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JERS-1 Optical System (OPS) Format Description

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Overview

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Summary: This document describes the JERS-1 Optical System data format as delivered by the European Space Agency

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Signed: ..... [O. Arino]
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1.0 Overview of the JERS-1 OPS Format

The JERS-1 Optical System (OPS) digital products are recorded on a Magnetic Media (MM) (CCT, Exabyte) in a format that is conform to the CEOS Standard Family Format (CEOS Format or SFF) conventions. This format is recommended by the Landsat Technical Working Group (LTWG) and the Committee on Earth Observation Systems (CEOS). The CEOS Format allows to read the same sensor data on MM that has been generated by different stations.

1.1 Sensor Characteristics

The OPS is a high resolution radiometer that measures solar radiation reflected by the earth's surface in the visible, near infrared, and short wavelength infrared.

The Visible and Near Infrared Radiometer (VNIR) has a stereoscopic capacity using band 3 which views the nadir and band 4 which looks 15,3 degrees forward in the orbit at the same wavelength. The stereo images are useful for geomorphology and digital elevation models. In the case of OPS this stereo capacity is not constricted by surface radiometric changes or clouds displacement because of the quasi simultaneous measurements of the two views.

The four spectral bands in the Short Wavelength Infrared Radiometer (SWIR) are similar to the ones used by Landsat Thematic Mapper to discriminate rock and mineral types. The SWIR's improved spectral resolution should permit more definitive mineral discrimination.These spectral bands should also allow hydrothermal mapping, vegetation and soil moisture, and finally discrimination of snow from clouds

Each spectral band in

wavelength (μm)

- 1- 0.52~0.60
- 2- 0.63~0.69
- 3- 0.76~0.86
- 4- 0.76~0.86
- 5- 1.60~1.71
- 6- 2.01~2.12
- 7- 2.13~2.25
- 8- 2.27~2.40

Stereoscopic angle	15.33 degrees (B/H = 3)
Ground resolution	18.3 m (across track)
	24.2 m (along track)
Swath width	75 km
Sampling period	3.45 msec +- 1 %
Output data rate	30 Mbps x 2 channels
Field of view	7.55 +- 0.2 degrees

IFOV	32.2 +- 1.0 μradian

1.2 Processing levels

ESA/ESRIN provides raw and system corrected VNIR and SWIR data. System corrected (S/C) products for the VNIR images have only bands 1, 2, 3. The pixel size of approximately 18 x 24.2 meters for raw data is newly dimensioned to 18 x 18 meters for S/C data using a cubic convolution algorithm. Raw data images have 3200 lines of 4096 pixels. System corrected images have 4096 lines of 4512 pixels including left and right filled pixels. No radiometric correction is applied at the moment due to the lack of the calibration coefficients.

1.3 Product Characteristics

Dependent on the type of product (sensor, processing applied) the number of imagery files (equivalent to the number of bands) and the number of image records differ as shown in the table below.

Table 1: Product Characteristics

Sensor	Processing Type	No. of Bands No. of Imagery Files	No. of Image Records
VNIR	Raw	4	3200
VNIR	System Corrected (S / C)	3	4096
SWIR	Raw	4	3200
SWIR	System Corrected (S / C)	4	4096

1.4 Tape Organization

Conventionally, the individual media is referred to as a **physical volume.** The **logical volume** refers to data files logically grouped on the tape. The CEOS Format allows that more than one logical volume (a volume set) can be stored on the same physical volume.

Dependent on the media (Exabyte or CCT 6250) the following two types of product organization are possible (FIGURE 1. containing only one product, e.g. SWIR or VNIR Data, FIGURE 2. several products are available on one tape (only Exabyte)).

