and to collect samples (tens of mm^3) at different controllable depth up to 230mm (assuming a clearance between the Lander Balcony and comet surface of 300 mm);
- capable to move and distribute the collected samples to the different scientific instruments (visible and I/R microscope, gas volatile analysers);
- capable to cope with the expected Comet material properties (e.g. hardness in the range from fluffy snow to some MPa);
- compatibility with the extreme temperature environmental condition (for the electromecanics down to –160°C for storage and –140°C operative);
- compatibility with vacuum environment;
- compatibility with the long inactivity time at extreme environmental condition (9 years during cruise);
- no thermal and chemical contamination are allowed to the sample material;
- challenging mass and power budgets: ~5 kg and 10 W average including mechanics and electronics.

The SD2 system has been conceived as a four degrees of freedom (d.o.f.) robotic system.
Particular importance has been given to the tribological and to the reliability aspects. Indeed all materials, processes and technological solutions have been carefully selected in order to cope with the given conditions, specifically:

- solid and self lubrication;
- brushless actuation and sensors;
- low friction/ antijamming approaches;
- cutting technology (for all range of materials);
- low power consumption and radiation resistant electronics;
- special composite material approach.

2.1 SYSTEM OVERVIEW

The subsystem consists of:
Mechanical Unit;
Electronic Unit (with embedded SD2 software);
Harness (electrically connects Mechanical and Electronic Units)

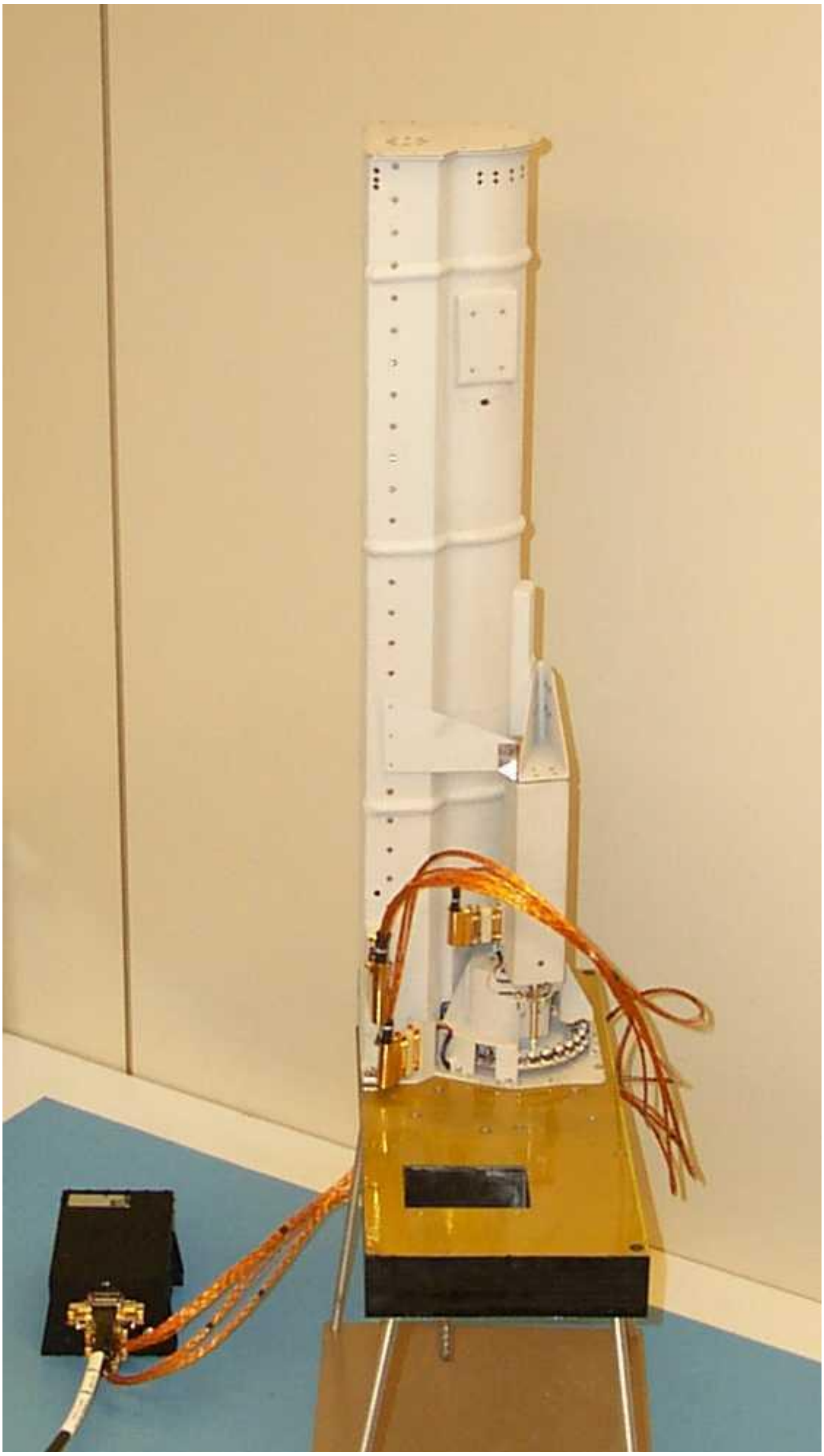


Figure 1 : SD2 system

The picture of SD2 is shown in Figure 1.

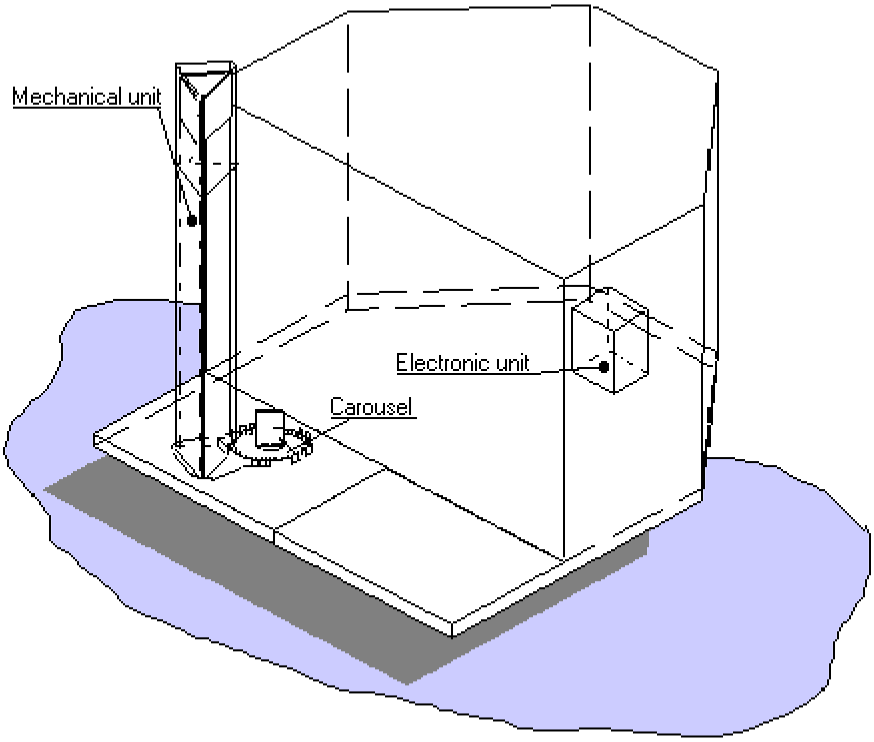


Figure 2 Accommodation of the SD2 subsystem on the Lander

Accommodation of the SD2 units on the Lander is outlined in Figure 2.
The Mechanical Unit is mounted on the Lander Balcony while the Electronic Unit is installed in the warm compartment of the Lander.

The total mass of the SD2 Subsystem is ~ 5.1 kg:
Mechanical Unit ~ 3700 g;
Electronic Unit ~ 1000 g;
Harness ~ 400 g.

Power consumption of SD2 during operations does not exceed the following levels:
Average power consumption in stand by 1.5 W;
Average power consumption during drilling/sampling operations 6.0 W;
Max power consumption during drilling/sampling operations 14.5 W.

2.2 MECHANICS

The SD2 Mechanical Unit configuration and main dimensions are shown in Figure 3 :

SD2 center of gravity: X = 80 mm from right side of base plate placed at the bottom
Y = 72 mm from rear side of base plate placed at the bottom
Z = 320 mm from interface between balcony and SD2 (bottom)

Carousel position: X = 7,5 mm Y = 54 mm Z = Not relevant

(In SD2 reference system)

Drill bit center at zero position: X = -14 mm Y = 6,5 mm Z = -283 mm
(In SD2 reference system)

The Unit consists of the following main components (as shown in Figure 3) :
Tool Box,
Carousel/Base Plate,
Volume Checker,
Ovens.

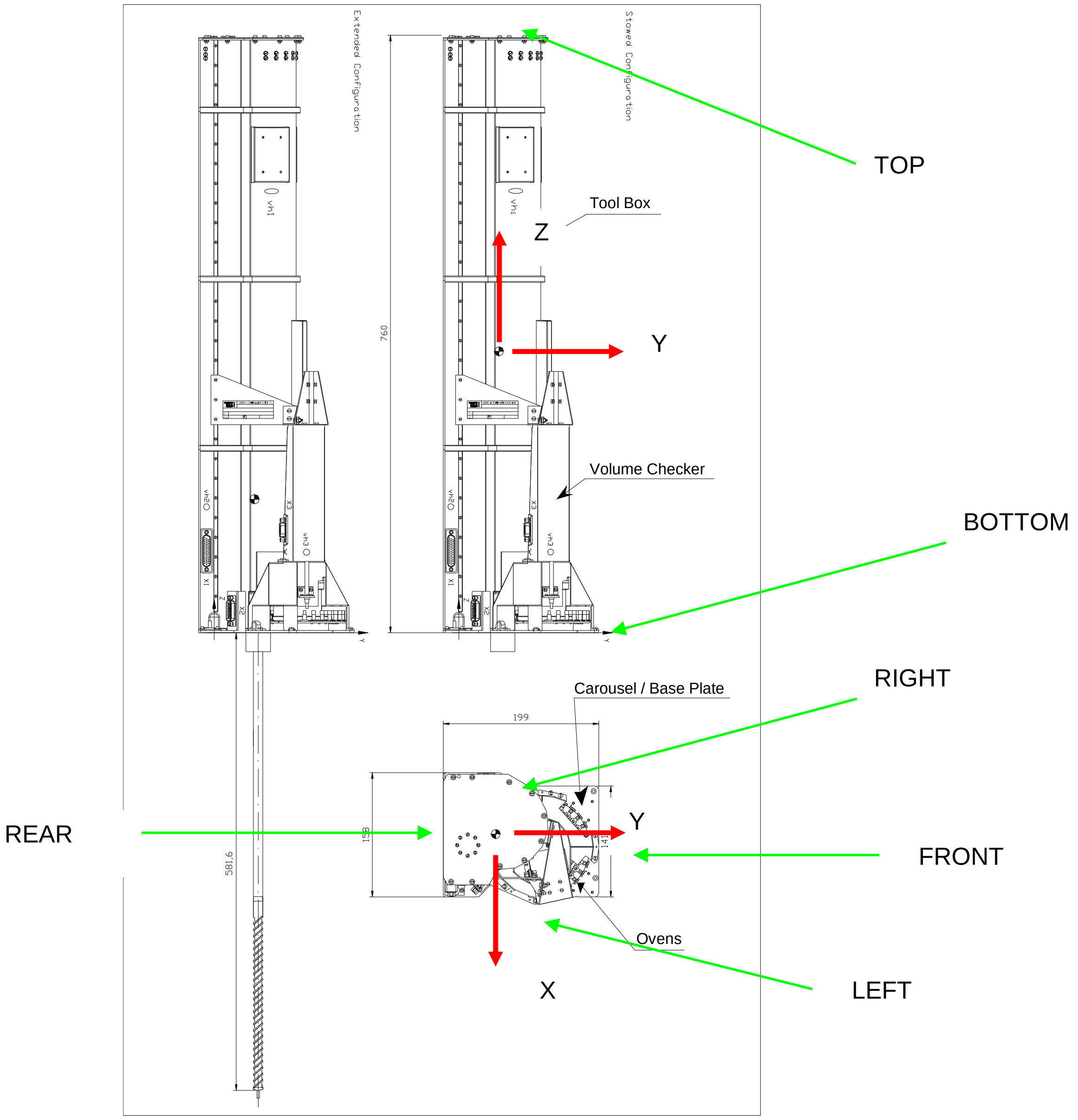


Figure 3 SD2 system in stowed and extended configuration

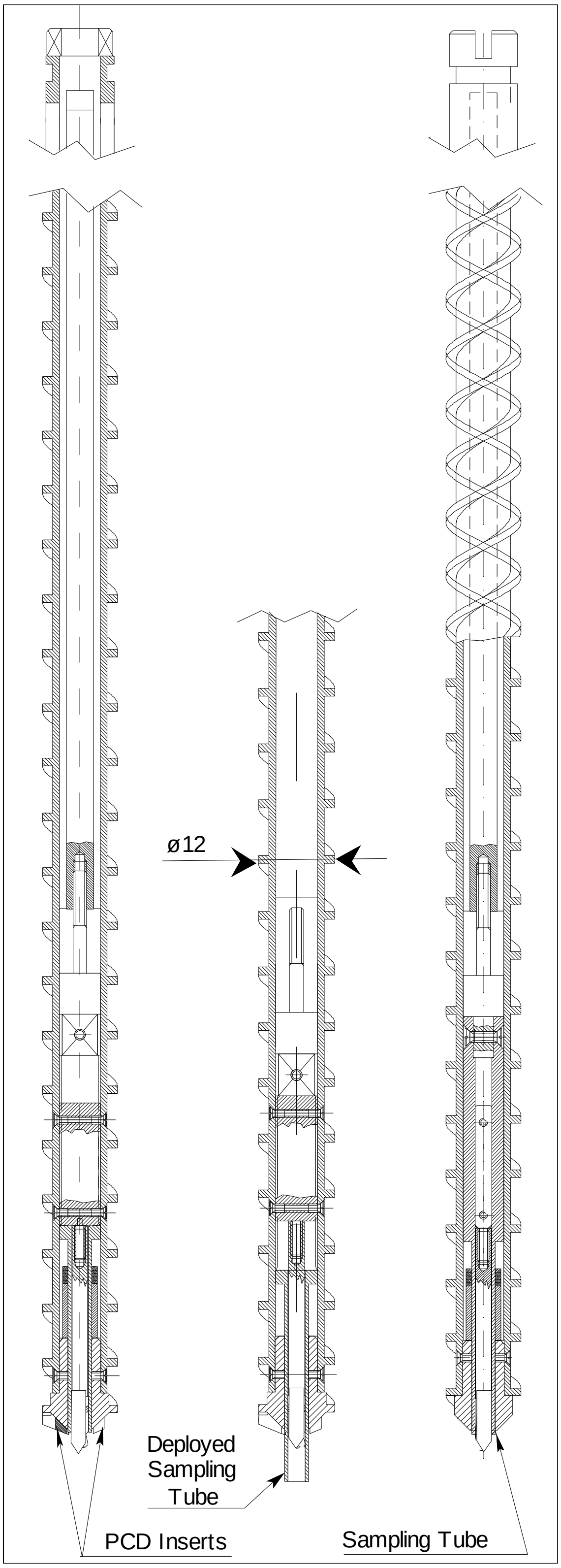


Figure 4 Drill Tool.

