The SPOT Scene

Standard Digital

Product Format

S4-ST-73-01-SI

Edition 1 - Revision 2

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63	1.0
64	1.1
65	1.2
66	1.0
67	1.0
68	1.0
69	1.0
70	1.0
71	1.0
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78	1.2
79	1.0
80	1.2

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1. SCOPE

This document describes the format of the "SPOT scene" digital products which are produced and distributed by SPOT IMAGE. These digital products are delivered, either on magnetic tapes (6250 Bpi) or on CD-ROM.

This format is also called the "CAP format", since it has been designed to be produced by the Centre d'Archivage et de Prétraitement (CAP) located at SPOT IMAGE premices, in Toulouse as well as at SSC-Satellitbild facilities, in Kiruna (Sweden) and at SPOT IMAGE Corporation facilities in Reston (VA, U.S.A.). Some Direct Receiving stations are also capable of providing such a format.

This format concerns the SPOT scenes which are processed at level 1A, 1B or 2A. For other digital products (level 2B, Ortho-images, Imagemaps like SPOTView®), the format is the GIS-Geospot format (or "DIMAP" format) which is outside the scope of this document.

This format is capable of handling the additionnal Short Wave Infra-Red (SWIR) band of SPOT 4. In the following, all specific to SPOT 4 will be with this font, in italic (titles or comments in "Times" italic are not to be considered as "SPOT 4 specific")

It has to be noticed that the previous format, defined in the document SI/AT/85.0113 as well as in the Volume 2, chapter 2 of the SPOT Users Handbook will still be delivered for the following reasons :

- there is an existing stock of old SPOT scenes, already processed at level 1B, which are available only with the old format,
- and it is impossible to convert the old one into the new one and vice-versa, because of the different characteristics of the Level 1B geometric modelisation.

IMPORTANT NOTICE :

THIS DOCUMENT IS A TECHNICAL DOCUMENT WHICH DESCRIBES A GENERAL FORMAT USED TO ENCODE SOME OF THE SPOT DATA. AS SUCH, IT COVERS A WIDE RANGE OF PRODUCTS AND OF PREPROCESSING, SOME OF THEM NOT BEING OFFERED BY SPOT IMAGE. FOR A DESCRIPTION OF THE ACTUAL SPOT IMAGE OFFER, PLEASE REFER TO THE SPOT IMAGE PRICE LIST.

2. REFERENCE DOCUMENTS

[1] "Recorded Magnetic Tape for Information Intercharge (6250 CPI Group Coded Recording)" dated : 1976 Ref : ANSI X 3.54 - 1976.

[2] The Standard CCT Family of Tape Formats (LGSOWG CCT format CCB document). Ref : CCB-CCT-0002 Rev.E.

[3] "Information processing - Volume and file structure of CD-ROM for information interchange". Ref : ISO 9660.

3. SPOT HRV DATA DEFINITIONS

SPOT IMAGE is delivering SPOT scenes processed at standard levels, and recorded on CCT or CD-ROM.

The elementary data set is one SPOT scene,

either in Panchromatic mode (P*or M*),

or in Multispectral mode*without SWIR* (Xs),

or in Multispectral mode with SWIR (Xi)

preprocessed up to levels called 1A, 1B or 2A.

3.1 THE SPOT SCENE

The SPOT scene is the result of a preprocessing applied to an input raw scene defined as follows:

- one image made of 6000 lines of 6000 pixels each, in Panchromatic mode (P*or M*),

or

- three registered images made of 3000 lines of 3000 pixels each, in Multispectral*without SWIR* (Xs),

or

- *four registered images made of 3000 lines of 3000 pixels each, in Multispectral with SWIR (Xi),*

with corresponding auxiliary data.

A SPOT scene designates also, on the ground, the area covered by the image.

In panchromatic mode, this corresponds to 60 km in the along track direction, and 60 km to 81.5 km in the across track direction. The ground resolution is then 10 m by 10 m when the imaging direction is close to the vertical and 10 m by 13.6 m when the imaging direction corresponds to the extreme sidelook.

In multispectral mode, this corresponds to 60 km in the along track direction (3 bands of 3000 lines by 3000 pixels in multispectral*without SWIR and 4 bands of 3000 lines by 3000 pixels in multispectral with SWIR*), and 60 km to 81.5 km in the across track direction. The ground resolution is then 20 m by 20 m when the imaging direction is close to the vertical, and 20 m by 27.2 m when the imaging direction corresponds to the extreme sidelook.