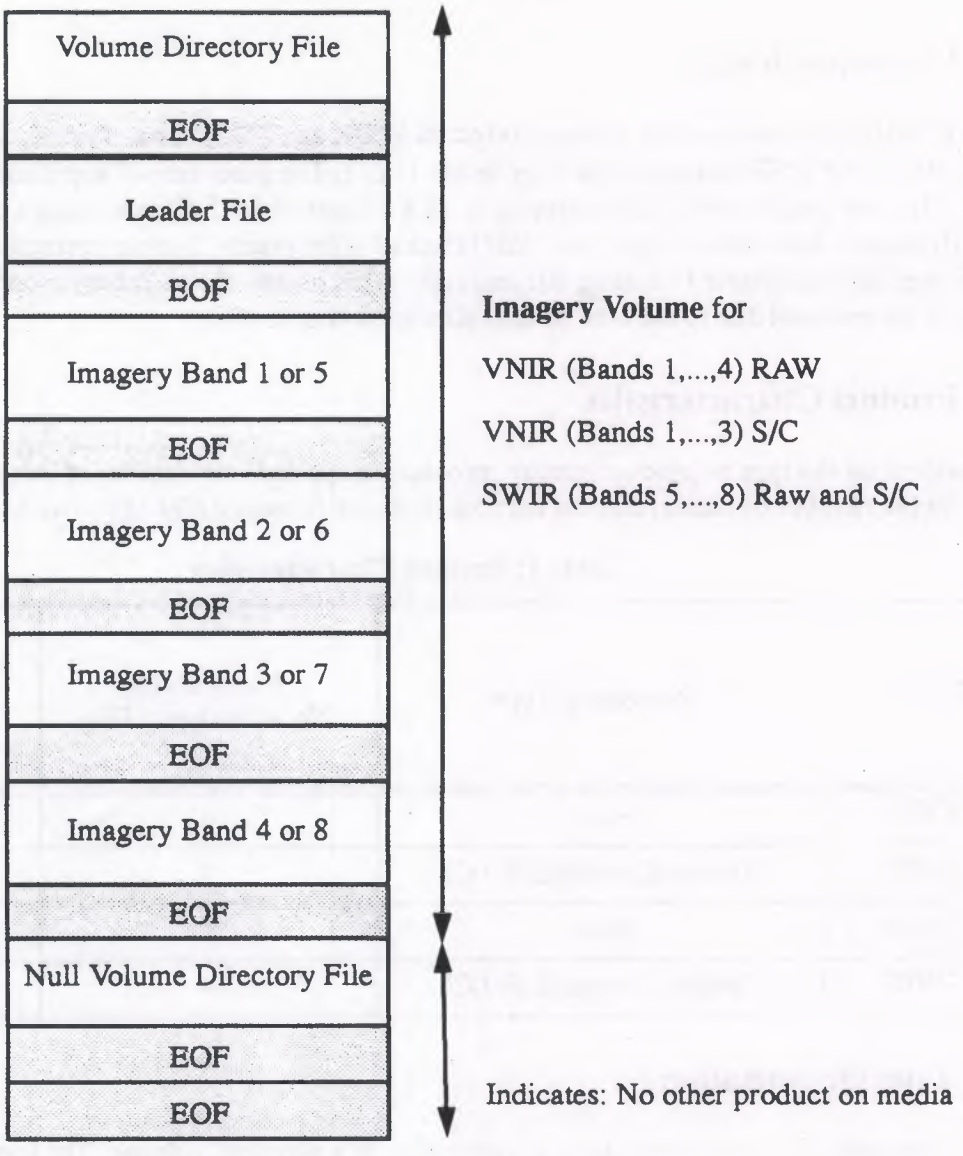


FIGURE 1. CCT 6250 or Exabyte

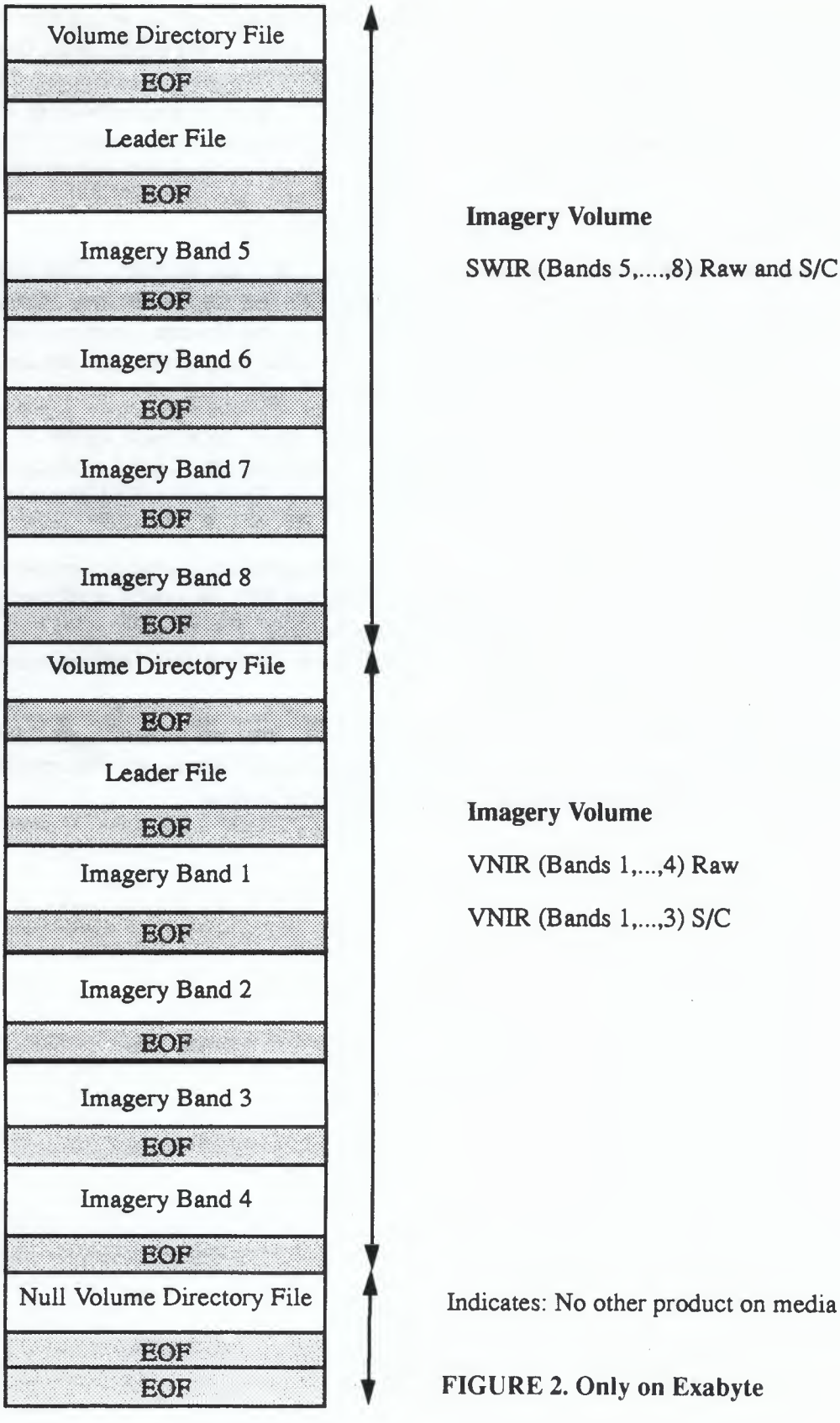


FIGURE 2. Only on Exabyte

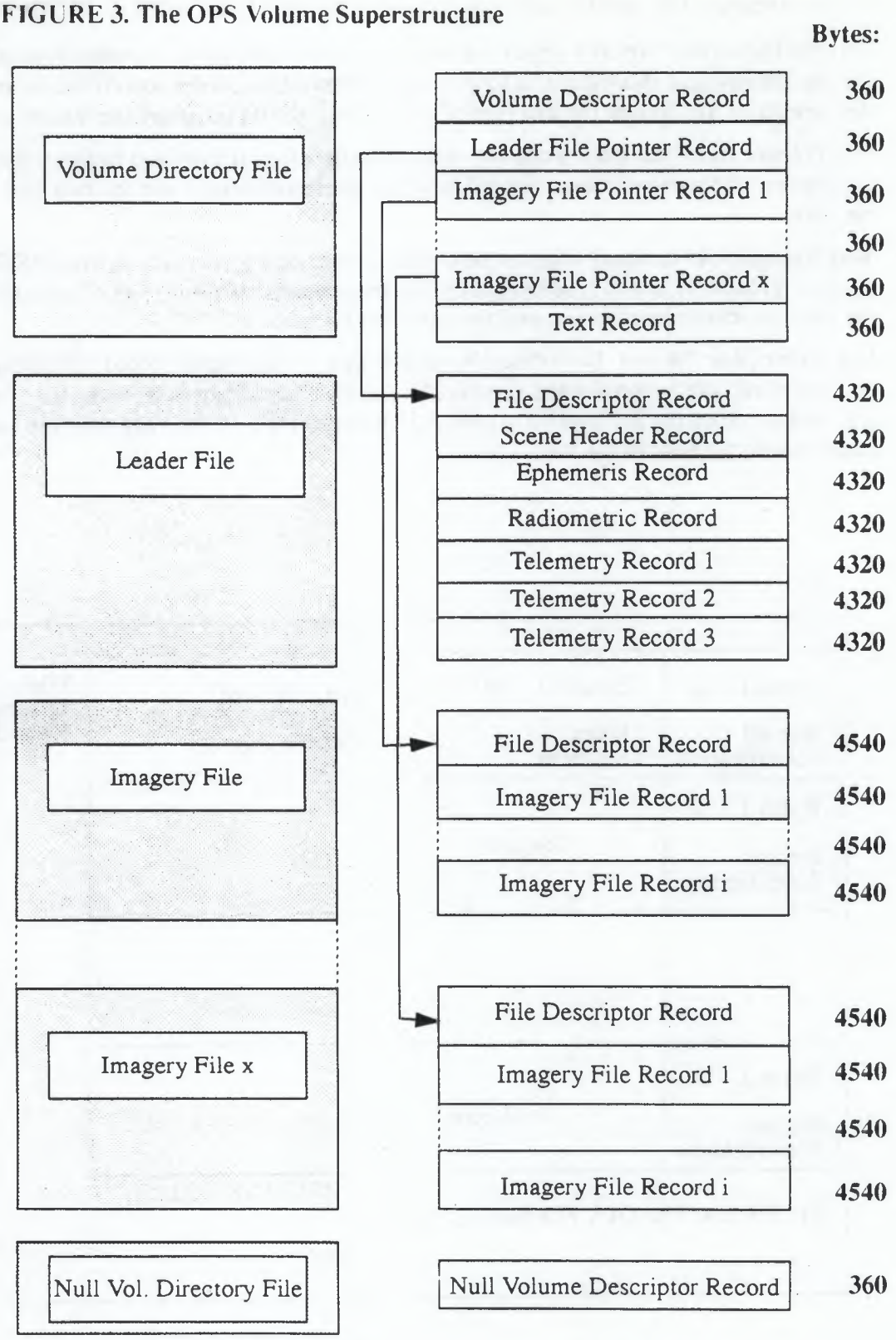
1.5 Logical Volume Organization

The CEOS Standard Family Formats use the "superstructure concept" in which data is organized at four distinct levels: volume, file, record, and data field. Image Data products are organized into one logical volume: Imagery volume. ESA/ESRIN JERS-1 OPS products (Imagery Volumes) contain beside the imagery data, also orbital information data, such as ephemeris or telemetry data. The Null Volume indicates that no further Imagery Volume is on the media. Please, note that one Exabyte can contain several Imagery Volumes (a volume set) (see subsection before).

The OPS products consist of the following files (FIGURE 3.):

- **Volume Directory File** which contains the logical and physical structure of the product on the media (the number of all files on the media; the position and content of these files; the number of records and maximum record length within each file); the Volume Directory File has (band number + 3) records, namely the Volume descriptor and the file pointers (for the Leader file and the Image files), plus a Text record. Each record is 360 bytes long.
- **Leader File** which includes scene introductory information, ephemeris, telemetry data, processing parameters, sensor housekeeping. The Leader file has 7 fixed records, namely the File descriptor, the Scene header and 5 ancillary records (Ephemeris, Radiometric, and 3 Telemetry). Each record is 4320 bytes long.
- **Imagery Files**. The Image files are structured following the BSQ arrangement with 4 (VNIR raw and SWIR) or 3 (VNIR S/C) image files containing 3201 for raw or 4097 for S/C records: one file descriptor record and 3200 or 4096 image records of 4540 bytes each. The 3200 or 4096 records correspond to a full VNIR or SWIR scene for one band (approximately 75 km across track and 75 km along track).
- **Null Volume Directory File** which indicates the end of the collection of logical volumes; when the logical volume spans over more than one physical volume, the volume directory file for that logical volume is repeated at the start of the new media.