See 3.2.3 for more details about SD2 reference systems.

The **Tool Box** contains the mechanisms in charge of performing drill and sample acquisition functions in a protective structural shell, which assures that no external contamination can reach the tools and the actuators inside.

The drilling bit is assembled by utilising polycristalline diamonds capable to cope also with hard soil. The position, shape and geometry of the inserts are optimised by analysis and tests.

The drilling and sampling functions are integrated in a unique auger. With this configuration there is the certainty to collect the sample at the established/measured depth, preventing hole collapsing during sampling tool actuation. The Drill / Sampler Tool is shown in Figure 4.
The Drill / Sampler Tool has two degrees of freedom: one translation to approach and penetrate the comet surface and one rotation around its axis. It also foresees an actuator for the sample collecting/discharging mechanism.
During the final phase of the drilling operation, the sampling mechanism collects the sample; soil sample is then placed into an oven for the subsequent scientific analysis.

To actuate the sampling tube, a dedicated mechanism, based on an electromagnet, has been designed.
The design is such that there are no sliding contacts or rotating parts directly in contact with non-rotating parts.

The main dimension of the auger (pitch, diameter and thickness) are a compromise of the proportions normally used for drill tools, the tests' results of the Rosetta CNSR-SAS (performed by a team lead by Tecnospazio for ESA) project and theoretical analysis and simulation performed on purpose.

The reference system of drill has the zero position when SD2 is in stowed configuration Figure 3. The zero position allows the rotation of carousel and has positive direction when the drill goes down. Negative value of PME1 (Position of resolver #1 - drill translation - see ***Table 2-1***) is allowed in order to reach the launch configuration (-0.7 mm).

The **Carousel** is a rotating disc that accommodates the foreseen ovens, to contain the collected sample material, for the distribution to the scientific instrumentation.

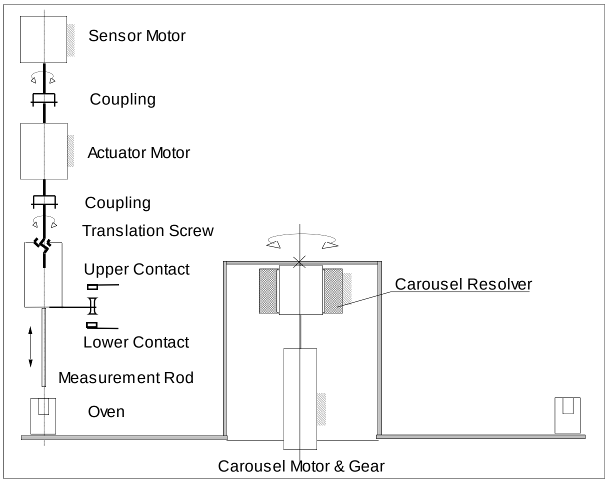


Figure 5 Carousel and Volume Checker Kinematics

The Carousel kinematics is shown in

Figure 5.

The **Ovens** provide interface between the collected sample and scientific instruments: a visible microscope, an I/R microscope and two envolved gas analyser stations.
Two kinds of Ovens are foreseen:

Medium Temperature Ovens (MTOs) with an optical sapphire prism, suited for the analysis by visible and I/R microscope before heating up for medium temperature experiment (+180°C),
High Temperature Ovens (HTOs, provided by MPAe) suited for sample heating for high temperature experiments (+800°C).

There are 10 MTOs and 16 HTOs installed on the Carousel disc.

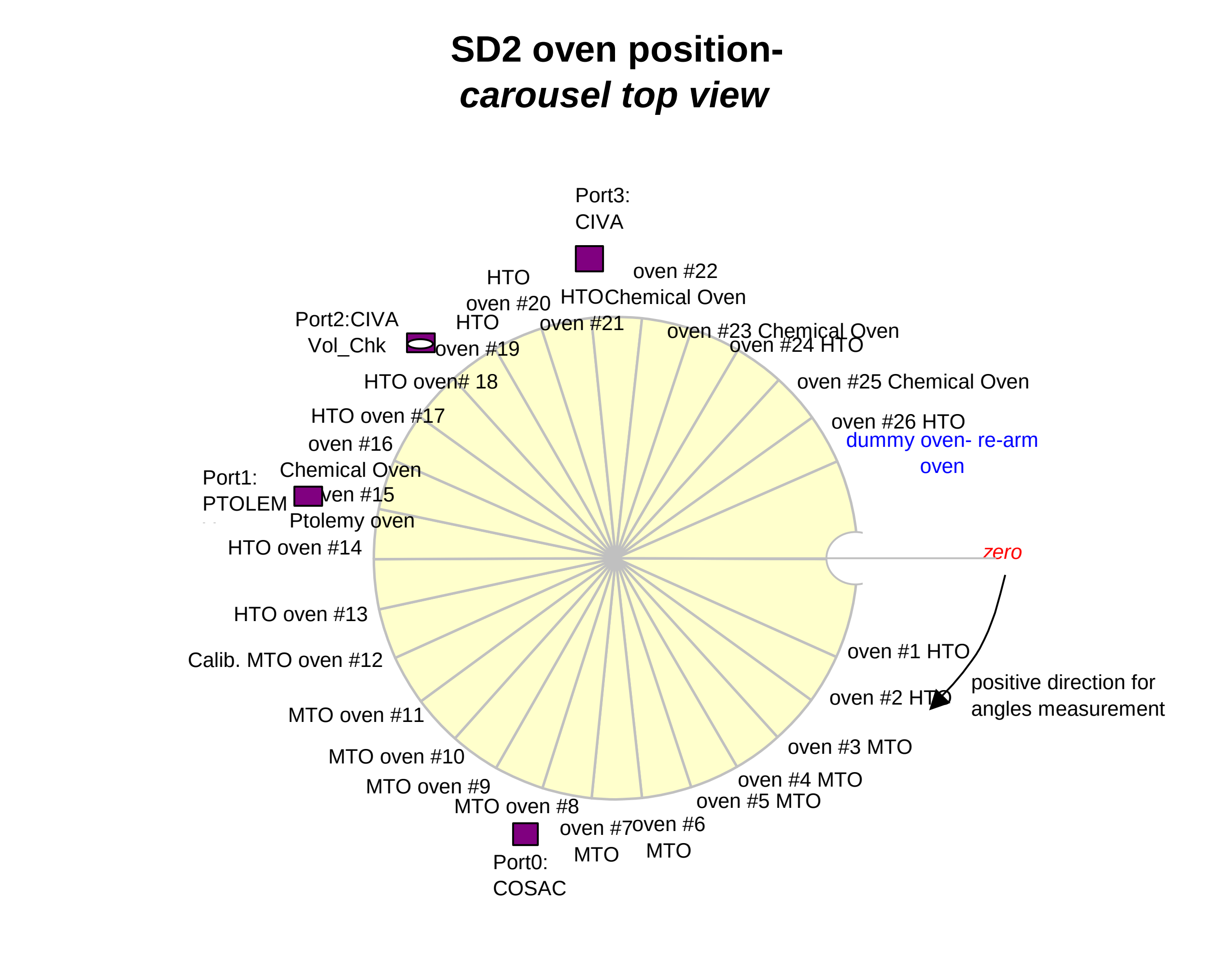


Figure 6 Reference system of carousel

The reference system of carousel is showed in Figure 6. The position zero is the position that allows to perform the drilling (hole of carousel under drill). The Figure 6 gives you the top view of carousel. Clock wise movement of carousel perform an increment of value of PME2 (arcmins), counter clockwise movement of carousel perform a decrement of value of PME2 (arcmins). The movement starts from zero position with counter clockwise movement the next value showed by PME2 is 21599 arcmins.

The **Volume Checker** is a mechanism that allows measurement of the amount of sample discharged into the oven.
It is based on a translating rod that is lowered and pressed into the filled oven. A displacement sensor permits to determine the volume of the deposited material.

Furthermore, for the Ovens provided with the optical prism, an homogeneous distribution of the collected material on the optical window is achieved.

The Volume Checker kinematics is shown in Figure 5.
Reference system of Volume Checker is not relevant because it is a sort of "piston" and the value checked is a differential measurement between two measurements. So we don't have a zero position fixed. It depends on which oven is used for the sampling.

The science provided by SD2 are summarized in Table 2-1.

MEASURE	CODE	UNIT OF MEASURE
Resolver #1	PME1	Millimetre [mm]
Resolver #2	PME2	Arc minute [arcmin]
Drill Speed Rotation	RODRI	Round per Minute [RPM]
Status	OPST	N/A
Volume Checker Microswitch #1	VOLCHKSW1	ON/OFF
Volume Checker Microswitch #2	VOLCHKSW2	ON/OFF
Volume Checker Displacement #1	VC1	Millimetre [mm]
Volume Checker Displacement #2	VC2	Millimetre [mm]
Volume Checker Displacement #3	VC3	Millimetre [mm]
Volume Checker Displacement	VCD	Millimeter [mm]

Table 2-1: Scientific measure made by SD2 (for detail about the measures refer to AD 3 and AD 4)

2.3 Scientific Objectives

The goal of SD2 is to drill and take samples of the comet surface and make them available to the experiments CIVA, COSAC and PTOLEMY following their requirements.
In addition by telemetry we can provide the deep at which the sample is collected and the volume of samples.
These tasks are performed during the "on comet phase".
In Table 2-1 are defined the measures that give the scientific data in order to evaluate the sample collected.
The data are collected in .rolbin files and transformed in Level 1 data in .spr (scientific data) and .csv (Housekeeping data) files. All kind of files are collected and archived.

2.4 Data Handling Process

The SONC is responsible for SD2 data sets generation and delivery to the PSA.

The SD2 telemetry data is provided by the ESA DDS (Data Distribution Server). Following the operations plan the SONC pulls out archived packets (SC and HK) by direct request to the DDS via FTP and stores them into SONC database.
The raw data are passed through the SONC data processing software for decommutation, conversion to physical values and calibration. The calibrated data are also stored into SONC database.

Science (SC) and Housekeeping (HK) raw data are available through W3-SONC server (http://sonc-rosetta.cnes.fr) and the authorized users can get them for a selected time interval as binary files with .rolbin extension.
To read and to understand the raw data the user shall refer to AD 3 and AD 4, and use the software developed to display the raw data in a readable way.
The software called SD2-Telemetry Analyser (SD2-TA) is the EGSE software developed to read the raw data. It does not calibrate the data.
Geometry of SD2 hardware is showed in AD 3 and AD 4.
Calibrated SC data are available through W3-SONC server and authorized users can get refined data for a selected time interval as ASCII files with .spr extension (directly readable).

Calibrated HK data are available through W3-SONC for a slected time interval as ASCII files with .csv extension (directly readable).

The W3-SONC provides interactive plots of SD2 data (drill and carousel position).

After the proprietary period, the SONC team provides the raw data, refined data and plots to the ESA –PDS team.
The delivery format is described in this document.

The people involved in receiving and processing data of SD2 are listed in Table 2-2.

Responsibilities	Name	Industry / Institute
Principal Investigator	Amalia Ercoli Finzi	Politecnico di Milano
Industrial Responsible	Edoardo Re	Galileo Avionica
Industrial Deputy Responsable	Patrizia Bologna	Galileo Avionica
Responsable of on ground data handling	Fabio Malnati	Politecnico di Milano
SONC data processing and PDS generation	Philippe Gaudon	CNES

Table 2-2 : People involved in processing data

2.5 Overview of Data Products

2.5.1 Pre-Flight Data Products

No ground data are present in archive. This section is left open until the test campaign is done.

2.5.2 Sub-System Tests

GRM test data both pre-flight and on-mission phase is archived.

2.5.3 In-Flight Data Products

The in-flight data correspond to all the on board data. They can be produced during three mission phases :
- commissioning phase (CVP) : the first phase of flight (2004)
- cruise (CRU) : the second phase of flight (2005-2014)
- comet phase (COM) : the third phase of flight (2014-2015)

The data, both scientific and housekeeping, are listed in Documents AD 3 and AD 4 and they describe the behaviour of the instrument.
The housekeeping data are automatically collected from CDMS when SD2 is powered, (about one frame each 4 minutes).
The SC data are collected by SD2 into an internal circular buffer, at frequency specified by user, dimension of buffer is fixed (64 packets). So it is possible to collect data either in short period at high frequency and in long period at low frequency.
The SC data are dumped only by command MHIT (see AD 3).
The presence of some science data in the housekeeping frame allows the monitoring of health status of SD2 operation without requiring the dump of SC data.

2.5.4 Software

In order to read easily the content of data packets archived in the PDS archive, a software called SD2-TA is provided to archive (see § 3.4.3.6).

The software is able to load packets from ".rolbin" file, to read the raw data and to display the data in readable form. Moreover SD2-TA is able to save file ".out" with the refined data. A user manual of SD2-TA is delivered with the program to the PDS Archive.

2.5.5 Documentation

The documentation directory contains the following documents:

- CDMS – SD2 Data Interface Control Document [AD 3]
- SD2 subsystem user manual [AD 8]
- SD2 Specification [AD 9]
- SD2 User Requirement Document [AD 10]
- Rosetta Experiment Interface Documents [AD 11] and [AD 12]
- EAICD (Present document)
- TIMELINE_ph.TXT, timeline Ascii file for phase ph
- TIMELINE_ph_DESC.TXT, description of the timeline file for phase ph
- TIMELINE_ph_obty.PNG, timeline Image file for phase ph and observation type obty

3 Archive Format and Content

3.1 Format and Conventions

Data processing level number used in SD2 naming scheme conforms to CODMAC norm:

Raw Data (codmac 1) : Telemetry data with data embedded.
Calibrated Data (codmac 3) : Edited data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so edited data can be reconstructed (NASA Level 1A).

3.1.1 Deliveries and Archive Volume Format

Four data sets are delivered, one for data from the Ground Reference Model (GRND) and one for each of the following mission phases: commissioning (CVP), cruise phase (CRU) and comet (COM). Each data set contains:

- ✓ all the raw data contained in .DAT files (both packet HK and SC mixed), in RAW directory. The raw data correspond to CODMAC level 1.
- ✓ SC data level 1 in .TAB file (CODMAC level 3)
- ✓ HK calibrated data in .TAB file (CODMAC level 3)
- ✓ Plots of drill position (word 0 of SD2 SC telemetry) in .png file (CODMAC level 3)
- ✓ Plots of carousel position (word 1 of SD2 SC data telemetry) in .png file (CODMAC level 3)
- ✓ Plots of drill position (word 5 of SD2 HK telemetry) in .png file (CODMAC level 3)
- ✓ Plots of carousel position (word 6 of SD2 HK telemetry) in .png file (CODMAC level 3)
- ✓ Documents (chapter 3.4.3.9)
- ✓ Software

3.1.2 Data Set ID Formation

The following naming formation scheme is used for the data sets :

DATA_SET_ID = <INSTRUMENT_HOST_ID>-<target id>-<INSTRUMENT_ID>-<data processing level number>-<mission phase abbreviation>-<version>
DATA_SET_NAME = <INSTRUMENT_HOST_NAME>-<target name>-<INSTRUMENT_ID>-<data processing level number>-<mission phase abbreviation>-<description>-<version>

Note: The description field for the DATA_SET_NAME is used only for the GRND mission phase.

See appendix F (16.1.1, 16.1.2) of Archive Plan Issue 2/1.