REMARK
In the document, thefollowingnaming conventionswill be found for the "**Spectral Mode**" :

"Panchromatic" (SPOT 1, 2 or 3) :	**"Pan"**, or **"P"**
"Multispectral" (SPOT 1,2,3 *or SPOT 4 without SWIR*) :	**"XS**", or **"X"**
"Multispectral" *(SPOT 4 with SWIR) :*	***"Xi****", or* ***"X"***
"Monospectral" *(SPOT 4, Band 2 10 m) :*	***"M"***

REMARK CONCERNING THE SCENE IDENTIFICATION:

For the ordering purpose, a scene is identified by a code called “Scene ID” built as follows:

<S><KKK><JJJ><YY><MM><DD><HH><SS><I><M>, where S is the satellite number, KKK and JJJ are the GRS designator of the scene, YY, MM, DD, HH, MM, SS are the date and time of the center of the scene, I is the instrument number (HRV 1 or 2), and M is the spectral mode of acquisition.

It must be noticed that the actual characteristics of the processed scene may differ from those in the Scene ID in the two following circumstances:

- when the scene is Shifted Along the Track (cf. § 3.5.2), the Scene ID designates the above GRS scene. Therefore the actual time of the center of the shifted scene is different from the time in the Scene ID. In the Header record (cf. Table 7.2), the time in bytes 37-52 refers to the above GRS scene, and the time in bytes 581-612 refers to the actual center of the shifted scene. In the ancillary “Ephemeris/Attitude” Record (cf. Table 7.3), the time in bytes 965-994 is the time of the actual center of the shifted scene.
- *when the scene has been acquired by SPOT 4 in a Multispectral Mode with SWIR (Mode “Xi”), and when the product has been ordered without SWIR (the SWIR band being dropped when making the product, leading to an “Xs” mode with 3 bands) the “Spectral mode of acquisition” (bytes 645-660 of the Header record) contains the value “Xi”, but the “Number of spectral bands” and the “Spectral bands identification” (bytes 1045-1316 of the Header Record) contains the value “3” and “XS1$XS2$XS3$$$$$….$”. On the other hand, the information “Spectral mode” of the product encoded in the File Pointer Records of the Volume Directory File (Table 6.2, bytes 21-36) as well as in each File Descriptor Record (bytes 49-64) of the Leader File (Table 7.1), Imagery file (Table 8.1), and trailer File (table 9.1), is then set to “X”, instead of “I”.*

3.2 THE PREPROCESSING LEVELS

The preprocessings applied to the raw data are :

- Level 1A preprocessing :
  - detector radiometric equalization (MTF enhancement and optional digital dynamic streching),
  - no geometric correction.
- Level 1B preprocessing :
  - detector radiometric equalization, MTF enhancement and optional digital dynamic streching,
  - bulk geometric processing (geometric corrections using an "a priori" knowledge of the system distorsions).
- Level 2A preprocessing :
  - detector radiometric equalization, MTF enhancement and digital dynamic streching,
  - mapping into a given cartographic projection (using an "a priori" knowledge of the system distorsions, without any Ground Control Point).

3.3 THE PREPROCESSED SPOT SCENE SIZE

According to:

- the raw image size given in section 3.1. of this document,
- the "panoramic effects" which depends on the pointing mirror position (for "Off Nadir" viewing),
- the resampling step i.e. 10 meters in Panchromatic or 20 meters in Multispectral (except for Level 1A preprocessing),
- the map projection and the latitude of the scene (for Level 2A preprocessing),
- the different products specifications,

the size of a preprocessed SPOT scene will vary in a range given in Table 3.1.