FIGURE 3. The OPS Volume Superstructure



1.6 File Organization

OPS Superstructure File and Record Organization (FIGURE 3., FIGURE 4., FIGURE 5.):

- **Volume Descriptor Record** which contains the information about the entire logical volume, such as information about the data source, tape identification, scene identification and specifies the number of file pointer records (hence the number of data files) and the text record.
- **File Pointer Records**, always one for each of the data files (leader and imagery files), contain the number and name of the associated data file, the record length and the type and format of the data.
- **Text Record** adds optional information or repeats mandatory information in an ASCII readable manner: product type and processing applied, the location, date and time of product creation, the specific scene identification and the tape identification.
- **File Descriptor Record**. Each data file starts with a file descriptor record which explains the number of records in the file and contains locators for significant data fields: the "fixed" data segment specifies the file number, name and format and the variable segment the location of important parameters in the file.

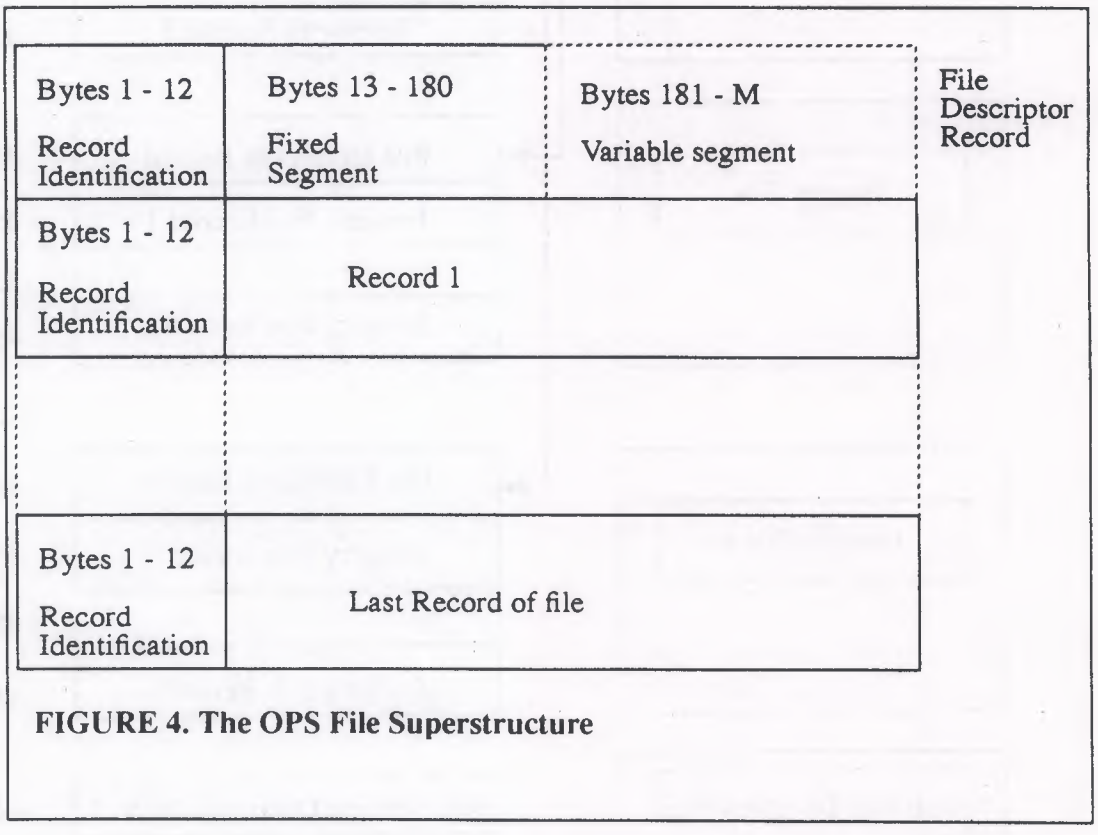


FIGURE 4. The OPS File Superstructure

1.7 Record Organization

All records start with a record identification segment, stored in binary (total of 12 bytes) which consists of (FIGURE 5.):

- record sequence number (bytes 1 - 4)
- record type code (bytes 5 - 8) Record Codes for JERS-1 can be found in the (ANNEX 3.1).
- record length (bytes 6 - 12)

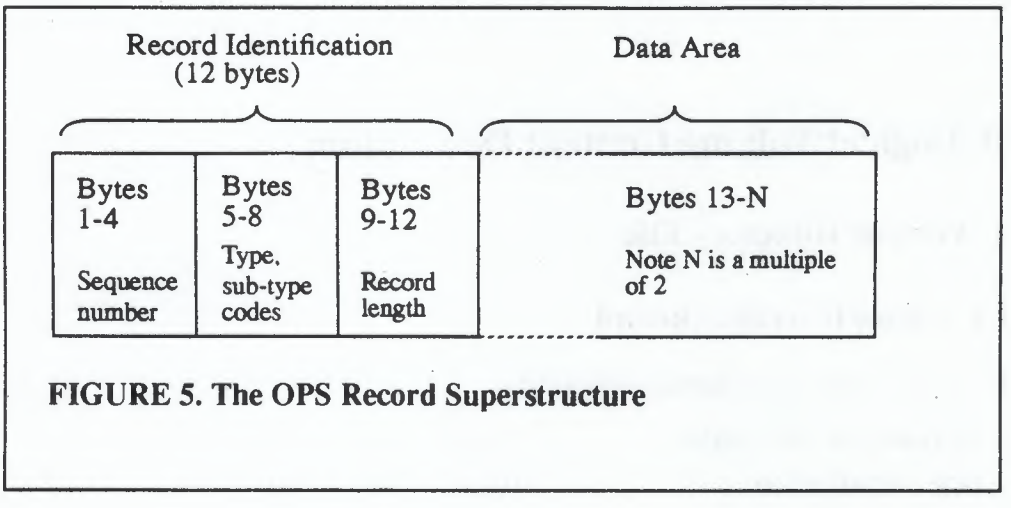


FIGURE 5. The OPS Record Superstructure

1.8 Data Fields

1.8.1 Columns in the Format Description Document

This subsection describes the meaning of the columns within each record provided in (Chapter 4.0). The order of the columns reflects the order in which the file is written on media (CCT, Exabyte).

Each record is represented as a table consisting of seven columns:

col 1 - name of the field or of the field-group (defined in ANNEX 3.2)

col 2 - field-group indicator: 'blank' if single field '*' if field-group

col 3 - starting byte of the field (or field-group)

col 4 - last byte of the field (or field-group)

col 5 - format in which the data of this field is written: Binary or ASCII (see 1.8.2)

col 6 - definition and explanation of the content of the field (or field-group)

col 7 - actual content of the field if it is a constant for an ESA/ESRIN product

1.8.2 Type Formats for Data Fields

The type format described in column 5 is standard Fortran. The formats used in this product are:

xBn - x times data written in binary form on n bytes (unformatted).

xAn - x strings of n ASCII characters.

xFn.m - x times data written as real number on a total of n digits including dot and sign, with m digits for the decimal part.

xEn.m - x times data written as exponential number.

2.0 Logical Volume Content Description

2.1 Volume Directory File

2.1.1 Volume Descriptor Record

The Volume Descriptor Record contains:

- software release number	(bytes	33	-	44)	
- tape identification	(bytes	45	-	60)	
- scene identification	(bytes	61	-	76)	
- logical volume generating country	(bytes	129	-	140)	
- logical volume generating agency	(bytes	141	-	148)	
- logical volume generating facility	(bytes	149	-	160)	
- no. of file pointer records	(bytes	161	-	164)	one for the Leader file and one for each of the bands.
- total number of records in the file	(bytes	165	-	168)	
- no. of logical vol. on physical vol.	(bytes	169	-	172)	

2.1.2 File Pointer Records

Each pointer record provides information about its referenced file (or associated file):

- class	(bytes	37	-	64)	LEADER or IMAGERY
- class code	(bytes	65	-	68)	LEAD or IMGY
- data type	(bytes	69	-	96)	MIXED BINARY AND ASCII or BINARY ONLY.
- data type code	(bytes	97	-	100)	MBAA (mixed binary and ASCII) or BINO (binary only)
- no. of records in referenced file	(bytes	101	-	108)	
- maximum record length	(bytes	117	-	124)	in bytes

- record length type	(bytes	125 - 136)	always FIXED LENGTH
- record length type code	(bytes	137 - 140)	always FIXD (fixed length).