Examples of DATA_SET_ID and DATA_SET_NAME for SD2 data obtained from the Ground Refrence Model:

DATA_SET_NAME= "ROSETTA-LANDER CAL SD2 3 GRND GRM-TEST V1.0"

DATA_SET_ID = "RL-CAL-SD2-3- GRND-V1.0"

3.1.3 Data Directory Naming Convention

The DATA directory of each data set contains subdirectories named CALIBRATED and RAW.
The RAW directory contains all the files with raw physical data (telemetry packets, CODMAC level 1).
The CALIBRATED directory contains all files with calibrated data (CODMAC level 3).

3.1.4 Filenaming Convention

The following file naming scheme is used:

{**exp**}_{**datatype**}_{**begin of observation**}_{**length of observation**}.{**ext**}

- **exp** (3 character) = SD2
- **datatype** (3 character) = XYZ
  - X = **G** for Ground, **F** for Flight
  - Y = **S** for Science Data, **H** for Housekeeping Data, **B** for files with both data mixed together
  - Z = CODMAC level : **1** for raw Data, **3** for calibrated Data, **P** for Plots
- **begin of observation** (12 characters) = time of test or working session yymmddhhmnss:
  - yy = year
  - mm = month
  - dd = day
  - hh = hour
  - mn = minute
  - ss = second
- **length of observation** (4 character) = duration of test or working session expressed in minutes. A file do not contain more than 7 days of data
- **ext** = extension of file. For SD2 the files can be:
  - .DAT for Raw Data containing HK and SC data mixed together (CODMAC level 1)
  - .TAB for calibrated Data containig SC Data (CODMAC level 3)
  - .TAB for calibrated Data containig HK Data (CODMAC level 3)
  - .PNG for Plot Data in BROWSE directory (plots of SPR and CSV data)

Exemple : SD2_FS3_041005204117_21.TAB
This file begins at 2004/10/05 20:41:17 and contains 21 minutes of SD2 calibrated flight Science data

We consider the **observation** starts for the beginning of mission plan until the dump of science data (end of mission plan).
During this phase we have in rolbin files HK and SC data mixed.

The raw data are splitted into spr file (containing only SC data) and csv file (containing HK data).
The HK data for a single observation start: from the SD2 powered (if we are collecting data of the first observation) till the end of mission plan (dump of SC data), or from the end of previous observation (dump of previous SC data) till the end of following observation (dump of following SC data).
In this way we have for each observation one rolbin file, one spr (SC data) file and one csv (HK data) file.

3.2 Standards Used in Data Product Generation

3.2.1 PDS Standards

PDS Standard version 3.6 was used for the design of the ROSETTA-SD2 archive.

3.2.2 Time Standards

3.2.2.1 Generalities

This paragraph gives a summary of the different existing formats in the Rosetta Ground segment, from their generation by the instruments to their availability at SONC :

- The Lander CDMS requires the scientific instruments to transmit the data by bursts of 8 or 64 bytes (4 or 32 16-bit words)

- When sufficient data are received, the CDMS builds packets containing 256 bytes of instrument data. The CDMS adds 18 bytes header (unit PID, sequence count, OOBT : Orbiter OBT, data type) and a 2 bytes checksum (DECW) and creates packets with a fixed length of 276 bytes[1]. For transmission between Lander and Orbiter, a 4 bytes synchro header and a 2 bytes trailing checksum (PECW) are added, increasing the packet size to 282 bytes. The extra bytes are removed by the ESS.

  To comply with ESA requirements, the time registered in the CDMS packets is the **OOBT**. It is reconstituted from the LOBT, as shown in Figure 7:

[1] The Lander CDMS header and the headers of the telemetry source packets from the Orbiter instruments are quite similar. There is a difference in the data field header. The byte containing PUS version, checksum flag and spare fields is set to zero in the CDMS header. Besides the last byte of the OOBT is set to zero in th e CDMS header. The CDMS header has an additional word (2 bytes) after the data field header named "FORMAT ID". This word is mainly used for HK data and it contains the HK scanning period and the SID (structure identification).

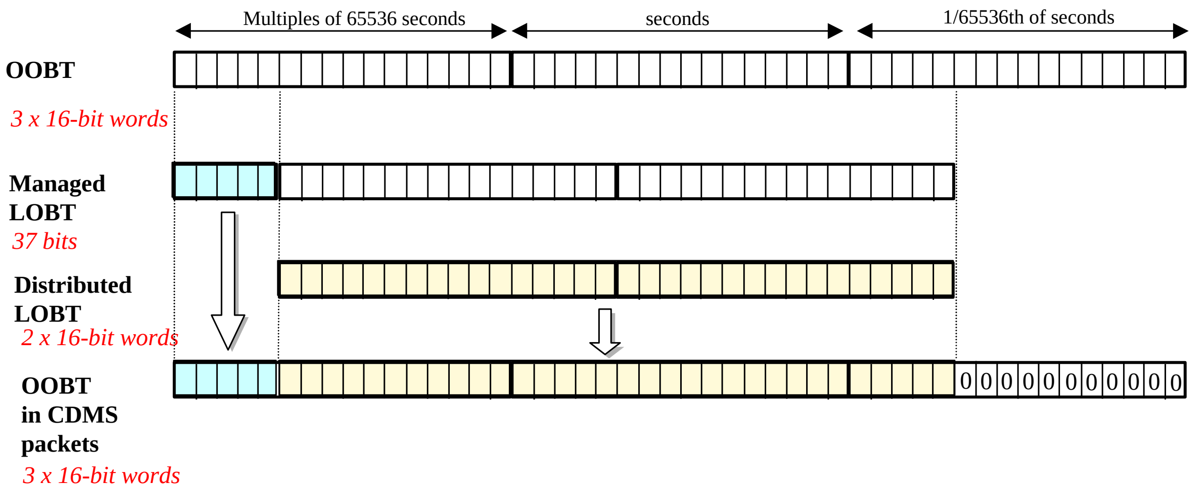


Figure 7 Reconstruction of on board time in CDMS packets

- The ESS groups together several packets and passes them to the Orbiter OBDH, which transmits them according to the Space/Ground interface. This part is transparent for the Lander ground segment.
- The data are delivered by the Rosetta Data Distribution System (DDS) to the SONC in SFDU format. A SFDU file is basically a collection of 276-byte packets interspersed with auxiliary information records. An 18 bytes SFDU header is added to the CDMS 276-byte packets. This header contains information added at the ground station (time correlated OBT, ground station id, virtual channel id, service channel, type of data, time quality)
- SONC processes the SFDU files to retrieve the 276-byte packets. This format is available in the SONC database.

The relationship between both time (OOBT and LOBT) formats is given in AD 16.

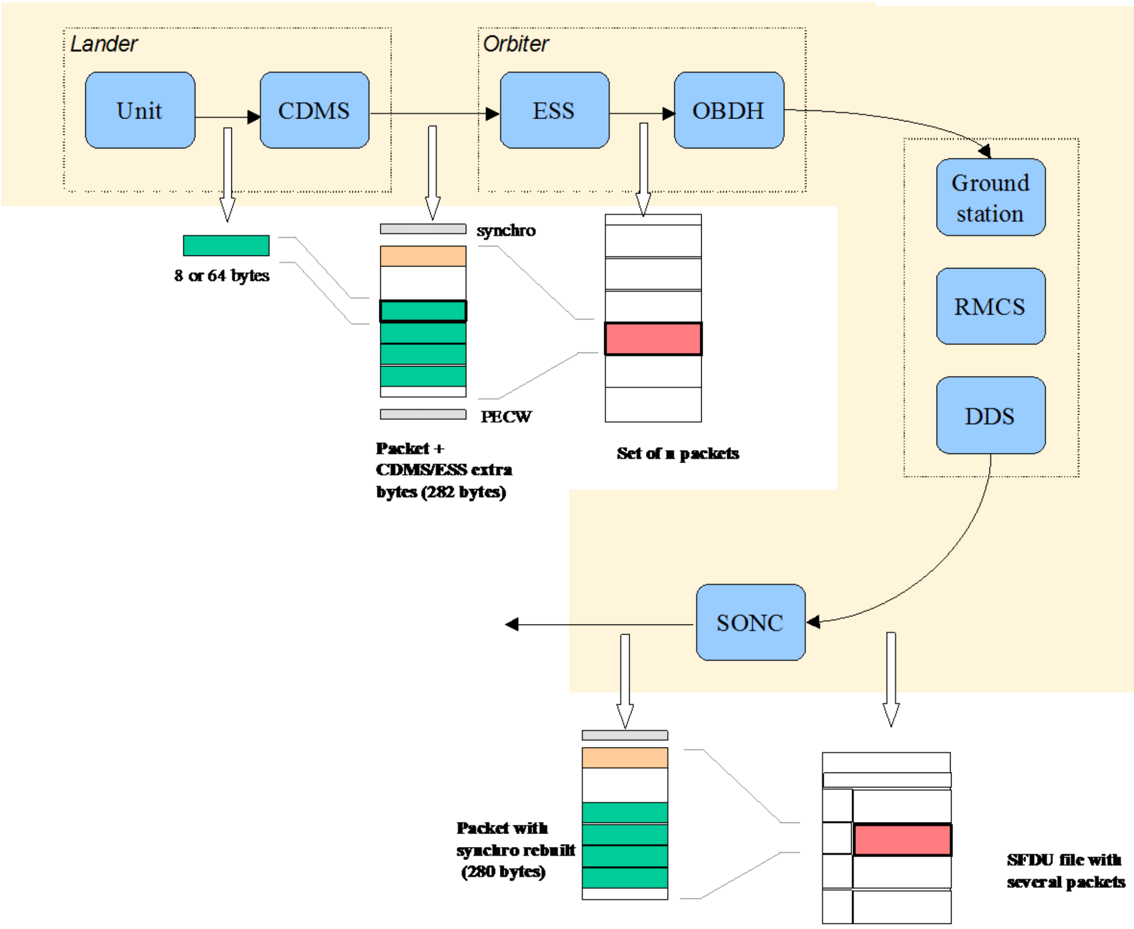


Figure 8 On board data flow

- Afterwards, SONC processes science raw packets in order to recompose the science measurement (e.g. an image, a spectrum, ...).

Figure 8 gives an overview of this data flow.

The following principles are applied :

- the packet wrapping is removed, and science frames that had to be split into several raw data packets are rebuilt. Basic error detection controls are applied, to recover from possible problems in the transmission chain.

- the Lander On-Board time (LOBT) (synchronised with OOBT) extracted from the packet, and corresponding UTC time coming from the SFDU header, are added.

- UTC time is calculated from the On-Board time taking into account the On-Board clock drift as following :
UTC (seconds since 01/01/1970) = LOBT(seconds) * Gradient + Offset (these coefficients are extracted from TCP packets delivered by DDS).
LOBT is either the LOBTextracted from CDMS header or the Experiment internal clock when it exists (CIVA, COSAC, PTOLEMY, ROMAP, ROLIS, SESAME). In the last case, it must be taken into account that the Internal clock (32 bits) resets all 4 years, 4 months, 3 days (first reset : 03/04/2007 10 :42 :07).

- in few cases, bit fields are expanded : flags that were stored as bits in the telemetry (to save bandwidth) are stored as integer values instead ; the aim is to ease further processing.

UTC time-stamped Science and HK data are available in the SONC database and used to generate PDS format.

3.2.2.2 SD2 Time standards

The time standards used in the SD2 data products are :
- the SD2 on-board time,
- the Lander on-board time,
- the DDS header time correlated,
- the UTC.

SD2 software maintains an internal timing, which starts up at SD2 power on. This time is used both to synchronize the SD2 software tasks and to timestamp the telemetry data, both scientific and the housekeeping frames. The time reported in telemetry is evaluated by SD2 as the time received by means of the RTIM CDMS standard command updated by the time elapsed between the reception of last RTIM command and the time when the telemetry data generation started. The time is reported in word #12 of housekeeping data (unit is second), and in words #11 and #12 of scientific data (unit is 31.25 millisecond). The SC data are generated by SD2 with a frequency that can be set by the command MHIT. The SC data are collected by CDMS when the dump of them is commanded. When the electronic of SD2 is on, HK frames are collected by CDMS with a frequency of about 4 minutes per frame. The On Board Time of each packet is the time when the packet is collected by CDMS.

3.2.2.3 The SD2 On-Board Time

The time standard used in HK and SC data (**SD2 On-Board Time**) is the time used by CDMS.

In SC data there are two words:
On Board Time Low (16 bit, unit in 31.25 ms)
On Board Time medium (16 bit, unit in (2^{16} * 31.25) ms).

In HK data there is a word (16 bit, unit in seconds)
The SD2 telemetry Time is synchronised with CDMS time for HK and SC data frames

3.2.2.4 The Lander On-Board Time (LOBT)

The instruments on board the spacecraft (Orbiter) generate telemetry source packets with an OOBT (orbiter on board time) time stamp in the header.
The OOBT written into the packet header specifies the time, when CDMS can complete a packet.

In terms of HK packets this is the time of the last HK word. Using the HK scanning rate, which is given in word #9 of the packet, one can calculate the OBT of every individual word in this packet. Note that this is only valid if packets with SID (word #9) 1 or 2 are generated. Packets with SID 4 and 5 are "snapshots", which means you can apply the packet OOBT for every word in this packet. SID 3 packets have to be analysed case by case.

In terms of SC packets this is the receiption of the last 32 word block by CDMS, which also completes the SC packet. How often 32 word blocks are created (and sent) by the unit, and corresponding to this the delta time between each block, might be different for each unit. So, re-calculation of OOBT for SC words depends on this unit feature.

The Orbiter On-Board Time (OOBT) is a linear binary counter having a resolution of 1/65536 sec stored in 3 16-bit words.

The Lander On-Board Time (LOBT) is a linear binary counter having a resolution of 1/32 sec, kept in 37 bits. Only the 32 least significant bits are distributed to the instruments, in 2 16-bit words. The 5 most significant bits are supposed constant during most of the mission, they are available through a specific service.
The LOBT is derived from the Orbiter On-Board Time (OOBT) : the 11 least significant bits of the OOBT are discarded to obtain the LOBT, hence the reduced resolution. A re-synchronization between OOBT and LOBT is performed regularly (see AD 5).
The Lander is synchronized prior to Separation and during every RF link after landing. So, during descent and the First Science Sequence this should not be a problem, since LOBT is kept synchronized as long as the Lander is powered.

Technical details about sychronisation of Lander On-board Time can be found in § 2.3.2.6 AD 5.

For a description of time handling in the Rosetta project see AD 7.
For a description of Lander on board time handling see AD 5 :
§ 2.3.2.6 Sychronisation and Adjustment of Lander On-board Time
§ 2.3.2.6.1 Absolute vs. relative time references
§ 2.3.2.6.2 On-board Time Failure Modes and Recovery Procedures
and AD 6, § 6. About Lander On-board Time.

3.2.2.5 The DDS header time correlated

The OOBT is converted to UTC (Coordinated Universal Time) by means of time correlation and included in the additional DDS packet header when the packets are distributed via the DDS server.
The **DDS header time correlated** (SCET field in the DDS header) is the UTC of the start of measurement derived from the OOBT by time correlation.

Its format is the Sun Modified Julian Time (MJT) i.e. two 32 bit integers. The first (MSB) contains the number of seconds since 00:00:00 on 1st January 1970 and the second (LSB) integer the number of micro-seconds from seconds in the first field.

Time correlation is described in AD 13(Appendix 18 § 18.1.2.1).