SPATIAL COVERAGE	PRODUCT TYPE	PREPROCESS LEVEL	SPECTRAL MODE	NUMBER OF LINES	NUMBER OF COLUMNS	NUMBER OF SPECTR. BANDS
SCENE	STANDARD	1A	P *or M* Xs *Xi*	6000 3000 *3000*	6000 3000 *3000*	1 3 *4*
		1B	P *or M* Xs *Xi*	≅6000 ≅3000 *@3000*	6400 to 8500 3200 to 4250 *3200 to 4250*	1 3 *4*
		2A	P *or M* Xs *Xi*	7200 to 10200 3600 to 5100 *3600 to 5100*	7500 to 10200 3750 to 5100 *3750 to 5100*	1 3 *4*
	P & Xs MERGE	1B 2A	Xs Xs	≅6000 7200 to 10200	6400 to 8500 7500 to 10200	3 3
	M & Xi MERGE	*1A* *1B* *2A*	*Xi* *Xi* *Xi*	*6000* *≅6000* *7200 to 10200*	*6000* *6400 to 8500* *7500 to 10200*	*4* *4* *4*
	M & Xs MERGE	*1A* *1B* *2A*	*Xs* *Xs* *Xs*	*6000* *@6000* *7200 to 10200*	*6000* *6400 to 8500* *7500 to 10200*	*3* *3* *3*
	OVER SAMPLING	1B	P or M Xs Xi	≅8000 ≅4000 ≅4000	8500 to 11350 4250 to 5700 4250 to 5700	1 3 4

TABLE 3.1

SPATIAL COVERAGE	PRODUCT TYPE	PREPROCESS LEVEL	SPECTRAL MODE	NUMBER OF LINES	NUMBER OF COLUMNS	NUMBER OF SPECTRAL BANDS
QUARTER SCENE	STANDARD	1A	P *or M* Xs *Xi*	3000 1500 *1500*	3000 1500 *1500*	1 3 *4*
		1B	P *or M* Xs *Xi*	≅3000 ≅1500 *@1500*	3200 to 4250 1600 to 2125 *1600 to 2125*	1 3 *4*
		2A	P *or M* Xs *Xi*	3600 to 5100 1800 to 2550 *1800 to 2550*	3750 to 5100 1875 to 2550 *1875 to 2550*	1 3 *4*
	P & Xs MERGE	1B 2A	Xs Xs	≅3000 3600 to 5100	3200 to 4250 3750 to 5100	3 3
	M & Xi MERGE	*1A* *1B* *2A*	*Xi* *Xi* *Xi*	*3000* *@3000* *3600 to 5100*	*3000* *3200 to 4250* *3750 to 5100*	*4* *4* *4*
	M & Xs MERGE	*1A* *1B* *2A*	*Xs* *Xs* *Xs*	*3000* *@3000* *3600 to 5100*	*3000* *3200 to 4250* *3750 to 5100*	*3* *3* *3*
	OVER SAMPLING	1B	P *or M* Xs *Xi*	≅4000 ≅2000 *@2000*	4250 to 5670 2125 to 2850 *2125 to 2850*	1 3 *4*

TABLE 3.1 (contíd)

3.4 THE PRODUCTS SUPPORTED BY THIS FORMAT :

This format can handle the following spatial coverages :

- Full scene
- Quarter scene

For each spatial coverage, one or several kind of processing can be applied :

- Standard processing (levels 1A, 1B or 2A),
- Merging P & Xs (for SPOT 1, 2, 3)
- *Merging M & Xs (for SPOT 4),*
- *Merging M & Xi (for SPOT 4),*
- Over sampling,

3.5 SPATIAL COVERAGE

3.5.1 QUARTER SCENE PRODUCTS

In Multispectral mode (Xs *or Xi*), in Panchromatic mode (P), *or in Monospectral mode (M),* "Quarter scene" products cover one quarter of a GRS scene. For a Level 1A, nb_lines and nb_pixels equal 1500.

This corresponds to 30 kms along track, and 30 to 40,75 kms across track.