2.1.3 Text Record

The text record is the last record in the Volume Directory file. It contains:

- product identification	(bytes	17 - 66)
- scene identification	(bytes	117 - 166)
- space segment information	(bytes	167 - 216)
- ground segment information	(bytes	217 - 266)
- satellite operation mode	(bytes	267 - 316)

2.2 Leader File

2.2.1 File Descriptor Record

The variable segment of this record provides the number and length of each of the records in the Leader file:

- no. of scene header records	(bytes	181 - 186)	always 1
- no. of ancillary records	(bytes	193 - 198)	always 5, (1 ephemeris, 1 radiometric, 3 telemetry)

The locator fields provide the location and format of 9 important data fields within the Leader file.

- locator fields	(bytes	217 - 392)

Standard codes used for the locators are explained in the logical volume content description.

2.2.2 Scene Header Record

This record provides information about scene, mission, sensor, and processing parameters. The scene parameters include:

- product identification	(bytes	21 - 36)	this parameter identifies if the scene is raw or system corrected
- input scene identification	(bytes	37 - 52)	with the day of data acquisition, expressed in year, day since launch.
- location of scene centre in lat	(bytes	53 - 68)	
- location of scene centre in long	(bytes	69 - 84)	
- line number at input scene centre	(bytes	85 - 100)	
- pixel number at input scene centre	(bytes	101 - 116)	

- scene centre time	(bytes 117 - 148)	year / month / day / hour / minute /second / millisecond (GMT time)
- WRS path and row	(bytes 165 - 180)	
- WRS cycle	(bytes 181 - 196)	
- mission parameters	(bytes 309 - 1412)	contain fixed information about the mission plus a flag for ascending/descending path.
- sensors parameters	(bytes 1413 - 1476)	contain fixed information plus the number of scene lines in the processed image.
- processing parameters	(bytes 1477 - 1732)	indicate that VNIR and SWIR products are geometrically processed, only applicable for system corrected scenes.

2.2.3 Ephemeris Ancillary Record

The original orbit and attitude information is contained in an orbital elements message list (e.g. telex) provided by NASDA. Information provided is:

X,Y,Z coordinates of satellite position

X,Y,Z components of satellite velocity

2.2.4 Radiometric Ancillary Record

Look Up Table for lost detectors. No information is available on the calibration at the moment.

2.2.5 Telemetry Ancillary Records

- raw telemetry data	(bytes 17 - 4112)	32 minor frames, each of 128 bytes

2.3 Imagery File

2.3.1 File Descriptor Record

- no. of lines per image	(bytes 237 - 244)	

The total number of lines including those for which no data have been acquired (3200 for the raw data and 4096 for the System corrected). There are 4096 pixels in the line for the raw data and 4512 pixels for the System Corrected data. For System corrected, these 4512 pixels include left and right fill pixels and the video data pixels).

The 8 bytes data locators indicate the location and format of 4 important data fields within the Imagery file. The seventh byte specifies, for each locator, if the information is stored in the prefix (P) parts of the image record.

The variable segment also describes the "pixel group data" (one pixel) in each band: 6 bit-pixels are for raw and system corrected data with a right justified format.

2.3.2 Image Records

These records are composed of two parts:

- prefix data	(bytes 13 - 28)	Prefix data give the current scan line and the acquisition station time.
- image data	(bytes 29 - 4540)	

When data along a scan line has not been acquired, pixels of the image data are filled with blanks.

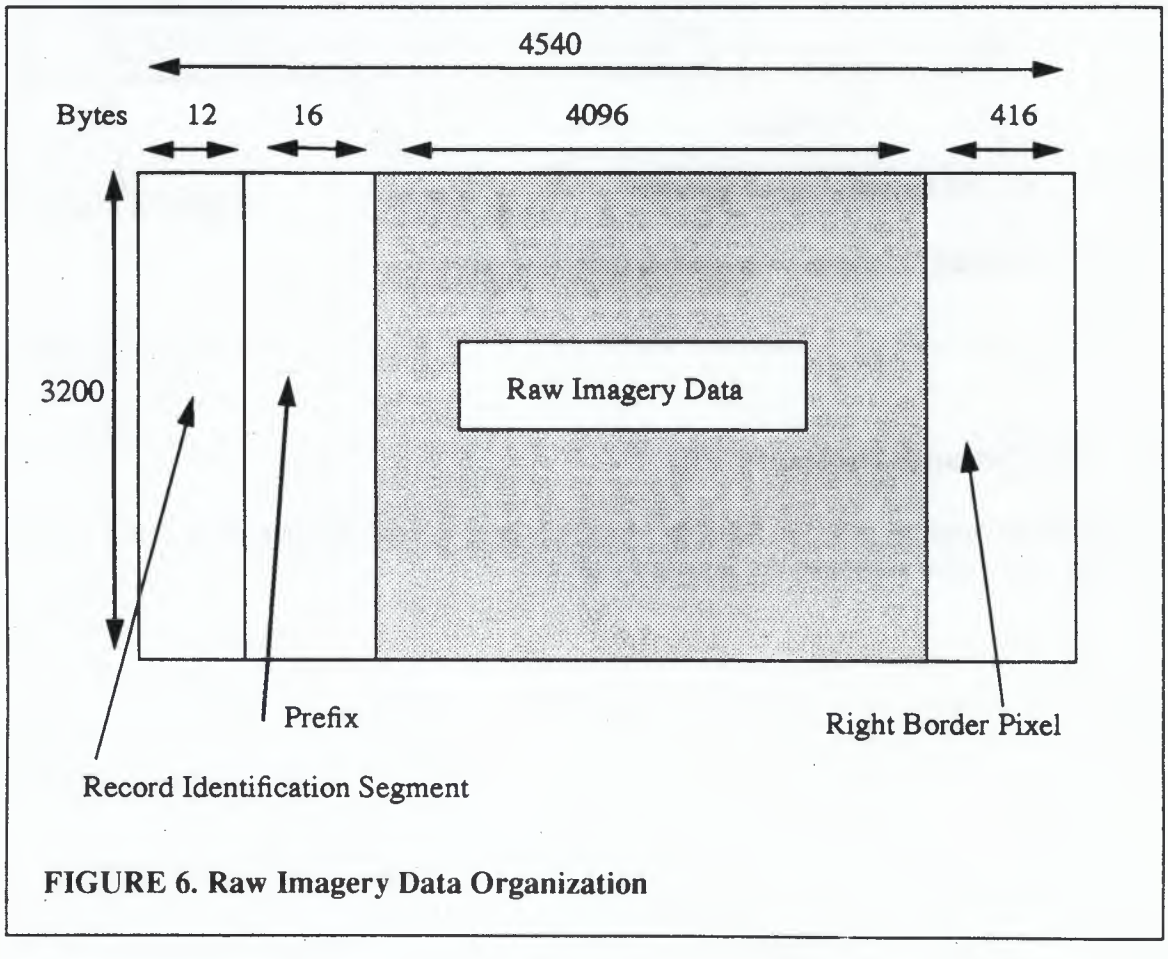


FIGURE 6. Raw Imagery Data Organization

For system corrected data, the geometric corrections are indicated in the Scene Header record of the Leader file.