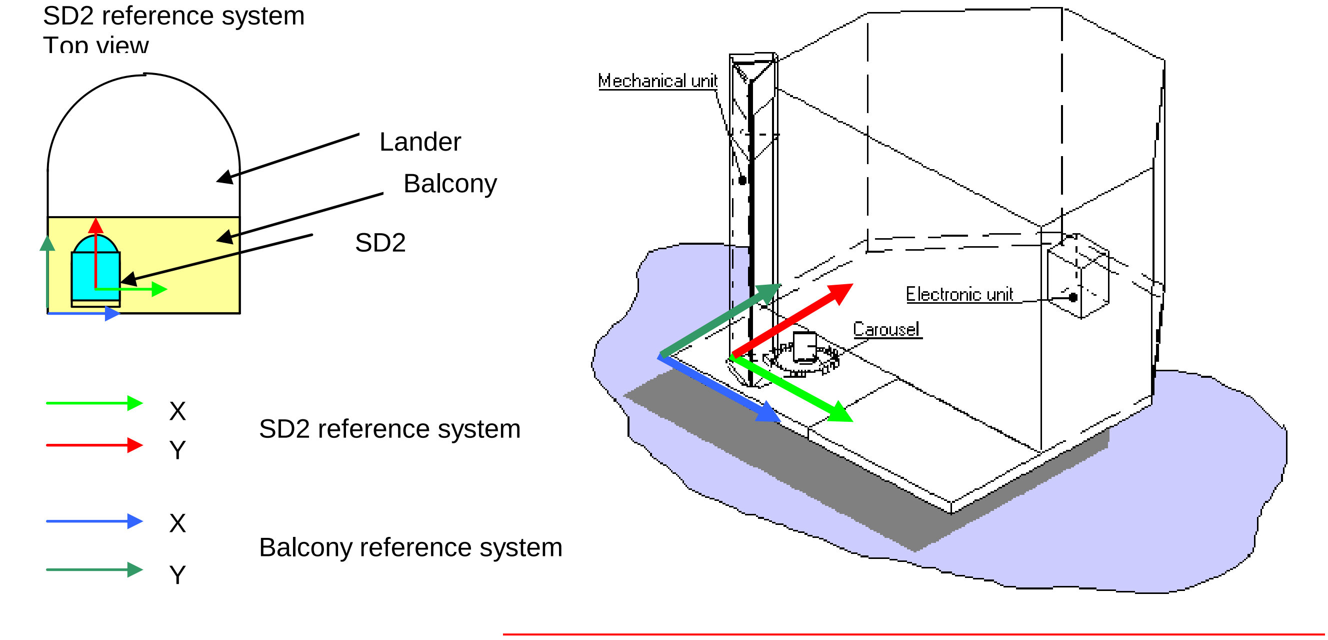
3.2.2.6 The UTC (Universal Time Coordinated)

The **UTC** used as time stamp for the level 3 SC and HK SD2 data products is the DDS header time correlated.

3.2.3 Reference Systems

Three reference systems are used to evaluate the position of :

- Drill translation
- Carousel Rotation
- Volume Checker displacement



X = 209,59 mm Y = 77 mm Z = 320 mm

Figure 9: SD2 reference system versus Balcony reference system

<u>Drill Translation reference system</u>
The position of drill can be retrieved from telemetry data in 1/100 of millimeter. The zero position is the position which allow the carousel to rotate. Positive value of drill position means that the drill has been moved down to perform a drilling phase. The range of values allowed are in range [-11,49; 625] mm (cf. AD 3).

<u>Carousel Rotation reference system</u>
The position of carousel has a relative reference system showed in Figure 9. It is relative to the angular position of carousel. The value of telemetry data related to carousel position is given in arc- minutes and can have a value in range [0; 21600]. During a movement if telemetry shows a increment of carousel position values this means that the carousel performs a clockwise rotation, if telemetry shows a decrement of carousel position values this means that the carousel performs a counter clockwise rotation (cf. AD 3).

<u>Volume Checker reference system</u>
The measurement of volume checker is performed as differential measurement. When the oven is empty the Volume Checker perform a measurement and the displacement is taken in memory. When the oven is filled the Volume Checker perform the second measurement and from the new displacement is subtract the first displacement. In this way the volume of sample is calculated knowing the area of the base of the oven where the sample is placed. So no reference system is necessary to evaluate the volume of sample (cf. AD 8).

3.3 Data Validation

The SD2 data products are delivered to PSA by SONC. The level 3 SC and HK data produced by SONC are validated by SD2 PI. These data are also distributed via the W3-SONC server and used by all Lander experiment teams.

3.3.1 Data Quality ID

SD2 science data contain information about functionality of system. No further refinement or calibration is required to evaluate the data. The user can read the raw data by the EGSE software to evaluate the status of SD2 and the movements performed.
Due to the way SD2 collects data and the lack of calibration, the missing of one or more packets could not affect the quality of data.

Data quality table:
-1 Not Assigned
0 Good Data
1 Missing science packets data not allow to evaluate the results of mission plan

3.4 Content

3.4.1 Volume Set

One volume corresponds to one data set. The possible values of VOLUME keywords can be found in [AD 15]. The volume keyword values for the Commissioning mission phase are given in the following example.

```
DESCRIPTION            = "This volume contains Rosetta SD2
                          level 2 data products and supporting
                          documentation from the Commissioning phase"
VOLUME_ID              = "RLSD22_1001"
VOLUME_NAME            = "SD2 RAW DATA FOR THE COMMISSIONING PHASE"
VOLUME_SERIES_NAME     = "ROSETTA SCIENCE ARCHIVE"
VOLUME_SET_ID          = "IT_POLIMI_AERO_RLSD2_100X"
VOLUME_SET_NAME        = "ROSETTA SD2 DATA"
VOLUME_VERSION_ID      = "VERSION 1"
VOLUMES                = 1
VOLUME_FORMAT          = "ISO-9660"
MEDIUM_TYPE            = "ONLINE"
PUBLICATION_DATE       = YYYY-MM-DD
```

3.4.2 Data Set

The SD2 data is archived in four Data Sets containing data from the Rosetta Lander Ground Reference Model (GRND), from the commissioning phase (CVP), from the Cruise phase (CRU) and from the Comet phase (COM).

Name element	**Data Set ID**	**Data Set Name**
INSTRUMENT_HOST_ID / INSTRUMENT_HOST_NAME	RL (Rosetta Lander)	ROSETTA-LANDER
Target id / target name	CAL for ground data, commissioning data, cruise data C for Comet data	CAL for ground data, commissioning data, cruise data 67P for Comet data
INSTRUMENT_ID / INSTRUMENT_NAME	SD2	SAMPLING, DRILLING AND DISTRIBUTION SUBSYSTEM

Data processing level number	3 (the highest data level in a data set; the data sets contain also level 1 data)	
mission phase abbreviation	GRND, Ground Reference Model CVP, Commisioning phase CRU, Cruise phase COM, Comet phase data	
description	N/A	GRM-TEST, Ground Reference Model data, for GRND. No description for the others.
version	The first version of a data set is V1.0 Remark: The cruise phase is composed of several phases (CR1, CR2,…). The cruise data set is re-delivered after each cruise phase. However the version number is not changed with each delivery in order to avoid the modification of DATA_SET_ID/NAME values in the labels of all previous data products	

3.4.3 Directories

The SD2 archive have the following directory structure :

```
                        |-AAREADME.TXT
                        |-BROWSE-
                        |-CATALOG-
                        |
                        |-DATA------------|-CALIBRATED-
|-root directory------- |                 |-RAW-
                        |-DOCUMENT-
                        |-EXTRAS-
                        |-INDEX-
                        |-LABEL-
                        |-VOLDESC.CAT
```

3.4.3.1 Root Directory

The root directory of SD2 contains the following files :

File Name	Contents
AAREADME.TXT	Volume content and format information
VOLDESC.CAT	A description of the contents of this volume in PDS format readable by both humans and computers

The name of the root directory is the data set ID.

3.4.3.2 Catalog Directory

The catalog directory provides a top level understanding of the mission, spacecraft, instruments and data sets.The catalog directory contains the following files:

File Name	Contents
CATINFO.TXT	A description of the contents of the catalog directory
DATASET.CAT	Data set information
INST.CAT	Instrument information
INSTHOST.CAT	Instrument host (spacecraft) information
MISSION.CAT	Mission information
PERSON.CAT	PDS personnel catalog information about the instrument team responsible for generating the data products. There is one file for each instrument team providing data to this data set.
REF.CAT	Full citations for references mentioned in any and all of the catalog files, or in any associated label files.
SOFTWARE.CAT	Information about the software included in the EXTRAS directory

3.4.3.3 Index Directory

The index directory contains the indices for all data products on the data set. The following files are included in the index directory :

3.4.3.3.1 Dataset Index File

File Name	Contents
BROWSE_INDEX.LBL	PDS label for the BROWSE index file BROWSE_INDEX.TAB
BROWSE_INDEX.TAB	Index of the BROWSE directory
INDEX.LBL	PDS label for the volume index file, INDEX.TAB
INDEX.TAB	Volume index in tabular format
INDXINFO.TXT	A description of the contents of the Index Directory

3.4.3.3.2 Geometric Index File

The following Geometry index files is created, according to reference targets. They are available in a general dataset TBD

File Name	File Contents
GEO_EARTH.LBL	A PDS detached label that describes GEO_EARTH.TAB
GEO_EARTH.TAB	A table listing the geometric index parameters for reference target EARTH
GEO_MARS.LBL	A PDS detached label that describes GEO_MARS.TAB
GEO_MARS.TAB	A table listing the geometric index parameters for reference target MARS
GEO_STEINS.LBL	A PDS detached label that describes GEO_STEINS.TAB
GEO_STEINS.TAB	A table listing the geometric index parameters for reference target STEINS

File Name	File Contents
GEO_LUTETIA.LBL	A PDS detached label that describes GEO_LUTETIA.TAB
GEO_LUTETIA.TAB	A table listing the geometric index parameters for reference target LUTETIA

3.4.3.4 Browse Directory and Browse Files

The Browse Directory contains plots (JPEG files) that are one to one mapping of the corresponding calibrated SC and HK data (SPR and CSV files) in the DATA directory.
The plot range lies between 0 and 65535. The allowed carousel value range is form 0 (min value) to 21599 (max value), if 65535 (FFFF in hexadecimal) is showed this means that the resolver is off an data is not available.
For Drill translation the range is from 0 to 64800 (1/100 mm). The range frorm 0 to 63650 (frorm 0 to 63.56mm) correspond to positive values and the range from 63651 to 64800 corresponds to negative values One has to use the following formula to find the correct value:
Value in decimal = (read_value (decimal) – 64800) *(-1) [1/100mm]

For filenaming convention see 3.1.4.

Applicable only for Comet phase.

3.4.3.5 Geometry Directory

TBD

3.4.3.6 Software Directory

The EGSE software is used to read raw telemetry data (CDMS rolbin files). As it does not comply with PDS strong requirements on software for long term archiving, it is instead located in the EXTRAS directory. All information regarding the usage and requirements for the software are provided in documentation located in SD2_EGSE directory. The SOFTWARE.CAT file in the CATALOG directory includes additional information pointing to the software and outlining its basic usage and requirements.

3.4.3.7 Gazetter Directory

No Gazetter directory is foreseen.

3.4.3.8 Label Directory

The Label directory contains the .FMT files (structure of the TABLE objects used for the data description). This directory contains the following files:

File Name	Contents
LABINFO.TXT	A description of the contents of this directory
SD2_CALIBRATED_HK.FMT	Table object for HK data
SD2_CALIBRATED_L1.FMT	Table object for L1 data

3.4.3.9 Document Directory

This directory contains documentation to help the user to understand and use the archive data. The following files are contained in the document directory:

File Name	Contents
DOCINFO.TXT	A description of the contents of this directory
SHARK-ICD-TS-043.PDF	CDMS – SD2 Data Interface Control Document
SHARK-ICD-TS-043.LBL	PDS label for file SHARK-ICD-TS-043.PDF
SD2-SUM-TS-011.PDF	SD2 Subsystem User Manual
SD2-SUM-TS-011.LBL	PDS label for file SD2-SUM-TS-011.PDF
SHARK-AB-TS-003.PDF	Rosetta Lander SD2 Subsystem Specification
SHARK-AB-TS-003.LBL	PDS label for file SHARK-AB-TS-003.PDF
SHARK-URD-TS-067.PDF	SD2 Software User Requirement Document
SHARK-URD-TS-067.LBL	PDS label for file SHARK-URD-TS-067.PDF
RO-EST-RS-3001.PDF	Rosetta Experiment Interface Document, Pard A
RO-EST-RS-3001.LBL	PDS label for file RO-EST-RS-3001.PDF
RO-LAN-RD-3111.PDF	Rosetta Experiment Interface Document, REID-A
RO-LAN-RD-3111.LBL	PDS label for file RO-LAN-RD-3111.PDF
EAICD_SD2.PDF	This document
EAICD_SD2.LBL	PDS label for file EAICD_SD2.PDF
TIMELINE_*ph*.TXT	Timeline Ascii file with the PDS label attached for phase *ph*
TIMELINE_*ph*_DESC.TXT	Description of the timeline file for phase *ph*
TIMELINE_*ph_obty*.PNG	Timeline Image file for phase *ph* and observation type *obty*
TIMELINE_*ph_obty*.LBL	PDS label for image TIMELINE_*ph_obty*.PNG

3.4.3.10 Extras Directory

The Extras directory contains EGSE software to read and visualize raw telemetry data (CDMS rolbin files, CODMAC level 1). The contents of the EXTRAS directory are shown below :

```
                                       |-SD2_V1_2.EXE
                                       |-SD2_V1_2.LBL
                                       |-PHILAE-SD-EUM-001.LBL
|-EXTRAS----------|-SD2_EGSE--------|-PHILAE-SD-EUM-001.PDF
                  |                    |-MFC42D.DLL
                  |                    |-MFC42D.LBL
                  |                    |-MFCO42D.DLL
                  |                    |-MFCO42D.LBL
                  |                    |-MSVCRTD.DLL
                  |                    |-MSVCRTD.LBL
                  |
                  |-EXTRINFO.TXT
```

The Egse Directory contains the following files :

File Name	Contents
SD2_V1_2.EXE	EGSE software (MS Windows executable) for extracting data

	from the raw data product files (rolbin), calibration and visualisation.
SD2_V1_2.LBL	PDS label for file SD2_V1_2.EXE
MFC42D.LBL	PDS label for file MFC42D.DLL
MFC42D.DLL	Library for EGSE software
MFCO42D.LBL	PDS label for file MFC42D.DLL
MFCO42D.DLL	Library for EGSE software
MSVCRTD.LBL	PDS label for file MFC42D.DLL
MSVCRTD.DLL	Library for EGSE software
PHILAE-SD-EUM-001.PDF	EGSE software user manual
PHILAE-SD-EUM-001.LBL	PDS label for file SD2_TA_USER_MANUAL..DOC
EXTRTINFO.TXT	A description of the contents of the Extras Directory

3.4.3.11 Data Directory

The structure and naming scheme of the data directory is described in chapter 3.1.3.

4 Detailed Interface Specifications

4.1 Structure and Organization Overview

Each .rolbin file containing the raw data (CODMAC level 1) is archived in a data set on the basis of the mission phase relative to the production of the data. The raw data file is placed in a DATA subdirectory named RAW with the file name that follows the rules explained in this document.
Each .spr file containing calibrated (CODMAC level 3) SC data and each .cvs file containing calibrated (CODMAC level 3) HK data are archived in a DATA subdirectory named CALIBRATED with the file name that follows the rules explained in this document.