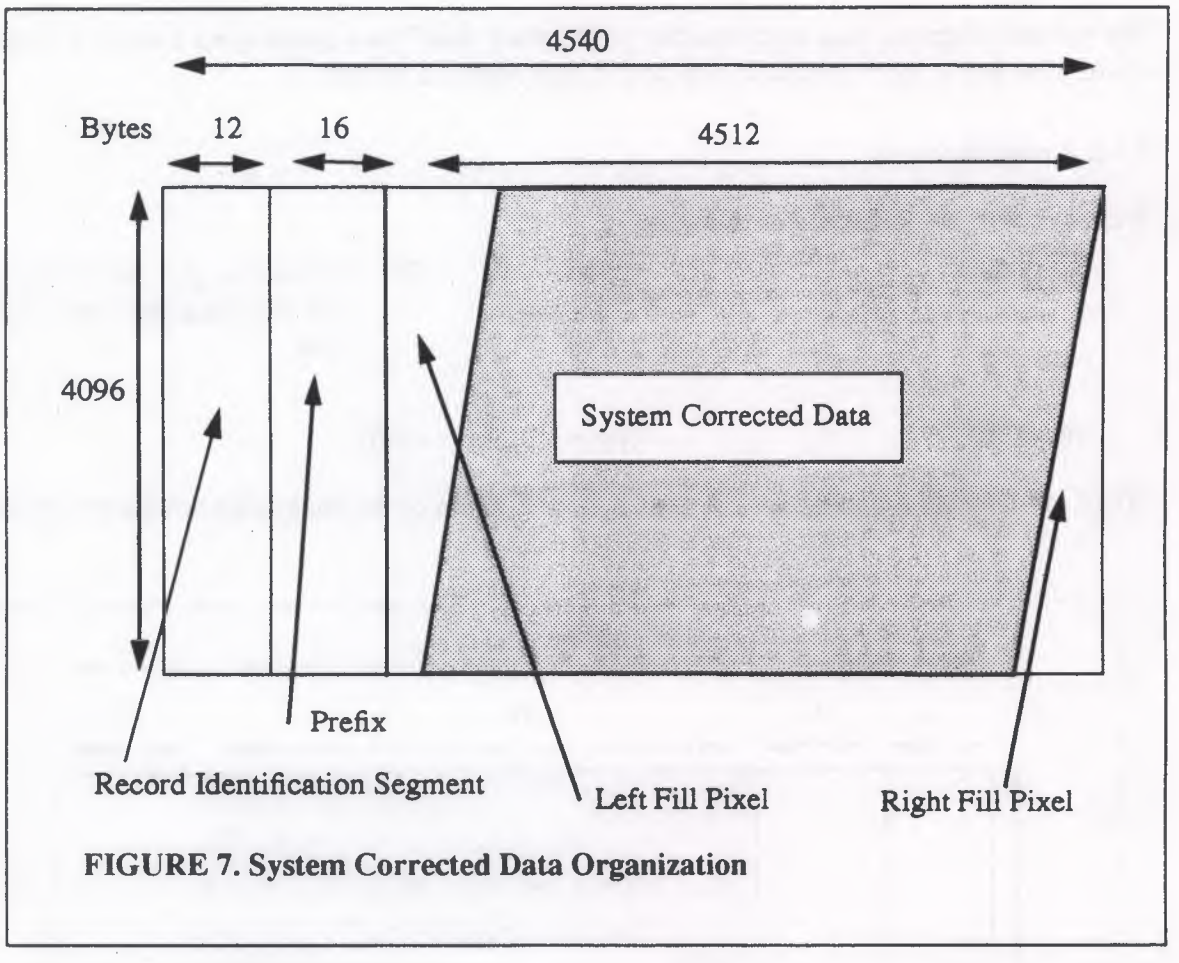


FIGURE 7. System Corrected Data Organization

2.4 Null Volume Directory File

This volume contains only the Null Volume Descriptor Record. The structure is the same as the Volume Descriptor record of the Imagery volume.

3.0 ANNEXES

3.1 Record Identification Codes (CEOS defined)

3.1.1 Superstructure Record Codes

The Committee on Earth Observation Satellites (CEOS) has suggested the following codes for the following different record types (they are all in decimal):

	CEOS file	CEOS record	CEOS mission	CEOS origin
VOLUME DESCRIPTOR	192	192	18	18
NULL VOLUME DESCRIPTOR	192	192	63	18
FILE POINTER	219	192	18	18
FILE DESCRIPTOR	63	192	18	18
TEXT RECORD	18	63	18	18

3.1.2 Codes for JERS-1 OPS

	CEOS file	CEOS record	CEOS mission	CEOS origin
JERS-1 MISSION (X-BAND)			70	
ESA				50
LEAD Scene Header	10	10	70	50
LEAD Ephemeris	10	40	70	50
LEAD Telemetry	10	50	70	50
LEAD Radiometric	10	60	70	50
IMGY Record	237	237	70	50

3.2 Field / Group of Fields Names

The CEOS recommends to use keywords for field record identification. These are the most important names used for the fields and group of fields in the JERS-1 OPS format description. Listed in the order of appearance:

REC_IDE_SEGM - Identifies the Record Identification Segment contained in all Records.

VOL_DOC_SEGM - Identifies the Volume Documentation Segment of the Volume Descriptor Record in the Volume Directory File.

VOL_IDE_SEGM - Identifies the Volume Identification Segment of the Volume Descriptor Record in the Volume Directory File.

FILE_IDE_SEGM - Identifies the File Identification Segment appearing in all File Pointer Records in the Volume Directory File.

PROD_DESC_SEGM - ASCII text Product Description Segment of the Text Record in the Volume Directory File.

FDR_FIXED_SEGM - The File Descriptor Record Fixed Segment appears in each File Descriptor Record.

FDR_VARIA_SEGM - The File Descriptor Record Variable Segment appears in each File Descriptor Record.

LOC_FIELDS - The Locators Fields Segment appear in the File Descriptor Records of the Leader and Imagery File.

SCE_PAR - Identifies the Scene Parameters Segment in the Scene Header Record of the Leader File.

MIS_PAR - Identifies the Mission Parameters Segment in the Scene Header Record of the Leader File.

SEN_PAR - Identifies the Sensor Parameters Segment in the Scene Header Record of the Leader File.

PRO_PAR - Identifies the Processing Parameters Segment in the Scene Header Record of the Leader File.

MAIN_EPH_SEGM - Main Ephemeris Segment containing the date and the satellite, ground and error time.

FIRST_EPH_SEGM - First Ephemeris Segment containing the ephemeris vectors in Ephemeris Record of the Leader File.

SECOND_EPH_SEGM - Second Ephemeris Segment containing the ephemeris vectors in Ephemeris Record of the Leader File.

26th_EPH_SEGM - Last Ephemeris Segment (26 altogether) the ephemeris vectors in Ephemeris Record of the Leader File.

CAL_ANC_DATA - Calibration Ancillary Data containing calibration coefficients (slope and intercept) in Radiometric Record of the Leader File.

LOST_DET_MAP - Lost Detector Map contains information and location of the lost detectors of each band in Radiometric Record of the Leader File.

RAW_TEL_DATA - Raw Telemetry Data in the 3 Telemetry Records of the Leader File.

IMA_PAR - Identifies the Image Parameters Segment in the File Descriptor Records of the Imagery Files.

REC_PAR - Identifies the Record Parameters Segments in the File Descriptor Records of the Imagery Files.

DATA_DESC - Identifies the Pixel Data Description Segment in the File Descriptor Records of Imagery Files.

PRE_DATA - Identifies the Prefix Data Segment in the Image Records of Imagery Files.

IMA_DATA - Identifies the Image Data Segment in the Image Record of the Imagery Files.

4.0 Format Description Document

IMAGERY_VOLUME
VOLUME_DIRECTORY_FILE
VOLUME_DESCRIPTOR_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	1
2		5		B1	File code	192
3		6		B1	Record code	192
4		7		B1	Mission code	18
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	360
7		13	16	A4	4 Blanks	$$$$
VOL_DOC_SEGM	*	**17**	**44**		**Volume Documentation Segment**	
8		17	28	A12	Superstructure format control document number	CCB-CCT-0002
9		29	30	A2	Revision number of above document <XX> (initially '$C')	$F
10		31	32	A2	Record format revision letter <XX> (initially '$A',then '$B',ext...)	$A
11		33	44	A12	Software release number	JERS1-OPS-01
VOL_IDE_SEGM	*	**45**	**172**		**Volume Identification Segment**	
12		45	60	A16	Tape Identification M = Mission (J = JERS) N = Mission number S = Sensor (V = VNIR, S = SWIR) YY = year of product creation MM = month of product creation DD = day of product creation HH = hour of product creation mm = minute of product creation PP = processing station (KI = Kiruna, FU = Fucino,...) L = level of correction applied (0 for raw, 2 for S/C)	<MNSYYMMDDHHmmPPL>
13		61	76	A16	Scene Identification YY = year of scene acquisition DDD = day of scene acquisition PPP = path number RRR = row number AA = acquisition station (KI = Kiruna, FU = Fucino,...)	<MNSYYDDDPPPRRRAA>
14		77	92	A16	Volume Set Identification XXXX = VNIR or SWIR	JERS1XXXXBSQ
15		93	94	A2	Number of Physical Volumes in the Logical Volume	$1
16		95	96	A2	Physical Volume Sequence Number for First Support	$1
17		97	98	A2	Physical Volume Sequence Number for Last Support	$1
18		99	100	A2	Physical Volume Sequence Number for Current Suppor	$1
19		101	104	A4	First Referenced File Number in this Physical	$$$1

				Volume	
20	105	108	A4	Logical Volume Number within Volume Set 1 if VNIR or SWIR on the support 2 if VNIR and SWIR on the same support	
21	109	112	A4	Logical Volume Number within Physical Volume 1 or 2 depending on the above considerations	
22	113	120	A8	Logical Volume Creation Date	<YYYYMMDD>
23	121	128	A8	Logical Volume Creation Time ss = secondes of volume creation cc = hundreth of seconde of volume creation	<HHmmsscc>
24	129	140	A12	Logical Volume Generating Country ITALY$$$$$$$ or SWEDEN$$$$$$	
25	141	148	A8	Logical Volume Generating Agency	ESA-EPO$
26	149	160	A12	Logical Volume Generating Facility FUCINO$$$$$$ or KIRUNA$$$$$$	
27	161	164	A4	Number of Pointer Records in Volume Directory (generally 5, 4 for VNIR S/C))	
28	165	168	A4	Number of Records in Volume Directory (generally 7, 6 for VNIR S/C)	
29	169	172	A4	Number of Logical Volumes on the Support 2 if VNIR or SWIR only 3 if SWIR and VNIR together	
30	173	360	A188	Blanks	Blanks

IMAGE_VOLUME
VOLUME_DIRECTORY_FILE
LEADER_FILE_POINTER_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	2
2		5		B1	File code	219
3		6		B1	Record code	192
4		7		B1	Mission code	18
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	360
7		15	16	A4	4 Blanks	$$$$
FILE_IDE_SEGM	*	**17**	**160**		**File Identification Segment**	
8		17	20	A4	Referenced File Number (not including VDF)	$$$1
9		21	36	A16	Referenced File Name XXXX = VNIR or SWIR TT = Processing level (00 for raw, 02 for S/C)	J1XXXXTTLEADBSQ$
10		37	64	A28	Referenced File Class	LEADER$FILE
11		65	68	A4	Referenced File Class Code	LEAD
12		69	96	A28	Referenced File Data Type	MIXED$BINARY$AND$ASCII
13		97	100	A4	Referenced File Data Type Code	MBAA
14		101	108	A8	Number of Records in Referenced File	$$$$$$$7
15		109	116	A8	Record Lenth of the First Record (bytes)	4320
16		117	124	A8	Maximum Record Length (bytes)	4320
17		125	136	A12	Record Length Type	FIXED$LENGTH
18		137	140	A4	Record Length Type Code	FIXD
19		141	142	A2	Physical Volume Number for First Record	$1
20		143	144	A2	Physical Volume Number for Last Record	$1
21		145	152	A8	1st Record Number for this Physical Volume	$$$$$$$1
22		153	160	A8	Last Record Number for this Physical Volume	$$$$$$$7
23		161	360	A200	Blanks	Blanks

IMAGE_VOLUME
VOLUME_DIRECTORY_FILE
IMAGE_FILE_POINTER_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number (3,4,5,6 or 3,4,5 for VNIR S/C)	
2		5		B1	File code	219
3		6		B1	Record code	192
4		7		B1	Mission code	18
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	360
7		15	16	A4	4 Blanks	$$$$
FILE_IDE_SEGM	*	**17**	**160**		**File Identification Segment**	
8		17	20	A4	Referenced File Number (2,3,4,5 or 2,3,4 for VNIR S/C)	
9		21	36	A16	Referenced File Name XXXX = VNIR or SWIR TT = Processing level (00 for raw, 02 for S/C) N refers to the band number	J1XXXXTTIMGYBSQN
10		37	64	A28	Referenced File Class	IMAGERY$FILE
11		65	68	A4	Referenced File Class Code	IMGY
12		69	96	A28	Referenced File Data Type	BINARY$ONLY
13		97	100	A4	Referenced File Data Type Code	BINO
14		101	108	A8	Number of Records in Referenced File (4097 for S/C or 3201 for raw)	
15		109	116	A8	Record Lenth of the First Record	4540
16		117	124	A8	Maximum Record Length	4540
17		125	136	A12	Record Length Type	FIXED$LENGTH
18		137	140	A4	Record Length Type Code	FIXD
19		141	142	A2	Physical Volume Number for First Record	$1
20		143	144	A2	Physical Volume Number for Last Record	$1
21		145	152	A2	1st Record Number for this Physical Volume	$$$$$$$1
22		153	160	A2	Last Record Number for this Physical Volume (4097 for S/C or 3201 for raw)	
23		161	360	A200	Blanks	Blanks

IMAGE_VOLUME
VOLUME_DIRECTORY_FILE
TEXT_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number (7 generally or 6 for VNIR S/C)	
2		5		B1	File code	18
3		6		B1	Record code	63
4		7		B1	Mission code	18
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	360
7		15	16	A4	Blanks	**$$$$**
PROD_DESC_SEGM	*	**17**	**316**			
8		17	66	A50	Product identification PRODUCT: <JERS1XXXXPPPRRRYYDDD$TT><CrL-F> XXXX = sensor type (VNIR or SWIR) PPP = path number RRR = row number YY = year of scene acquisition DDD = day of scene acquisition TT = correction applied (00 for raw or 02 for S/C)	
9		67	116	A50	Location and date/time of product creation PRODUCT CREATION: ESA-EPO-FUCINO-YYMMDDHHmmSS<CrL-F> see previous description	
10		117	166	A50	Scene Identification SCENE IDENTIFICATION: <MNSYYDDDPPPRRRAA><CrL-F> see previous description	
11		167	216	A50	Space Segment Information SPACE SEGMENT INFORMATION: <SYYMMDDHHmmSSttt><CrL-F> S - electronic system (1 or 2) YY - year of centre scene acquisition (at WRS) MM - month of scene acquisition DD - day of scene acquisition HH - GMT hour of scene acquisition (00-23) mm - GMT minutes of scene acquisition (00-59) SS - GMT seconds of scene acquisition (00-59) ttt - GMT milliseconds of scene acquisition (000-999)	
12		217	266	A50	Ground Segment Information GROUND SEGMENT INFORMATION: <RRTTTTTT><CrL-F> RR = HDDR number TTTTTT = KIRUNA or FUCINO	
		267	316	A50	Satellite Operation Mode during the Passage OPERATION MODE: VNIR&SWIR$ or VNIR$ONLY$<CrL-F>	
13		317	360	A44	Blanks	Blanks

IMAGERY_VOLUME
LEADER_FILE
FILE_DESCRIPTOR_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	1
2		5		B1	File code	63
3		6		B1	Record code	192
4		7		B1	Mission code	18
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	4320
7		13	16	A4	4 Blanks	$$$$
FDR_FIXED_SEGM	*	**17**	**180**		**File Descriptor Record Fixed Segment**	
8		17	28	A12	Document number describing this format	BO-921223-01
9		29	30	A2	Document version for the above	01
10		31	32	A2	Revision Number of this File Format <XX>, (Initially '$A',then '$B',etc.)	$A
11		33	44	A12	Software Release Number	JERS1-OPS-01
12		45	48	A4	File Number (not including VDF)	$$$1
13		49	64	A16	File Name XXXX = sensor type (VNIR or SWIR) TT = correction applied (00 for raw or 02 for S/C)	J1XXXXTTLEADBSQ$
14		65	68	A4	Record Sequence and Location Type Flag	FSEQ
15		69	76	A8	Byte position of the Sequence Number	$$$$$$$1
16		77	80	A4	Sequence Number Field Length in bytes	$$$4
17		81	84	A4	Record Code and Location Type Flag	FTYP
18		85	92	A8	Byte Position of the Record Code	$$$$$$$5
19		93	96	A4	Record Code Field Length in bytes	$$$4
20		97	100	A4	Record Length and Location Type Flag	FLGT
21		101	108	A8	Byte Position of the Record Length	$$$$$$$9
22		109	112	A4	Record Length Field Length	$$$4
23		113	116	A4	CEOS Reserved Flag	YNNN
24		117	180	A64	Blanks	Blanks
FDR_VARIA_SEGM	*	**181**	**216**		**File Descriptor Record Variable Segment**	
25		181	186	A6	Number of scene header records	$$$$$1
26		187	192	A6	Header record length	$$4320
27		193	198	A6	Number of ancillary records 1 ephemeris 1 radiometric 3 telemetry	$$$$$5
28		199	204	A6	Ancillary record length	$$4320
29		205	216	A12	Blanks	Blanks
LOC_FIELDS	*	**217**	**392**		**Locator Fields**	