4.2 Data Sets, Definition and Content

The following table gives the definition of the name and id of the foreseen data sets :

Data Set ID	Data Set Name
RL-CAL-SD2-3-GRND-V1.0	ROSETTA-LANDER CAL SD2 3 GRND GRM-TEST V1.0
RL-CAL-SD2-3-CVP-V1.0	ROSETTA-LANDER CAL SD2 3 CVP V1.0
RL-CAL-SD2-3-CRU-V1.0	ROSETTA-LANDER CAL SD2 3 CRU V1.0
RL-C-SD2-3-COM-V1.0	ROSETTA-LANDER 67P SD2 3 COM V1.0

The following data sets are foreseen:

RL-CAL-SD2-3-GRND-Vx.x contains data of SD2 tests on GRM
RL-CAL-SD2-3-CVP-Vx.x contains data of CVP phase (2004)
RL-CAL-SD2-3-CRU-Vx.x contains data of cruise phase (2005-2014)
RL-C-SD2-3-COM-Vx.x contains data of comet phase (2014-2015).

4.3 Data Product Design

4.3.1 Data Product Design of raw SD2 data (level 1)

Level 1 contains mixed raw housekeeping and science data packets delivered by the Rosetta Lander with detached PDS labels. In order to understand correctly the meaning of data stored in Archive refer to document AD 3.

4.3.1.1 File Characteristics Data Elements

The PDS file characteristic data element for raw (level 1) SD2 data are:

```
PDS_VERSION_ID           = PDS3
LABEL_REVISION_NOTE      = “V1.0”
RECORD_TYPE              = UNDEFINED
PRODUCT_ID               = "SD2_GB1_040228030000_0088"
PRODUCT_CREATION_TIME    = 2004-11-29T12:04:02Z
PRODUCT_TYPE             = UDR
PROCESSING_LEVEL_ID      =  1
MISSION_NAME           = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME     = "GROUND"
MISSION_ID             = ROSETTA
TARGET_NAME            = "CALIBRATION"
TARGET_TYPE            = "CALIBRATION"
START_TIME             = 2004-02-28T02:56:16.000Z
STOP_TIME              = 2004-02-28T04:28:04.875Z
SPACECRAFT_CLOCK_START_COUNT = "N/A"
SPACECRAFT_CLOCK_STOP_COUNT = "N/A"
PRODUCER_ID            = "SONC"
PRODUCER_FULL_NAME     = "Science Operations and Navigation Center"
PRODUCER_INSTITUTION_NAME = "CNES"
DATA_QUALITY_ID          = "N/A"
DATA_QUALiTY_DESC        = "N/A"
```

The RECORD_TYPE for raw data is UNDEFINED. The description of the file content can be found in the file pointed to by ^DESCRIPTION keyword.
These data are intended to be processed with the EGSE software available in the EXTRAS directory.

4.3.1.2 Data Object Pointers Identification Data Elements

The label refers to a single data object which is a FILE. The data object pointers (^FILE) reference rolbin (.ROL) files.

4.3.1.3 Instrument and Detector Descriptive Data Elements

```
INSTRUMENT_HOST_NAME      = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID        = RL
INSTRUMENT_ID             = SD2
INSTRUMENT_NAME           = "SAMPLING, DRILLING AND DISTRIBUTION SUBSYSTEM"
INSTRUMENT_TYPE           = "DRILL"
INSTRUMENT_MODE_ID        = "N/A"
INSTRUMENT_MODE_DESC      = "N/A"
```

4.3.1.4 Description of Instrument

The description of the instrument is done in AD 8 and as a brief overview in the INST.CAT catalog file.

4.3.2 Data Product Design of calibrated SD2 SC data (level 3)

Level 3 SC contains calibrated SD2 science data, drill position and carousel position with PDS detached labels.

4.3.2.1 File Characteristics Data Elements

The PDS file characteristic data elements for SD2 calibrated science data (level 3) are:

```
RECORD_TYPE             = FIXED_LENGTH
RECORD_BYTES            = 366
FILE_RECORDS            = 40
PRODUCT_TYPE            = RDR
PROCESSING_LEVEL_ID     =  1
```

4.3.2.2 Data Object Pointers Identification Data Elements

The calibrated SC data are organized as a table and PDS label refers to a single data object which is a TABLE. The data object pointers (^TABLE) reference SPR files.

4.3.2.3 Data Object Definition

```
OBJECT                    = TABLE
  NAME                    = "SC_TABLE"
  INTERCHANGE_FORMAT      = ASCII
  ROWS                    = 40
  COLUMNS                 = 39
  ROW_BYTES               = 426
  ^STRUCTURE              = "SD2_CALIBRATED_L1.FMT"
END_OBJECT                = TABLE
```

The structure of the TABLE object is described in the file SD2_CALIBRATED_L1.FMT as follows:

```
/*          Contents of format file  "CALIBRATED_L1.FMT"       */

OBJECT          = COLUMN
  NAME          = "UTC_TIME"
  DATA_TYPE     = TIME
  START_BYTE    = 1
  BYTES              = 23
  DESCRIPTION   = "This column represents the UTC in
                   PDS standard date/time format YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "LOBT_TIME"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 26
  BYTES         = 14
DESCRIPTION     = "This column represents the Lander On Board Time
                   as 6 hexadecimal characters in three groups separated by
                   a space ; (resolution 1/32 s)"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "PME1"
  DATA_TYPE     = ASCII_REAL
  START_BYTE    = 42
  BYTES         = 7
  UNIT          = MILLIMETRE
  FORMAT        = "F7.2"
```

```
  DESCRIPTION    = "Position of resolver #1 (drill translation)
                   The allowed  Drill translation range is from 0 to 64800 (1/100 mm).
                   The range from 0 to 63650 (frorm 0 to 63.56mm)  correspond to positive
                   values and the range  from 63651 to 64800 corresponds to negative values
                   One has to use the following formula to find the correct value:
                   Value in decimal = (read_value (decimal) - 64800) *(-1) [1/100mm]"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "PME2"
  DATA_TYPE      = ASCII_INTEGER
  START_BYTE     = 50
  BYTES          = 7
  UNIT           = ARCMIN
  DESCRIPTION    = "Position of resolver #2  (carousel rotation)
                    The  allowed carousel value range is from 0 (min value) to 21599 (max
                    value), if 65535 (FFFF in hexadecimal) is showed this means that the
                    resolver is off an data is not available."
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "VCD"
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 58
  BYTES          =7
  UNIT           = MILLIMETRE
  FORMAT         = "F7.2"
  DESCRIPTION    = "Volume Checker Displacement when the command
                    [Move Volume Checker] MVCK is performed.
                    See also AD 10 (pages 28 29) of EAICD"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "RODRI"
  DATA_TYPE      = ASCII_INTEGER
  START_BYTE     = 66
  BYTES          = 7
  UNIT           = "ROUND PER MINUTE"
  DESCRIPTION    = "Drill Spead Rotation Measurement"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "VC1"
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 74
  BYTES          = 7
  UNIT           = MILLIMETRE
  FORMAT         = "F7.2"
  DESCRIPTION    = "Volume Checker Displacement #1 when the first movement UP
                    of Volume Checker command [Perform Volume Checker Activation]
                    VCAC is performed. See also AD 10 (pages 29 30) of EAICD"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "VC2"
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 82
  BYTES          = 7
  UNIT           = MILLIMETRE
  FORMAT         = "F7.2"
  DESCRIPTION    = "Volume Checker Displacement #2 when the movement DOWN
                    of Volume Checker command [Perform Volume Checker Activation]
                    VCAC is performed. See also AD 10 (pages 29 30) of  EAICD"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
```

```
  NAME           = "VC3"
  DATA_TYPE      = ASCII_REAL
  START_BYTE     = 90
  BYTES          = 7
  UNIT           = MILLIMETRE
  FORMAT         = "F7.2"
  DESCRIPTION    = "Volume Checker Displacement #3 when the second movement UP
                    of Volume Checker command [Perform Volume Checker Activation]
                    VCAC is performed. See also AD 10 (pages 29 30) of EAICD."
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "CAROUSEL_MOTOR_DIRECTION"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 99
  BYTES          = 3
  DESCRIPTION    = "Part of STFG (Status Flag of SD2) : Carousel Motor Direction
                    Possible values are :
                         CW (clockwise)
                         CCW (counter clockwise)"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "DRILL_ROTATION_MOTOR_DIRECTION"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 105
  BYTES         = 3
  DESCRIPTION    = "Part of STFG (Status Flag of SD2):
                   Drill Rotation Motor Direction ; Possible values are
                      CW (clockwise)
                      CCW (counter clockwise)"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "DRILL_TRANSLATION_MOTOR_DIRECTION"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 111
  BYTES          = 3
  DESCRIPTION    = "Part of STFG (Status Flag of SD2) :
                    Drill Translation Motor Direction
                    Possible values are :
                     CW (clockwise)
                     CW (counter clockwise)"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "VOLUME_CHECKER_MOTOR_DIRECTION"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 117
  BYTES          = 3
  DESCRIPTION    = "Part of STFG (Status Flag of SD2) :
                    Volume checker motor Direction ; Possible values are :
                       CW (clockwise)
                       CCW (counter clockwise)"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "DRILL_TRANSLATION_WINDING_MAIN"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 123
  BYTES          = 8
  DESCRIPTION    = "Part of STFG (Status Flag of SD2) :
                    Drill Translation Winding Main Activation;Possible values are
                      ACTIVE
                      INACTIVE"
END_OBJECT       = COLUMN
```

```
OBJECT          = COLUMN
  NAME          = "DRILL_TRANSLATION_WINDING_REDUNDANT"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 134
  BYTES         = 8
  DESCRIPTION   = "Part of STFG (Status Flag of SD2) : Drill Translation
                   Winding Redundant Activation ; Possible values are :
                     ACTIVE
                     INACTIVE"
END_OBJECT      = COLUMN


OBJECT          = COLUMN
  NAME          = "DRILL_TRANSLATION_RECOVERY_TORQUE"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 145
  BYTES         = 8
  DESCRIPTION   = "Part of STFG (Status Flag of SD2): Drill Translation recovery
                   Torque selection ; Possible values are :
                      ACTIVE
                      INACTIVE"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "STFG_UNUSED"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 156
  BYTES         = 3
  DESCRIPTION   = "Part of Status Flag of SD2 Unused : 9 bits (8 to 0) display
                   in Hexadecimal form as '1FF' which is the Default Value)"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "DRILL_ROTATION_DRIVER"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 162
  BYTES         = 3
  DESCRIPTION   = "Part of STPW : Drill Rotation Driver (bit 15)
                   Possible values are :
                      ON
                      OFF"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "SAMPLE_DRIVER"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 168
  BYTES         = 3
  DESCRIPTION   = "Part of STPW : Sample Driver (bit 14)
                   Possible values are
                     ON
                     OFF "
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "CAROUSEL_ROTATION_DRIVER"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 174
  BYTES         = 3
  DESCRIPTION   = "Part of STPW :Carousel Rotation Driver (bit 13)
                   Possible values are :
                     ON
                     OFF"
END_OBJECT      = COLUMN
```

```
OBJECT          = COLUMN
  NAME          = "DRILL_TRANSLATION_DRIVER_MAIN"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 180
  BYTES        = 3
  DESCRIPTION   = "Part of STPW : Drill Translation Driver Main  (bit 12)
                   Possible values are :
                   ON
                   OFF"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "DRILL_TRANSLATION_DRIVER_REDUNDANT"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 186
  BYTES         = 3
  DESCRIPTION   = "Part of STPW : Drill Translation Driver Redundant (bit 11)
                   Possible values are :
                      ON
                      OFF"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "R/D_CONVERTER_DRILL_TRANSLATION"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 192
  BYTES         = 3
  DESCRIPTION   = "Part of STPW : R/D Converter of Drill Translation  (bit 10)
                   Possible values are :
                     ON
                     OFF"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "R/D_CONVERTER_CAROUSEL_ROTATION"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 198
  BYTES         = 3
  DESCRIPTION   = "Part of STPW : R/D Converter of Carousel Rotation  (bit 9)
                   Possible values are :
                     ON
                     OFF"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "VOLUME_CHECKER_DRIVER"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 204
  BYTES         = 3
  DESCRIPTION   = "Part of STPW : Volume Checker Driver (bit 8)
                   Possible values are :
                     ON
                     OFF"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "STPW_UNUSED"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 210
  BYTES         = 2
  DESCRIPTION   = "Status Flag of SD2 Unused (8 bits display in
                   Hexadecimal form as 'FF' which represents Default Value)"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "MEMORY_STATE"
```

```
  DATA_TYPE     = CHARACTER
  START_BYTE    = 215
  BYTES         = 9
  DESCRIPTION   = "Memory State : Memory address and its value in
                   hexadecimal format
                   These 2 informations are separated by a space
                   This field is intended only for technical use.
                   It contains data after execution of RDAD (read address content)
                   ommand; MEMADR contains the address specified in the RDAD command.
                   It should be used only for direct commands by experts in SD2 procedures.
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "SD2_ON_BOARD_TIME"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 227
  BYTES         = 8
  DESCRIPTION   = "4 bytes SD2 internal On Board Time Counter
                  (31.25 ms resolution)"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "VOLCHKSW_UPPER"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 238
  BYTES         = 6
  DESCRIPTION   = "VOLCHKSW : Upper Volume checker microswitch
                  status (bit 14) ; 0 : CLOSED , 1: OPEN
                  This field is a character string that takes
                  the values OPEN or CLOSED"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "VOLCHKSW_LOWER"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 247
  BYTES         = 6
  DESCRIPTION   = "VOLCHKSW : Lower Volume checker microswitch
                   status (bit 15) ; 0 : CLOSED , 1: OPEN
                   This field is a character string that takes
                   the values OPEN or CLOSED"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "WINDING_RECOVERY"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 256
  BYTES         = 8
  DESCRIPTION   = "EHSTATUS : Redundant winding recovery
                   procedure status (bit 2) ; 0 : DISABLED , 1: ENABLED
                   This field is a character string that  takes the values
                   DISABLED or ENABLED"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "SOFT_EMERGENCY_RECOVERY"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 267
  BYTES         = 8
  DESCRIPTION   = "EHSTATUS : Soft Emergency recovery
                   procedure status (bit 1) ; 0 : DISABLED , 1: ENABLED
                   This field is a character string that  takes the values
                   DISABLED or ENABLED"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
```

```
  NAME           = "HARD_EMERGENCY_RECOVERY"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 278
  BYTES          = 8
  DESCRIPTION    = "EHSTATUS : Hard Emergency recovery
                    procedure status (bit 0) ; 0 : DISABLED , 1: ENABLED
                    This field is a character string that  takes the values
                    DISABLED or ENABLED"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "SD2_CMD_STATUS"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 289
  BYTES         = 12
  DESCRIPTION    = "Status of Current Command
                    Possible values are
                    IN_PROGRESS         (hex value 9D8),
                    COMPLETED           (hex value 9CE),
                    FAILED              (hex value 9E2),
                    UNKNOWN_<hex value> where <hex value> is a 4 bytes
                    character string representing the unknown
                    (none of the above) hex code  of the SD2_Cmd_status
                    This field is a character string that takes the values :
                    IN_PROGRESS, COMPLETED, FAILED or UNKNOWN_<hex value>"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "ERFG"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 304
  BYTES          = 4
  DESCRIPTION    = "Error Flag of SD2 controlled devices
                    This field takes 2 characters hex values from
                    the following list (first the hex value):
                       0026 EC_SPC_CMD_CHECKSUM_FAILURE
                       0036 EC_SPC_CMD_SYNTAX_FAILURE
                       0046 EC_SPC_CMD_ID_FAILURE
                       0056 EC_SPC_CMD_WRDC_FAILURE
                       0066 EC_SPC_CMD_COMMAND_EMPTY
                       0076 EC_SPC_CMD_NOT_ALLOWED_IN_MP
                       0081 EC_SPC_CMD_REJ_DURING_LDMP
                       0091 EC_SPC_CMD_REJECTED_IN_DEAD
                       00A1 EC_SPC_CMD_REJECTED_IN_UNDEFINED
                       00B6 EC_SPC_CMD_REJECTED_IN_POWER_ON
                       00C6 EC_ABRT_CMD_CHECKSUM_FAILURE
                       00D6 EC_EMST_CMD_CHECKSUM_FAILURE
                       00E6 EC_ABRT_CMD_SYNTAX_FAILURE
                       00F6 EC_EMST_CMD_SYNTAX_FAILURE
                       0106 EC_ABRT_CMD_WRDC_FAILURE
                       0206 EC_EMST_CMD_WRDC_FAILURE
                       0200 EC_RERC_DESTINATION_UNIT_OFF
                       0215 EC_RERC_SCIENCE_DATA_OUT
                       0225 EC_RERC_MEMORY_FULL
                       0235 EC_RERC_REQ_UNDUE
                       0245 EC_RERC_ILLEGAL_ADDRESS
                       0255 EC_RERC_ILLEGAL_REQ_CODE
                       0261 EC_RERC_REASON_UNKNOWN
                       0270 EC_RASV_RECEIVED
                       0280 EC_RAXT_RECEIVED
                       0290 EC_RSCS_RECEIVED
                       02A0 EC_RBUS_RECEIVED
                       02B1 EC_TRG_RECEIVED
                       02D5 EC_USR_CMD_ILLEGAL_AC
                       02E5 EC_USR_DATA_ILLEGAL_AC
                       02F5 EC_STBY_RECEIVED
```

```
0305 EC_RCMS_RECEIVED_WITH_NO_MP_LOAD
0311 EC_RMOD_NORMAL_MODE
0321 EC_RMOD_NO_NORMAL_MODE
0331 EC_RSST_INIT_RECOVERY_PROC
0340 EC_RSST_NO_RECOVERY_PROC
0403 EC_CHK_DRILLROT_SPEED_FAILURE
0412 EC_CHK_DRILLTRA_SPEED_FAILURE
0423 EC_CHK_CAROUSEL_SPEED_FAILURE
0506 EC_BH_SWITCHONOFF_ERROR
0516 EC_BH_SETSTD_ERROR
0526 EC_BH_SWITCHTUBE_ERROR
0603 EC_DEADLINE_MISSED
0613 EC_COSAC_STATUS_ENGAGED
0623 EC_COSAC_STATUS_UNDEFINED
0633 EC_PTOLEMY_STATUS_ENGAGED
0643 EC_PTOLEMY_STATUS_UNDEFINED
0656 EC_SARE_CONFIGURATION_CHECK_FAILURE
0664 EC_DRILL_POS_CHECK_FAILURE
0674 EC_RESOLVER_DATA_INVALID
0684 EC_CAROUSEL_POS_CHECK_FAILURE
0693 EC_VCK_MICROSW_CHECK_FAILURE
06A3 EC_VOLUME_COUNTER_INVALID
06B3 EC_LANDG_POS_CHECK_FAILURE
06C3 EC_DRTR_MAIN_MOTION_CHECK_FAILURE
06D3 EC_DRTR_RED_MOTION_CHECK_FAILURE
0716 EC_PH_HW_ERROR
0726 EC_PH_POSE_OUT_OF_RANGE
0733 EC_PH_CAR_RAMP_DOWN_TIMEOUT
0806 EC_SH_HW_ERROR
1006 EC_Q_SH_FULL_QUEUE
1016 EC_Q_EH_FULL_QUEUE
1026 EC_Q_TM_FULL_QUEUE
1036 EC_Q_ELPTIM_FULL_QUEUE
1046 EC_Q_EMSCMD_FULL_QUEUE
1056 EC_Q_CDMS_FULL_QUEUE
1066 EC_Q_TIMER_FULL_QUEUE
1076 EC_Q_EM_CIH_FULL_QUEUE
1086 EC_Q_PH_FULL_QUEUE
1096 EC_Q_SCMD_FULL_QUEUE
10A6 EC_Q_CHK_FULL_QUEUE
1106 EC_Q_RH_FULL_QUEUE
1116 EC_Q_RERC_FULL_QUEUE
2006 EC_SH_INTERNAL_ERROR
2016 EC_TM_INTERNAL_ERROR
2026 EC_SCMD_INTERNAL_ERROR
2036 EC_SCMDLIB_INTERNAL_ERROR
2046 EC_BITLIB_INTERNAL_ERROR
2056 EC_CIH_INTERNAL_ERROR
2066 EC_OPRT_INTERNAL_ERROR
2076 EC_TIMER_INTERNAL_ERROR
2086 EC_MVCK_INTERNAL_ERROR
2096 EC_GBUS_IO_INTERNAL_ERROR
20A6 EC_DIRECT_INTERNAL_ERROR
20B6 EC_PH_INTERNAL_ERROR
20C6 EC_CHK_INTERNAL_ERROR
20D6 EC_CAPO_INTERNAL_ERROR
20E6 EC_DRILL_INTERNAL_ERROR
20F6 EC_EMERGCY_INTERNAL_ERROR
2106 EC_Q_SCMD_INTERNAL_ERROR
2116 EC_Q_CDMSIF_INTERNAL_ERROR
2126 EC_ZERO_INTERNAL_ERROR
2136 EC_VCAC_INTERNAL_ERROR
2146 EC_RH_INTERNAL_ERROR
2156 EC_RH_LIB_INTERNAL_ERROR
2166 EC_BRR_INTERNAL_ERROR
2176 EC_MPL_INTERNAL_ERROR
```

```
                          2186 EC_BH_INTERNAL_ERROR
                          2196 EC_SCHEDUL_INTERNAL_ERROR
                          3001 EC_LDMP_REJECTED_IN_DEAD
                          3011 EC_LDMP_REJECTED_IN_UNDEF
                          3021 EC_LDMP_REJ_DURING_LDMP
                          3031 EC_LDMP_REJECTED_IN_DUMP
                          3041 EC_LDMP_CMD_CHECKSUM_FAILURE
                          3051 EC_LDMP_SSCMD1_SYNTAX_ERR
                          3061 EC_LDMP_OFFSET_PARAM_ERR
                          3071 EC_LDMP_LEN_PARAM_ERR
                          3081 EC_LDMP_OFF_LEN_PARAM_ERR
                          3091 EC_MP_ADLER32_CKSUM_FAILURE
                          30A1 EC_LDMP_CMD_WRDC_FAILURE
                          30B1 EC_MP_LOAD_FAILED
                          4001 EC_RERC_DUO_RECEIVED_WITHOUT_REQ
                          4011 EC_RERC_SDO_RECEIVED_WITHOUT_REQ
                          4021 EC_RERC_MF_RECEIVED_WITHOUT_REQ
                          4031 EC_RERC_RU_RECEIVED_WITHOUT_REQ
                          4041 EC_RERC_IA_RECEIVED_WITHOUT_REQ
                          4051 EC_RERC_IR_RECEIVED_WITHOUT_REQ
                          4061 EC_RERC_UR_RECEIVED_WITHOUT_REQ
                          4071 EC_SRDY_TIMEOUT_EXPIRED
                          4081 EC_FLSP_TIMEOUT_EXPIRED
                          4091 EC_OCPL_TIMEOUT_EXPIRED
                          40A1 EC_SCMD_TIMEOUT_EXPIRED
                          40B1 EC_RDBF_TIMEOUT_EXPIRED
                          40C1 EC_WRBF_TIMEOUT_EXPIRED
                          40D1 EC_SRDY_MAX_NUM_RETRY_REACHED
                          40E1 EC_FLSP_MAX_NUM_RETRY_REACHED
                          40F3 EC_OCPL_MAX_NUM_RETRY_REACHED
                          4101 EC_SCMD_MAX_NUM_RETRY_REACHED
                          4113 EC_RDBF_MAX_NUM_RETRY_REACHED
                          4123 EC_WRBF_MAX_NUM_RETRY_REACHED"
END_OBJECT     = COLUMN

OBJECT         = COLUMN
  NAME         = "OPST"
  DATA_TYPE    = CHARACTER
  START_BYTE   = 311
  BYTES        = 30
  DESCRIPTION  = "OPST : SD2 Current Status
                  The possible values are (hex value first):
                      0000 SD2 undefined status
                      F000 SD2 ready
                      A000 SD2 dead
                      0F00 Drill in progress
                      0A00 Drill completed
                      00F0 Sampling in progress
                      00A0 Sampling completed
                      000F Carousel rotation in progress
                      000A Carousel rotation completed
                      UNKNOWN_<hex value>
                  This field is a character string that  takes
                  one of the following values
                      SD2 undefined status
                      SD2 ready
                      SD2 dead
                      Drill in progress
                      Drill completed
                      Sampling in progress
                      Sampling completed
                      Carousel rotation in progress
                      Carousel rotation completed
                      UNKNOWN_<hex value>, where <hex value> is a 4 bytes
                      character string representing the unknown
                      (none of the above) hex code  of the SD2 status"
```

```
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "STATUS_LDMP_COMMAND"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 345
  BYTES         = 12
  DESCRIPTION   = "Status of the LDMP Command (Load Mission Plan)
                   this command to SD2 to load a sequence of specific commands
                   stored in CDMS called Mission Plan. The possible values are :
                       IN_PROGRESS          (hex value AA0)
                       COMPLETED            (hex value A96)
                       FAILED               (hex value AAA)
                       UNKNOWN_<hex value> where <hex value> is a 4 bytes
                         character string representing the unknown
                         (none of the above) hex code  of the STATUS_LDMP_COMMAND
                   This field is a character string that takes
                   one of the following values
                       IN_PROGRESS
                       COMPLETED
                       FAILED
                       UNKNOWN_<hex value>"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "SPC"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 360
  BYTES         = 49
  DESCRIPTION   = "Replica of Specific command in execution
                   ten 16 bits words in hexadecimal format, separated by a space"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "FILLER_WORDS"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 412
  BYTES         = 12
  DESCRIPTION   = "Filler Words (3 trailing words of record)"
END_OBJECT      = COLUMN
```

4.3.2.4 Mission Specific Keywords

4.3.2.4.1 Sample Tracking Specific Keywords

These keywords has been defined to track the cometary material drilled and distributed by SD2 system.

ROSETTA : SD2_OVEN_FILLING
- **Type:** character
- **Standard values:** "YES" or "NO"
- **Description:** filling conditions of the pictured oven as deduced from the SD2 data

ROSETTA : SD2_DRILL_DEPTH
- **Type**: real, unit mm
- **Standard values**: refer to SD2 data (or missing value)
- **Description:** depth of the drilling process as deduced from the SD2 data

ROSETTA : SD2_OVEN_NUMBER
- **Type:** integer
- **Standard values:** 1 to 26
- **Description:** number of the oven filled by the SD2 system

ROSETTA : SD2_OVEN_TYPE
- **Type:** character
- **Standard values**: "MTO" or "HTO"
- **Description:** type of the oven filled by the SD2 system (Medium Temperature Oven or High Temperature Oven)

ROSETTA : SAMPLE_TAPPING
- **Type:** character
- **Standard values:** "YES" or "NO" or "N/A"
- **Description:** tapping conditions of the pictured oven as deduced from the PTOLEMY or COSAC data

ROSETTA : SAMPLE_NUMBER
- **Type:** integer
- **Standard values**: 1, 2,…or missing value
- **Description:** number of number of sample (1 for the first sample of the mission and n+1 for the following ones)

ROSETTA : SAMPLE_VOLUME
- **Type:** real, mm3
- **Standard values**: from Volume Checker
- **Description:** amount of sample discharged into the oven from the Volume Checker data

ROSETTA : INSTRUMENT_ENDUSER
- **Type:** character
- **Standard values**: "CIVA-MI " or "CIVA-MV" or "COSAC " or "PTOLEMY"
- **Description:** instrument served by SD2 oven and analysing the sample

4.3.3 Data Product Design of calibrated SD2 HK data (level 3)

Level 3 HK contains calibrated SD2 housekeeping data, drill position and carousel position with PDS detached labels..

4.3.3.1 File Characteristics Data Elements

The PDS file characteristic data elements for SD2 calibrated science data (level 3) are:

```
RECORD_TYPE           = FIXED_LENGTH
RECORD_BYTES        = 267
FILE_RECORDS          = 256
The FILE_NAME is described in §3.1.4
```

4.3.3.2 Data Object Pointers Identification Data Elements

The calibrated HK data are organized as a table and PDS label refers to a single data object which is a TABLE. The data object pointers (^TABLE) reference TAB files.