The locator fields point to the position in
the file where various information can be found.
The locator information is coded in 16 bytes ASCII :
Bytes 1- 6 = record number containing that field
Bytes 7-12 = byte position of the field within the rec
Bytes 13-15 = length of field in bytes
Byte 16 = type of data code
A for alphanumeric;
B for binary;
N for numeric;

30	217	232	A16	Scene identification field locator	$$$$$2$$$$37$16A
31	233	248	A16	WRS designator field locator	$$$$$2$$$165$16A
32	249	264	A16	Mission identification field locator	$$$$$2$$$309$16A
33	265	280	A16	Sensor identification field locator	$$$$$2$$$325$16A
34	281	296	A16	Scene center date/time locator	$$$$$2$$$117$32A
35	297	312	A16	Geographic reference fields locator	$$$$$2$$$213$32N
36	313	328	A16	Imagery format field locator	$$$$$2$$1717$16A
37	329	344	A16	Band indicator locator	$$$$$2$$1653$64N
38	345	360	A16	Geometric correction designator	$$$$$2$$1525$16A
39	361	392	A32	Blanks	Blanks
40	393	4320	A3928	Blanks	Blanks

IMAGERY_VOLUME
LEADER_FILE
SCENE_HEADER_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**20**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	2
2		5		B1	File code	10
3		6		B1	Record code	10
4		7		B1	Mission code	70
5		8		B1	Origin code	50
6		9	12	B4	Length of this record	4320
7		13	20	A8	Blanks	Blanks
SCE_PAR	*	**21**	**308**		**Scene Parameters**	
8		21	36	A16	Tape identification see previous description	<MNSYYMMDDHHmmPPL>
9		37	52	A16	Input scene identification see previous description	<MNSYYDDDPPPRRRAA>
10		53	68	F16.7	Input scene centre latitude in degrees	
11		69	84	F16.7	Input scene centre longitude in degrees	
12		85	100	F16.7	Line number at input scene centre	
13		101	116	F16.7	Pixel number at input scene centre	
14		117	148	A32	Input scene centre time YY = year MM = month DD = day HH = GMT hours (00 to 23) mm = GMT minutes (00 to 59) SS = GMT seconds (00 to 59) ttt = GMT milliseconds (000 to 999)	<YYMMDDHHmmSSttt$...$>
15		149	164	A16	Blanks	Blanks
16		165	180	A16	WRS (World Reference System) designator: where: M = Mission number PPP = WRS nominal path number (001-659) RRR = WRS nominal row number (152-449)	<MPPPRRR>$$$$$$$$$
17		181	196	A16	WRS cycle (659)	$$$$$$$$$$$$$$$659
18		197	212	A16	Reserved for floating scenes	Blanks
19		213	228	F16.7	Reserved for floating scenes	Blanks
20		229	244	F16.7	Reserved for floating scenes	Blanks
21		245	260	A16	Reserved for floating scenes	Blanks
22		261	276	A16	Reserved for floating scenes	Blanks
23		277	308	A32	Blanks	Blanks
MIS_PAR	*	**309**	**1412**		**Mission Parameters**	
24		309	324	A16	Mission identification	JERS-1$$$$$$$$$$

25		325	340	A16	Sensor identification VNIR$$$$$$$$$$$$$ or SWIR$$$$$$$$$$$$$	
26		341	356	I16	Path number	
27		357	372	A16	Orbital direction ASCENDING$$$$$$$ or DESCENDING$$$$$$	
28		373	1412	A1030	Blanks	Blanks
SEN_PAR	*	**1413**	**1476**		**Sensor Parameters**	
29		1413	1428	A16	Number of active bands in the processed image (Generally 4, 3 for VNIR S/C)	
30		1429	1444	A16	Number of scene pixels per line in the processed image (4096 for raw or 4512 for S/C)	
31		1445	1460	A16	Number of scene lines in the processed image (3200 for raw or 4096 for S/C)	
32		1461	1476	A16	Blanks	Blanks
PRO_PAR	*	**1477**	**1732**		**Processing Parameters**	
33		1477	1492	A16	Blanks	Blanks
34		1493	1508	A16	Radiometric resolution designator	$$$$$$$$$$$$$$$6
35		1509	1524	A16	Blanks	Blanks
36		1525	1540	A16	Geometric correction designator RAW$$$$$$$$$$$$$$ or SYSTEM-CORRECTED	
37		1541	1556	A16	Resampling algorithm designator for raw data: NONE$$$$$$$$$$$$$ for S/C data: CUBICCONVOLUTION	
38		1557	1636	A80	Blanks	Blanks
39		1637	1652	A16	Number of Radiometric ancillary records	$$$$$$$$$$$$$$$1
40		1653	1716	A64	Bands available 1 if the band is active, and 0 otherwise 11110000000... for VNIR raw 11100000000... for VNIR S/C 00001111000... for SWIR raw 00001111000... for SWIR S/C Left alignment	
41		1717	1732	A16	Interleaving indicator	BSQ$$$$$$$$$$$$$$
42		1733	4320	A2540	Blanks	Blanks

IMAGERY_VOLUME
LEADER_FILE
EPHEMERIS_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**12**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	3
2		5		B1	File Code	10
3		6		B1	Record Code	40
4		7		B1	Mission Code	70
5		8		B1	Origin Code	50
6		9	12	B4	Length of this record	4320
MAIN_EPH_SEGM	*	**13**	**54**		**The Main Ephemeris Segment**	
7		13	20	A8	Registration Date	<YYYYMMDD>
8		21	36	A16	GMT Ground Time	<YYMMDDHHmmSSttt
9		37	46	A10	Preset Satellite Time (secondes)	
10		47	54	A8	Time Error (millisecondes)	
FIRST_EPH_SEGM	*	**55**	**214**		**The First Ephemeris Segment**	
11		55	70	A16	Time (GMT) of orbit data YY = year MM = month DD = day HH = hours mm = minutes SS = seconds ttt = milliseconds	<YYMMDDHHmmSSttt
12		71	94	E24.16	X coordinates of the satellite position (km) (Earth Centred Inertial Reference Frame)	
13		95	118	E24.16	Y coordinates of the satellite position (km)	
15		119	142	E24.16	Z coordinates of the satellite position (km)	
16		143	166	E24.16	X component of satellite velocity (km/s)	
17		167	190	E24.16	Y component of satellite velocity (km/s)	
18		191	214	E24.16	Z component of satellite velocity (km/s)	
SECOND_EPH_SEGM	*	**215**	**374**		**The Second Ephemeris Segment**	
26th_EPH_SEGM	*	**4055**	**4214**		**The 26th Ephemeris Segment**	
19		4215	4320	A106	Blanks	Blanks

IMAGERY_VOLUME
LEADER_FILE
RADIOMETRIC_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**12**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	4
2		5		B1	File code	10
3		6		B1	Record code	60
4		7		B1	Mission code	70
5		8		B1	Origin code	50
6		9	12	B4	Length of this record	4320
CAL_ANC_DATA	*	**13**	**82**		**Calibration Ancillary Data** (not available at the moment)	
7		13	18	A6	Reserved for the calibration date	Blanks
8		19	34	2F8.4	Reserved for the calibration coefficients	Blanks
9		35	50	2F8.4	Reserved for the calibration coefficients	Blanks
10		51	66	2F8.4	Reserved for the calibration coefficients	Blanks
11		67	82	2F8.4	Reserved for the calibration coefficients	Blanks
LOST_DET_MAP	*	**83**	**2146**		**Lost Detectors Mapping**	
12		83	86	A4	Number of lost detectors Band 1 or 5	
13		86	598	512B1	Lost detector bit map Band 1 or 5	
14		599	602	A4	Number of lost detectors Band 2 or 6	
15		603	1114	512B1	Lost detector bit map Band 2 or 6	
16		1115	1118	A4	Number of lost detectors Band 3 or 7	
17		1119	1630	512B1	Lost detector bit map Band 3 or 7	
18		1631	1634	A4	Number of lost detectors Band 4 or 8 set to 0 for VNIR S/C	
19		1635	2146	512B1	Lost detector bit map Band 4 or 8 set to 0 for VNIR S/C	
20		2147	4320	A2174	Blanks	Blanks