4.3.3.3 Data Object Definition

```
OBJECT                        = TABLE
  NAME                        = "HK_TABLE"
  INTERCHANGE_FORMAT          = ASCII
  ROWS                         = 256
  COLUMNS                      = 33
  ROW_BYTES                    = 313
```

```
  ^STRUCTURE                 = "SD2_CALIBRATED_HK.FMT"
END_OBJECT                   = TABLE
```

The structure of the TABLE object is described in the file SD2_CALIBRATED_HK.FMT as follows:

```
/*          Contents of format file  "CALIBRATED HK.FMT"   for  SD2    */

  OBJECT          = COLUMN
    NAME          = "UTC_TIME"
    DATA_TYPE     = TIME
    START_BYTE    = 1
    BYTES         = 23
    DESCRIPTION   = "This column represents the UTC Time in PDS standard format
                     YYYY-MM-DDThh:mm:ss.sss"
  END_OBJECT      = COLUMN

  OBJECT          = COLUMN
    NAME          = "LOBT_TIME"
    DATA_TYPE     = CHARACTER
    START_BYTE    = 26
    BYTES         = 14
    DESCRIPTION   = "This column represents the Lander On Board Time
                     as 6 hexadecimal characters in three groups separated by
                     a space ; (resolution 1/32 s)"
  END_OBJECT      = COLUMN

  OBJECT          = COLUMN
    NAME          = "CURRENT_+5V_LINE"
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 42
    BYTES         = 7
    UNIT          = MILLIAMPERE
    FORMAT        = "F7.1"
    DESCRIPTION   = "Current value on +5V line"
  END_OBJECT      = COLUMN

  OBJECT          = COLUMN
    NAME          = "CURRENT_-5V_LINE"
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 50
    BYTES         = 7
    UNIT          = MILLIAMPERE
    FORMAT        = "F7.1"
    DESCRIPTION   = "Current value on -5V line"
  END_OBJECT      = COLUMN

  OBJECT          = COLUMN
    NAME          = "CURRENT_+12V_LINE"
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 58
    BYTES         = 7
    UNIT          = MILLIAMPERE
    FORMAT        = "F7.1"
    DESCRIPTION   = "Current value on +12V line"
  END_OBJECT      = COLUMN

  OBJECT          = COLUMN
    NAME          = "CURRENT_-12V_LINE"
    DATA_TYPE     = ASCII_REAL
    START_BYTE    = 66
    BYTES         = 7
    UNIT          = MILLIAMPERE
    FORMAT        = "F7.1"
    DESCRIPTION   = "Current value on -12V line"
  END_OBJECT      = COLUMN
```

```
OBJECT          = COLUMN
  NAME          = "SD2 POWER"
  DATA_TYPE     = ASCII_REAL
  START_BYTE    = 74
  BYTES         = 9
  UNIT          = WATT
  FORMAT        = "F9.2"
  DESCRIPTION   = "SD2 Power (watt)"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "PME1"
  DATA_TYPE     = ASCII_REAL
  START_BYTE    = 84
  BYTES         = 6
  UNIT          = MILLIMETRE
  FORMAT        = "F4.2"
  DESCRIPTION   = "Position of resolver #1 (drill translation)
                  The allowed  Drill translation range is from 0 to 64800 (1/100 mm).
                  The range from 0 to 63650 (frorm 0 to 63.56mm)  correspond to positive
                  values and the range  from 63651 to 64800 corresponds to negative
                  values One has to use the following formula to find the correct value:
                  Value in decimal = (read_value (decimal) - 64800) *(-1) [1/100mm]"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "PME2"
  DATA_TYPE     = ASCII_INTEGER
  START_BYTE    = 91
  BYTES         = 6
  UNIT          = ARCMIN
  DESCRIPTION   = " Position of resolver #2  (carousel rotation)
                 The  allowed carousel value range is from 0 (min value) to 21599 (max
                 value), if 65535 (FFFF in hexadecimal) is showed this means that the
                 resolver is off an data is not available."
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "CAROUSEL_MOTOR_DIRECTION"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 99
  BYTES         = 3
  DESCRIPTION   = "Carousel Motor Direction (STFG bit 15)
                   0 = CW (clockwise), 1 = CCW  (counter clockwise)
                   Possible values are :
                      CW
                      CCW"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "DRILL_ROTATION_MOTOR_DIRECTION"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 105
  BYTES         = 3
  DESCRIPTION   = "Drill Rotation Motor Direction (STFG bit 14)
                   0 = CW (clockwise), 1 = CCW  (counter clockwise)
                    Possible values are :
                      CW
                      CCW"
END_OBJECT      = COLUMN

OBJECT          = COLUMN
  NAME          = "DRILL_TRANSLATION_MOTOR_DIRECTION"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 111
```

```
  BYTES          = 3
  DESCRIPTION    = "Drill Translation Motor Direction (STFG bit 13)
                    0 = CW (clockwise), 1 = CCW  (counter clockwise)
                    Possible values are :
                       CW
                       CCW"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "VOLUME_CHECKER_MOTOR_DIRECTION"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 117
  BYTES          = 3
  DESCRIPTION    = "Part of STFG (Status Flag of SD2, bit 12):
                    Volume checker motor Direction ; Possible values are :
                    0 = CW (clockwise), 1 = CCW  (counter clockwise)
                     Possible values are :
                       CW
                       CCW"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "DRILL_TRANSLATION_WINDING_MAIN"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 123
  BYTES          = 8
  DESCRIPTION    = "Drill Translation Winding Main (STFG bit 11)
                    0 = INACTIVE, 1= ACTIVE
                    Possible values are :
                       ACTIVE
                       INACTIVE"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "DRILL_TRANSLATION_WINDING_REDUNDANT"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 134
  BYTES          = 8
  DESCRIPTION    = "Drill Translation Winding Redundant Activation (STFG bit 10)
                    0 = INACTIVE, 1= ACTIVE
                    Possible values are :
                       ACTIVE
                       INACTIVE"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "DRILL_TRANSLATION_RECOVERY_TORQUE"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 145
  BYTES          = 8
  DESCRIPTION    = "STFG (Status Flag of SD2, bit 9): Drill Translation recovery
                                         Torque selection ; 0 = INACTIVE, 1= ACTIVE
                    Possible values are :
                       ACTIVE
                       INACTIVE"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "STFG_UNUSED"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 156
  BYTES          = 3
  DESCRIPTION    = "Status Flag of SD2 Unused : 9 bits (8 to 0) display in
                   Hexadecimal format as '1FF' which represents Default Value)"
END_OBJECT       = COLUMN
```

```
OBJECT            = COLUMN
  NAME            = "DRILL_ROTATION_DRIVER"
  DATA_TYPE       = CHARACTER
  START_BYTE      = 162
  BYTES           = 3
  DESCRIPTION     = "Part of STPW : Drill Rotation Driver (bit 15)
                      0 = OFF , 1 = ON
                       Possible values are :
                         ON
                         OFF"
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = "SAMPLE_DRIVER"
  DATA_TYPE       = CHARACTER
  START_BYTE      = 168
  BYTES           = 3
  DESCRIPTION     = "STPW : Sample Driver (bit 14)
                      0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT        = COLUMN

OBJECT          = COLUMN
  NAME            = "CAROUSEL_ROTATION_DRIVER"
  DATA_TYPE       = CHARACTER
  START_BYTE      = 174
  BYTES           = 3
  DESCRIPTION     = "STPW :Carousel Rotation Driver (bit 13)
                       0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = "CAROUSEL_TRANSLATION_DRIVER_MAIN"
  DATA_TYPE       = CHARACTER
  START_BYTE      = 180
  BYTES           = 3
  DESCRIPTION     = "STPW : Carousel Translation Driver Main (bit 12)
                      0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = "CAROUSEL_TRANSLATION_DRIVER_REDUNDANT"
  DATA_TYPE       = CHARACTER
  START_BYTE      = 186
  BYTES           = 3
  DESCRIPTION     = "STPW : Carousel Translation Driver Redundant (bit 11)
                      0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT        = COLUMN

OBJECT            = COLUMN
  NAME            = "R/D_CONVERTER_DRILL_TRANSLATION"
  DATA_TYPE       = CHARACTER
  START_BYTE      = 192
  BYTES           = 3
  DESCRIPTION     = "STPW : R/D Converter of Drill Translation  (bit 10)
```

```
                      0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "R/D_CONVERTER_CAROUSEL_ROTATION"
  DATA_TYPE         = CHARACTER
  START_BYTE        = 198
  BYTES             = 3
  DESCRIPTION       = "STPW : R/D Converter of Carousel Rotation (bit 9)
                      0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "VOLUME_CHECKER_DRIVER"
  DATA_TYPE         = CHARACTER
  START_BYTE        = 204
  BYTES             = 3
  DESCRIPTION       = " Part of STPW : Volume Checker Driver (bit 8)
                        0 = OFF , 1 = ON
                      Possible values are :
                         ON
                         OFF"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "STPW_UNUSED"
  DATA_TYPE         = CHARACTER
  START_BYTE        = 210
  BYTES             = 2
  DESCRIPTION       = "Status Flag of SD2 Unused 8 bits (0 to 7)display in
                      Hexadecimal form as 'FF' which represents Default Value)"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "SD2_SH_CMD_STATUS"
  DATA_TYPE         = CHARACTER
  START_BYTE        = 215
  BYTES             = 12
  DESCRIPTION       = "Status of Speed Control Command
                      IN_PROGRESS (0x9D8), COMPLETED (0x9CE), FAILED (0x9E2)
                      UNKNOWN_<hex value>, where <hex value> is a 4 bytes
                      character string representing the unknown
                      (none of the 3 above) hex code of the status
                      The possibles values are :
                         IN_PROGRESS
                         COMPLETED
                         FAILED
                         UNKNOWN_<hex value>"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
  NAME              = "SD2_PH_CMD_STATUS"
  DATA_TYPE         = CHARACTER
  START_BYTE        = 230
  BYTES             = 12
  DESCRIPTION       = "Status of Position Control Command

                      IN_PROGRESS (0x9D8), COMPLETED (0x9CE), FAILED (0x9E2)
                      UNKNOWN_<hex value>, where <hex value> is a 4 bytes
                      character string representing the unknown
```

```
                   (none of the 3 above) hex code of the status
                   The possibles values are :
                      IN_PROGRESS
                      COMPLETED
                      FAILED
                      UNKNOWN_<hex value>"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "SD2_CMD_STATUS"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 245
  BYTES          = 12
  DESCRIPTION    = "Status of Current Command
                   IN_PROGRESS (0x9D8), COMPLETED (0x9CE), FAILED (0x9E2)
                   UNKNOWN_<hex value>, where <hex value> is a 4 bytes
                   character string representing the unknown
                   (none of the 3 above) hex code of the status
                   The possibles values are :
                      IN_PROGRESS
                      COMPLETED
                      FAILED
                      UNKNOWN_<hex value>"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "TIME_S"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 260
  BYTES          = 4
  DESCRIPTION    = "SD2 On Board Time (in seconds) synchronized with
                   CDMS On Board Time"
END_OBJECT       = COLUMN

OBJECT           = COLUMN
  NAME           = "OPST"
  DATA_TYPE      = CHARACTER
  START_BYTE     = 267
  BYTES          = 30
DESCRIPTION      = "OPST : SD2 Current Status
                  The possible values are (hex value first):
                     0000 SD2 undefined status
                     F000 SD2 ready
                     A000 SD2 dead
                     0F00 Drill in progress
                     0A00 Drill completed
                     00F0 Sampling in progress
                     00A0 Sampling completed
                     000F Carousel rotation in progress
                     000A Carousel rotation completed
                     UNKNOWN_<hex value>,
                  This field is a character string that takes
                  one of the following values
                     SD2 undefined status
                     SD2 ready
                     SD2 dead
                     Drill in progress
                     Drill completed
                     Sampling in progress
                     Sampling completed
                     Carousel rotation in progress
                     Carousel rotation completed
                     UNKNOWN_<hex value>, where <hex value>
                  Is a 4 bytes character string representing the unknown
                  (none of the 9 above) hex code  of the SD2 status"
END_OBJECT       = COLUMN
```

```
OBJECT          = COLUMN
  NAME          = "ERFG"
  DATA_TYPE     = CHARACTER
  START_BYTE    = 300
  BYTES         = 4
  DESCRIPTION   = "Error Flag of SD2 controlled devices
                  This field takes 4 bytes characters hex values
                  from the following list (first the hex value):
                     0026 EC_SPC_CMD_CHECKSUM_FAILURE
                     0036 EC_SPC_CMD_SYNTAX_FAILURE
                     0046 EC_SPC_CMD_ID_FAILURE
                     0056 EC_SPC_CMD_WRDC_FAILURE
                     0066 EC_SPC_CMD_COMMAND_EMPTY
                     0076 EC_SPC_CMD_NOT_ALLOWED_IN_MP
                     0081 EC_SPC_CMD_REJ_DURING_LDMP
                     0091 EC_SPC_CMD_REJECTED_IN_DEAD
                     00A1 EC_SPC_CMD_REJECTED_IN_UNDEFINED
                     00B6 EC_SPC_CMD_REJECTED_IN_POWER_ON
                     00C6 EC_ABRT_CMD_CHECKSUM_FAILURE
                     00D6 EC_EMST_CMD_CHECKSUM_FAILURE
                     00E6 EC_ABRT_CMD_SYNTAX_FAILURE
                     00F6 EC_EMST_CMD_SYNTAX_FAILURE
                     0106 EC_ABRT_CMD_WRDC_FAILURE
                     0206 EC_EMST_CMD_WRDC_FAILURE
                     0200 EC_RERC_DESTINATION_UNIT_OFF
                     0215 EC_RERC_SCIENCE_DATA_OUT
                     0225 EC_RERC_MEMORY_FULL
                     0235 EC_RERC_REQ_UNDUE
                     0245 EC_RERC_ILLEGAL_ADDRESS
                     0255 EC_RERC_ILLEGAL_REQ_CODE
                     0261 EC_RERC_REASON_UNKNOWN
                     0270 EC_RASV_RECEIVED
                     0280 EC_RAXT_RECEIVED
                     0290 EC_RSCS_RECEIVED
                     02A0 EC_RBUS_RECEIVED
                     02B1 EC_TRG_RECEIVED
                     02D5 EC_USR_CMD_ILLEGAL_AC
                     02E5 EC_USR_DATA_ILLEGAL_AC
                     02F5 EC_STBY_RECEIVED
                     0305 EC_RCMS_RECEIVED_WITH_NO_MP_LOAD
                     0311 EC_RMOD_NORMAL_MODE
                     0321 EC_RMOD_NO_NORMAL_MODE
                     0331 EC_RSST_INIT_RECOVERY_PROC
                     0340 EC_RSST_NO_RECOVERY_PROC
                     0403 EC_CHK_DRILLROT_SPEED_FAILURE
                     0412 EC_CHK_DRILLTRA_SPEED_FAILURE
                     0423 EC_CHK_CAROUSEL_SPEED_FAILURE
                     0506 EC_BH_SWITCHONOFF_ERROR
                     0516 EC_BH_SETSTD_ERROR
                     0526 EC_BH_SWITCHTUBE_ERROR
                     0603 EC_DEADLINE_MISSED
                     0613 EC_COSAC_STATUS_ENGAGED
                     0623 EC_COSAC_STATUS_UNDEFINED
                     0633 EC_PTOLEMY_STATUS_ENGAGED
                     0643 EC_PTOLEMY_STATUS_UNDEFINED
                     0656 EC_SARE_CONFIGURATION_CHECK_FAILURE
                     0664 EC_DRILL_POS_CHECK_FAILURE
                     0674 EC_RESOLVER_DATA_INVALID
                     0684 EC_CAROUSEL_POS_CHECK_FAILURE
                     0693 EC_VCK_MICROSW_CHECK_FAILURE
                     06A3 EC_VOLUME_COUNTER_INVALID
                     06B3 EC_LANDG_POS_CHECK_FAILURE
                     06C3 EC_DRTR_MAIN_MOTION_CHECK_FAILURE
                     06D3 EC_DRTR_RED_MOTION_CHECK_FAILURE
                     0716 EC_PH_HW_ERROR
```

```
0726 EC_PH_POSE_OUT_OF_RANGE
0733 EC_PH_CAR_RAMP_DOWN_TIMEOUT
0806 EC_SH_HW_ERROR
1006 EC_Q_SH_FULL_QUEUE
1016 EC_Q_EH_FULL_QUEUE
1026 EC_Q_TM_FULL_QUEUE
1036 EC_Q_ELPTIM_FULL_QUEUE
1046 EC_Q_EMSCMD_FULL_QUEUE
1056 EC_Q_CDMS_FULL_QUEUE
1066 EC_Q_TIMER_FULL_QUEUE
1076 EC_Q_EM_CIH_FULL_QUEUE
1086 EC_Q_PH_FULL_QUEUE
1096 EC_Q_SCMD_FULL_QUEUE
10A6 EC_Q_CHK_FULL_QUEUE
1106 EC_Q_RH_FULL_QUEUE
1116 EC_Q_RERC_FULL_QUEUE
2006 EC_SH_INTERNAL_ERROR
2016 EC_TM_INTERNAL_ERROR
2026 EC_SCMD_INTERNAL_ERROR
2036 EC_SCMDLIB_INTERNAL_ERROR
2046 EC_BITLIB_INTERNAL_ERROR
2056 EC_CIH_INTERNAL_ERROR
2066 EC_OPRT_INTERNAL_ERROR
2076 EC_TIMER_INTERNAL_ERROR
2086 EC_MVCK_INTERNAL_ERROR
2096 EC_GBUS_IO_INTERNAL_ERROR
20A6 EC_DIRECT_INTERNAL_ERROR
20B6 EC_PH_INTERNAL_ERROR
20C6 EC_CHK_INTERNAL_ERROR
20D6 EC_CAPO_INTERNAL_ERROR
20E6 EC_DRILL_INTERNAL_ERROR
20F6 EC_EMERGCY_INTERNAL_ERROR
2106 EC_Q_SCMD_INTERNAL_ERROR
2116 EC_Q_CDMSIF_INTERNAL_ERROR
2126 EC_ZERO_INTERNAL_ERROR
2136 EC_VCAC_INTERNAL_ERROR
2146 EC_RH_INTERNAL_ERROR
2156 EC_RH_LIB_INTERNAL_ERROR
2166 EC_BRR_INTERNAL_ERROR
2176 EC_MPL_INTERNAL_ERROR
2186 EC_BH_INTERNAL_ERROR
2196 EC_SCHEDUL_INTERNAL_ERROR
3001 EC_LDMP_REJECTED_IN_DEAD
3011 EC_LDMP_REJECTED_IN_UNDEF
3021 EC_LDMP_REJ_DURING_LDMP
3031 EC_LDMP_REJECTED_IN_DUMP
3041 EC_LDMP_CMD_CHECKSUM_FAILURE
3051 EC_LDMP_SSCMD1_SYNTAX_ERR
3061 EC_LDMP_OFFSET_PARAM_ERR
3071 EC_LDMP_LEN_PARAM_ERR
3081 EC_LDMP_OFF_LEN_PARAM_ERR
3091 EC_MP_ADLER32_CKSUM_FAILURE
30A1 EC_LDMP_CMD_WRDC_FAILURE
30B1 EC_MP_LOAD_FAILED
4001 EC_RERC_DUO_RECEIVED_WITHOUT_REQ
4011 EC_RERC_SDO_RECEIVED_WITHOUT_REQ
4021 EC_RERC_MF_RECEIVED_WITHOUT_REQ
4031 EC_RERC_RU_RECEIVED_WITHOUT_REQ
4041 EC_RERC_IA_RECEIVED_WITHOUT_REQ
4051 EC_RERC_IR_RECEIVED_WITHOUT_REQ
4061 EC_RERC_UR_RECEIVED_WITHOUT_REQ
4071 EC_SRDY_TIMEOUT_EXPIRED
4081 EC_FLSP_TIMEOUT_EXPIRED
4091 EC_OCPL_TIMEOUT_EXPIRED
40A1 EC_SCMD_TIMEOUT_EXPIRED
40B1 EC_RDBF_TIMEOUT_EXPIRED
```

```
                      40C1 EC_WRBF_TIMEOUT_EXPIRED
                      40D1 EC_SRDY_MAX_NUM_RETRY_REACHED
                      40E1 EC_FLSP_MAX_NUM_RETRY_REACHED
                      40F3 EC_OCPL_MAX_NUM_RETRY_REACHED
                      4101 EC_SCMD_MAX_NUM_RETRY_REACHED
                      4113 EC_RDBF_MAX_NUM_RETRY_REACHED
                      4123 EC_WRBF_MAX_NUM_RETRY_REACHED"
  END_OBJECT      = COLUMN

  OBJECT          = COLUMN
    NAME          = "DUMMY"
    DATA_TYPE     = CHARACTER
    START_BYTE    = 307
    BYTES         = 4
    DESCRIPTION   = "DUMMY ; Always equal to FFFF"
 END_OBJECT     = COLUMN
```