IMAGERY_VOLUME
LEADER_FILE
TELEMETRY_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**12**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number (5, 6 or 7)	
2		5	5	B1	File code	10
3		6	6	B1	Record code	50
4		7	7	B1	Mission code	70
5		8	8	B1	Origin code	50
6		9	12	B4	Length of this record	4320
RAW_TEL_DATA	*	**13**	**4112**		**Raw Telemetry Data**	
7		13	14	A4	Telemetry record sequence number (1, 2 or 3)	
8		15	16	A2	Number of telemetry minor frame in the record (maximum 32 per record)	
8		17	4112	32B128	Sequence of Telemetry minor frames (32 minor frames of 128 bytes each)	
9		4113	4320	A208	Blanks	Blanks

IMAGERY_VOLUME
IMAGERY_FILE
FILE_DESCRIPTOR_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record Sequence Number	1
2		5		B1	File code	63
3		6		B1	Record code	192
4		7		B1	Mission code	18
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	4540
7		13	16	A4	4 Blanks	**$$$$**
FDR_FIXED_SEGM	*	**17**	**180**		**File Descriptor Record Fixed Segment**	
8		17	28	A12	Control document number for this data file format	BO-921223-01
9		29	30	A2	Control Document Revision Number	01
10		31	32	A2	File design descriptor revision letter	**$A**
11		33	44	A12	Software release number	JERS1-OPS-01
12		45	48	A4	File Number (2,3,4 or 5 not including VDF)	
13		49	64	A16	File Name see previous description	J1XXXXTTIMGYBSQN
14		65	68	A4	Record Sequence and Location Type Flag	FSEQ
15		69	76	A8	Sequence Number Location	**$$$$$$$1**
16		77	80	A4	Sequence Number Field Length	**$$$4**
17		81	84	A4	Record Code and Location Type Flag	FTYP
18		85	92	A8	Record Code Location	**$$$$$$$5**
19		93	96	A4	Record Code Field Length	**$$$4**
20		97	100	A4	Record Length and Location Type Flag	FLGT
21		101	108	A8	Record Length Location	**$$$$$$$9**
22		109	112	A4	Record Length Field Length	**$$$4**
23		113	116	A4	CEOS Reserved Flags	YNYN
24		117	180		Blanks	Blanks
FDR_VARIA_SEGM	*	**181**	**232**		**File Descriptor Record Variable Segment**	
25		181	186	A6	Number of image records (3200 for raw, 4096 for S/C)	
26		187	192	A6	Image records length	**$$4540**
27		193	232	A40	Blanks	Blanks
IMA_PAR	*	**233**	**272**		**Image Parameters**	
28		233	236	A4	Number of bands of imagery in this file	**$$$1**
29		237	244	A8	Number of lines per image (one band) (3200 for raw, 4096 for S/C)	
30		245	248	A4	Number of left border pixels	**$$$0**

31		249	256	A8	Number of image pixels per line (4096 for raw, 4512 for S/C)	
32		257	260	A4	Number of right border pixels (416 for raw, 0 for S/C)	
33		261	272	A12	Blanks	Blanks
REC_PAR	*	**273**	**296**		**Record Parameters**	
34		273	276	A4	Blanks	Blanks
35		277	280	A4	Number of bytes of prefix data per record	$$16
36		281	288	A8	Number of bytes of image data per record (4096 for raw, 4512 for S/C)	
37		289	292	A4	Number of bytes of suffix data per record	$$$0
38		293	296	A4	Blanks	Blanks
LOC_FIELDS	*	**297**	**432**		**Prefix Data Locators**	

The format for an 8 byte ASCII locator should be as follows :

Bytes 1-4 = start byte number of the field within prefix
Bytes 5-6 = length in bytes of the field to be located.
Byte 7 = letter 'P' or 'S' indicating the location of field is prefix or suffix.
Byte 8 = type of data format
A = ASCII
B = Binary

39		297	304	A8	Scan line number locator	$$$1$4PB
40		313	320	A8	Time of scan line locator	$$$5$4PB
41		321	328	A8	Left-fill count locator	$$$9$4PB
42		329	336	A8	Right-fill count locator	$$13$4PB
43		341	432	A92	Blanks	Blanks
DATA_DESC	*	**433**	**460**		**Pixel Data**	
44		433	436	A4	Number of left fill bits within pixel	$$$2
45		437	440	A4	Number of right fill bits within pixel	$$$0
46		441	448	A8	Maximum available data range of pixel (from zero)	$$$$$$63
47		449	452	A4	Number of bits per pixel	$$$6
48		453	456	A4	Number of pixels per data group	$$$1
49		457	460	A4	Number of bytes per data group	$$$1
47		461	4540	A4080	Blanks	Blanks

IMAGERY_VOLUME
IMAGERY_FILE
IMAGE_RECORD

field or field-group name	start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	***1**	**12**		**Record Identification Segment**	
1	1	4	B4	Record sequence number (from 2 to 3073 for raw, to 4097 for S/C)	
2	5		B1	File code	237
3	6		B1	Record code	237
4	7		B1	Mission code	70
5	8		B1	Origin code	50
6	9	12	B4	Length of this record	4540
PRE_DATA	***13**	**28**		**Prefix Data**	
7	13	16	B4	Scan line number	
8	17	20	B4	Time in GMT at start of scan in milliseconds (each byte of this field will be set to 255 if GMT timing information is not available)	
9	21	24	B4	Count of left fill pixels	
10	25	28	B4	Count of right fill pixels	
IMA_DATA	***29**	**4540**		**Image Data**	
11	29	4540	4512B1	Images pixels	

NULL_VOLUME
VOLUME_DIRECTORY_FILE
VOLUME_DESCRIPTOR_RECORD

field or field-group name		start byte	last byte	format	DESCRIPTION AND EXPLANATION	CONTENT
REC_IDE_SEGM	*	**1**	**16**		**Record Identification Segment**	
1		1	4	B4	Record sequence number	1
2		5		B1	File code	192
3		6		B1	Record code	192
4		7		B1	Mission code	63
5		8		B1	Origin code	18
6		9	12	B4	Length of this record	360
7		15	16	A4	4 Blanks	$$$$
VOL_DOC_SEGM	*	**17**	**44**		**Volume Documentation Segment**	
8		17	28	A12	Superstructure format control document number	CCB-CCT-0002
9		29	30	A2	Revision number of above document	$F
10		31	32	A2	Record format revision letter	$A
11		33	44	A12	Software release number	JERS1-OPS-01
VOL_IDE_SEGM	*	**45**	**172**		**Volume Identification Segment**	
12		45	60	A16	Tape Identification	<MNSYYMMDDHHmmPPL>
13		61	76	A16	Scene Identification	Blanks
14		77	92	A16	Volume Set Identification	Blanks
15		93	94	A2	Number of Physical Volumes in the Logical Volume	$1
16		95	96	A2	Physical Volume Sequence Number for First Tape	$1
17		97	98	A2	Physical Volume Number for Last Tape	$1
18		99	100	A2	Physical Volume Sequence for Current Tape	$1
19		101	104	A4	First Referenced File Number in this Physical Volume	Blanks
20		105	108	A4	Logical Volume Number within Volume Set Generally 2 3 if VNIR and SWIR are present on the same Support	
21		109	112	A4	Logical Volume Number within Physical Volume Generally 2 3 if VNIR and SWIR are present on the same Support	
22		113	120	A8	Logical Volume Creation Date	Blanks
23		121	128	A8	Logical Volume Creation Time	Blanks
24		129	140	A12	Logical Volume Generating Country	Blanks
25		141	148	A8	Logical Volume Generating Agency	Blanks
26		149	160	A12	Logical Volume Generating Facility	Blanks
27		161	164	A4	Number of Pointer Records in Volume Directory	Blanks
28		165	168	A4	Number of Records in Volume Directory	Blanks
29		169	172	A4	Number of Logical Volumes on this Physical Volume	Blanks
30		173	360	A188	Blanks	Blanks