5 Appendix A : Available Software to read PDS files

The level 3 housekeeping and science PDS files can be read with the PDS table verifier tool “tbtool” and readpds (Small Bodies Node tool).

6 Appendix B : Example of PDS label for SD2 HK level 3 data product

```
PDS_VERSION_ID                 = PDS3
LABEL_REVISION_NOTE  = "2010-12-23, SONC, version 1.0"
/* PVV version 3.6 */

/*           Calibrated Housekeeping Data (Level 3)    */


/*  FILE CHARACTERISTIC DATA ELEMENTS   */

RECORD_TYPE              = FIXED_LENGTH
RECORD_BYTES             = 316
FILE_RECORDS             = 16

/* DATA OBJECT POINTERS  */

^TABLE              = ("SD2_FH3_040314081924_0008.TAB",1)

/* IDENTIFICATION AND DESCRIPTIVE DATA ELEMENTS */

DATA_SET_ID               = "RL-CAL-SD2-3-CVP-V1.0"
DATA_SET_NAME             = "ROSETTA-LANDER CAL SD2 3 CVP V1.0"
PRODUCT_ID                = "SD2_FH3_040314081924_0008"
PRODUCT_CREATION_TIME = 2010-11-25T09:07:50
MISSION_NAME               = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME        = "COMMISSIONING"
MISSION_ID                 = ROSETTA
INSTRUMENT_HOST_NAME       = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID         = RL
OBSERVATION_TYPE       = "COMMISSIONING"

PRODUCT_TYPE              = RDR
PROCESSING_LEVEL_ID       = "3"
START_TIME                = 2004-03-14T08:19:24.492
STOP_TIME                 = 2004-03-14T08:27:32.117
SPACECRAFT_CLOCK_START_COUNT = " 1/37873151.04096"
SPACECRAFT_CLOCK_STOP_COUNT  = " 1/37873638.45056"
PRODUCER_ID                = "SONC"
PRODUCER_FULL_NAME         = "SCIENCE OPERATIONS AND NAVIGATION CENTER"
PRODUCER_INSTITUTION_NAME = "CNES"
```

```
INSTRUMENT_ID           = SD2
INSTRUMENT_NAME         = "SAMPLING, DRILLING AND DISTRIBUTION SUBSYSTEM"
INSTRUMENT_TYPE         = "DRILL"
INSTRUMENT_MODE_ID      = "N/A"
INSTRUMENT_MODE_DESC    = "N/A"
TARGET_NAME            = "CALIBRATION"
TARGET_TYPE            = "CALIBRATION"

DATA_QUALITY_ID         = "-1"
DATA_QUALITY_DESC       = "-1 : NOT QUALIFIED"

/* GEOMETRY PARAMETERS */

/* SPACECRAFT LOCATION: Position <km> */
SC_SUN_POSITION_VECTOR = (  144196046.9, -13267839.7,  -6008372.7)
/* TARGET PARAMETERS: Position <km>, Velocity <km/s> */
SC_TARGET_POSITION_VECTOR = ("N/A", "N/A", "N/A")
SC_TARGET_VELOCITY_VECTOR = ("N/A", "N/A", "N/A")
/* SPACECRAFT POSITION WITH RESPECT TO CENTRAL BODY */
SPACECRAFT_ALTITUDE =  "N/A"
SUB_SPACECRAFT_LATITUDE =  "N/A"
SUB_SPACECRAFT_LONGITUDE =  "N/A"
NOTE = "The values of the keywords SC_SUN_POSITION_VECTOR,
       SC_TARGET_POSITION_VECTOR and SC_TARGET_VELOCITY_VECTOR
       are related to the EMEJ2000 reference frame.
       The values of SUB_SPACECRAFT_LATITUDE and SUB_SPACECRAFT_LONGITUDE
       are northern latitude and eastern longitude in the standard
       planetocentric IAU_<TARGET_NAME> frame.
       All values are computed for the time = START_TIME.
       Distances are given in <km> velocities in <km/s>, Angles in <deg>"

/* SD2 PARAMETERS */
ROSETTA:SD2_OVEN_FILLING = "N/A"
ROSETTA:SD2_DRILL_DEPTH  = 999.99
ROSETTA:SD2_OVEN_NUMBER  = 99
ROSETTA:SD2_OVEN_TYPE    = "N/A"
ROSETTA:SAMPLE_NUMBER    = 99
ROSETTA:SAMPLE_TAPPING   = "N/A"
ROSETTA:SAMPLE_VOLUME    = 999.99
ROSETTA:INSTRUMENT_ENDUSER  = "N/A"

/* DATA OBJECT DEFINITION  */


OBJECT                 = TABLE
  NAME                 = "HK_TABLE"
  INTERCHANGE_FORMAT = ASCII
  ROWS                 = 16
  COLUMNS              = 33
  ROW_BYTES            = 316
  ^STRUCTURE           = "SD2_CALIBRATED_HK.FMT"
END_OBJECT             = TABLE


END
```

7 Appendix C : Example of Directory Listing of Data Set RL-CAL-SD2-3-CVP-V1.0

```
|-AAREADME.TXT
|
|           |-CATINFO.TXT
|           |-DATASET.CAT
|-CATALOG--|-INST.CAT
|           |-INSTHOST.CAT
|           |-MISSION.CAT
|           |-PERSON.CAT
|           |-REF.CAT
|           |-SOFTWARE.CAT
|
|                        |-SD2_FH3_040314081924_0008.LBL
|                        |-SD2_FH3_040314081924_0008.TAB
|                        |-SD2_FH3_040316051206_0008.LBL
|                        |-SD2_FH3_040316051206_0008.TAB
|                        |-SD2_FH3_040317050957_0008.LBL
|                        |-SD2_FH3_040317050957_0008.TAB
|                        |-SD2_FH3_040409230249_0008.LBL
|                        |-SD2_FH3_040409230249_0008.TAB
|                        |-SD2_FH3_040410014256_0012.LBL
|                        |-SD2_FH3_040410014256_0012.TAB
|                        |-SD2_FH3_040411002542_0008.LBL
|                        |-SD2_FH3_040411002542_0008.TAB
|                        |-SD2_FH3_040411011030_0012.LBL
|                        |-SD2_FH3_040411011030_0012.TAB
|                        |-SD2_FH3_040518233316_0087.LBL
|                        |-SD2_FH3_040518233316_0087.TAB
|                        |-SD2_FH3_040519201507_0096.LBL
|                        |-SD2_FH3_040519201507_0096.TAB
|                        |-SD2_FH3_041005203421_0038.LBL
|                        |-SD2_FH3_041005203421_0038.TAB
|                        |-SD2_FH3_041006184119_0113.LBL
|                        |-SD2_FH3_041006184119_0113.TAB
|           |-CALIBRATED-|-SD2_FH3_041006213549_0008.LBL
|           |            |-SD2_FH3_041006213549_0008.TAB
|           |            |-SD2_FH3_041006222836_0008.LBL
|           |            |-SD2_FH3_041006222836_0008.TAB
|           |            |-SD2_FH3_041007184222_0347.LBL
|           |            |-SD2_FH3_041007184222_0347.TAB
|           |            |-SD2_FS3_040409230456_0000.LBL
|           |            |-SD2_FS3_040409230456_0000.TAB
|           |            |-SD2_FS3_040410014736_0000.LBL
|           |            |-SD2_FS3_040410014736_0000.TAB
|           |            |-SD2_FS3_040411002828_0000.LBL
|           |            |-SD2_FS3_040411002828_0000.TAB
|           |            |-SD2_FS3_040411011556_0000.LBL
|           |            |-SD2_FS3_040411011556_0000.TAB
|           |            |-SD2_FS3_040518234657_0061.LBL
|           |            |-SD2_FS3_040518234657_0061.TAB
|           |            |-SD2_FS3_040519202228_0085.LBL
|           |            |-SD2_FS3_040519202228_0085.TAB
|           |            |-SD2_FS3_041005204117_0022.LBL
|           |            |-SD2_FS3_041005204117_0022.TAB
|           |            |-SD2_FS3_041006185257_0103.LBL
|           |            |-SD2_FS3_041006185257_0103.TAB
|           |            |-SD2_FS3_041006223248_0000.LBL
|-DATA-----|            |-SD2_FS3_041006223248_0000.TAB
|           |            |-SD2_FS3_041007185847_0333.LBL
|           |            |-SD2_FS3_041007185847_0333.TAB
|           |
```

```
                              |          |            |-SD2_FB1_040409230456_0000.DAT
                              |          |            |-SD2_FB1_040409230456_0000.LBL
                              |          |            |-SD2_FB1_040410014736_0000.DAT
                              |          |            |-SD2_FB1_040410014736_0000.LBL
                              |          |            |-SD2_FB1_040411002828_0000.DAT
                              |          |            |-SD2_FB1_040411002828_0000.LBL
                              |          |            |-SD2_FB1_040411011556_0000.DAT
                              |          |            |-SD2_FB1_040411011556_0000.LBL
                              |          |-RAW--------|-SD2_FB1_040518234657_0061.DAT
                              |                       |-SD2_FB1_040518234657_0061.LBL
                              |                       |-SD2_FB1_040519202228_0085.DAT
                              |                       |-SD2_FB1_040519202228_0085.LBL
                              |                       |-SD2_FB1_041005204117_0022.DAT
                              |                       |-SD2_FB1_041005204117_0022.LBL
                              |                       |-SD2_FB1_041006185257_0103.DAT
                              |                       |-SD2_FB1_041006185257_0103.LBL
                              |                       |-SD2_FB1_041006223248_0000.DAT
                              |                       |-SD2_FB1_041006223248_0000.LBL
                              |                       |-SD2_FB1_041007185847_0333.DAT
                              |                       |-SD2_FB1_041007185847_0333.LBL
                              |
|-RL-CAL-SD2-3-CVP-V1.0-------|
                              |
                              |          |-DOCINFO.TXT
                              |          |-EAICD_SD2.LBL
                              |          |-EAICD_SD2.PDF
                              |-DOCUMENT-|-SHARK-ICD-TS-043.PDF
                              |          |-SHARK-ICD-TS-043.LBL
                              |          |-SD2-SUM-TS-011.PDF
                              |          |-SD2-SUM-TS-011.LBL
                              |          |-SHARK-URD-TS-067.PDF
                              |          |-SHARK-URD-TS-067.LBL
                              |          |-SHARK-AB-TS-003.PDF
                              |          |-SHARK-AB-TS-003.LBL
                              |          |-RO-EST-RS-3001.PDF
                              |          |-RO-EST-RS-3001.LBL
                              |          |-RO-LAN-RD-3111.PDF
                              |          |-RO-LAN-RD-3111.LBL
                              |          |-TIMELINE_CVP.TXT
                              |          |-TIMELINE_CVP_DESC.TXT
                              |          |-TIMELINE_CVP_PART1.LBL
                              |          |-TIMELINE_CVP_PART1.PNG
                              |          |-TIMELINE_CVP_PART2.LBL
                              |          |-TIMELINE_CVP_PART2.PNG
                              |
                              |                            |-SD2_V1_2.EXE
                              |                            |-SD2_V1_2.LBL
                              |                            |-PHILAE-SD-EUM-001.LBL
                              |-EXTRAS---- |-SD2_EGSE-------|-PHILAE-SD-EUM-001.PDF
                              |            |               |-MFC42D.DLL
                              |            |               |-MFC42D.LBL
                              |            |               |-MFCO42D.DLL
                              |            |               |-MFCO42D.LBL
                              |            |               |-MSVCRTD.DLL
                              |            |               |-MSVCRTD.LBL
                              |            |
                              |            |-EXTRINFO.TXT
                              |
                              |
                              |
                              |-INDEX----|-INDXINFO.TXT
                              |          |-INDEX.LBL
                              |          |-INDEX.TAB
                              |
                              |          |- LABINFO.TXT
                              |-LABEL----|- SD2_CALIBRATED_HK.FMT
```

```
|           |- SD2_CALIBRATED_L1.FMT
|
|-VOLDESC.CAT
```