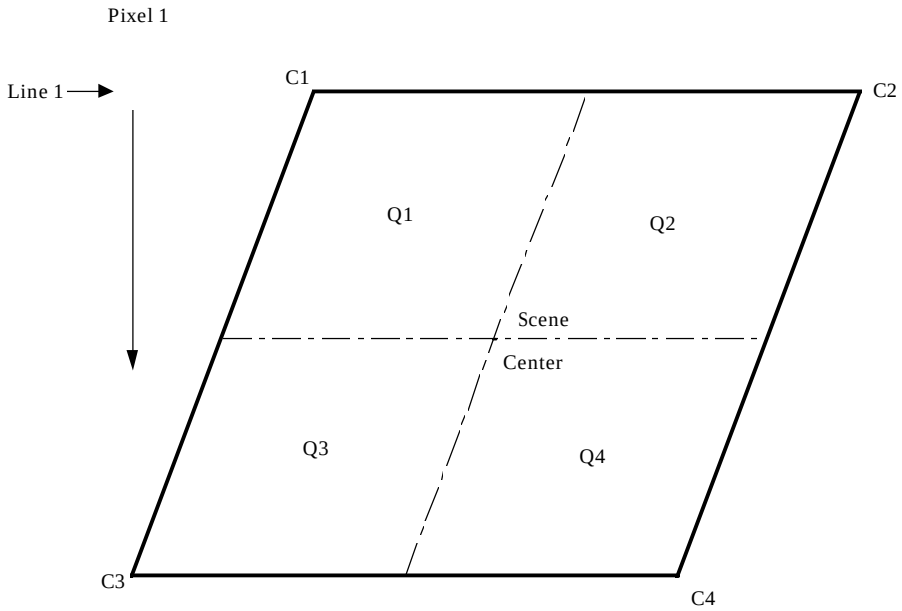


figure 3.5.1

The Quarter scene characteristics are derived from the information related to the original full scene. These informations are contained in the Header record of the Leader File , such as the followings :

- Scene characteristics :

- the (K,J) designator of the full scene,
- scene identification,
- scene center geographic location (latitude and longitude),
- scene center location within the image (line and pixel number),

- Corner characteristics :

- C1 : First scene corner geographic location
  (latitude, longitude),
  First scene corner image location
  (line, column)
- C2 : Second scene corner geographic location
  (latitude, longitude),
  Second scene corner image location
  (line, column)
- C3 : Third scene corner geographic location
  (latitude, longitude),
  Third scene corner image location
  (line, column)
- C4 : Fourth scene corner geographic location
  (latitude, longitude),
  Fourth scene corner image location
  (line, column)

In panchromatic mode and for Level 1A, the table 3.5.2 below indicates the coordinates of the first pixel of a quarter scene within the original SPOT scene.

Quadrant	First line	First Pixel	Original scene center location	
			line	Column
Q1	1	1	3000	3000
Q2	1	3000	3000	1
Q3	3000	1	1	3000
Q4	3000	3000	1	1

Table 3.5.2

3.5.2 SHIFT ALONG THE TRACK :

The scene obtained is down shifted of one to 10 tenth of a scene in the along track direction (i.e. : in the satellite motion direction).

3.6 ADDITIONNAL PROCESSING :

3.6.1 P and XS MERGE :

The SPOT Satellites can collect simultaneously Panchromatic data (with a 10 m resolution) and Multispectral Data (with 20 m resolution), with the same HRV(IR) instrument. For SPOT 1,2, or 3, for technologic reasons, a registration of these two data type is impossible on board and has to be performed on ground*With SPOT 4, the data M and X are registred on board.*

3.6.1.1 **MERGING P & Xs** : The "P & Xs MERGE" consists in combining data of P band with data of XS1 and XS2 bands to obtain XP1 and XP2 at 10m (for SPOT 1, 2, 3). The mixed product is then in Xs spectral mode.
Data from XS3 band undergo a 10m resampling..
The new bands XP1 and XP2 are calculated using the formulas :

$$L_p = \frac{L_{xp1} + L_{xp2}}{2} \qquad \frac{Xp1}{Xp2} = \frac{Xs1}{Xs2}$$

3.6.1.2 ***MERGING M & Xi :*** *The "M & Xi MERGE" consists in combining data of M band with data of other bands to obtain bands at 10 m (for SPOT 4). The mixed product is then in Xi spectral mode.*

3.6.1.3 ***MERGING M & Xs :*** *The "M & Xs MERGE" consists in combining data of M band with data of others bands to obtain bands at 10 m (for SPOT 4). The mixed product is then in Xs spectral mode.*

3.6.2 OVER SAMPLING

The "Oversampling" consists in a resampling of the original scene with a step less than 10 meters for a P or *M* mode, and less than 20 meters for a X*or I* mode. This processing is optionnal.

3.6.3 DIGITAL DYNAMIC STRETCHING

The "Dynamic Stretching" consists in applying a linear transformation to the data in order to increase the dynamic range of the radiometry. This contributes to improve the signal to noise ratio and, thus to decrease some striping effects. This processing is applied, when necessary.

3.6.4 PANELING EFFECT CORRECTIONS :

Due to the imaging process on board the satellite, it may happen that four vertical stripes, each corresponding to one CCD array, appear on the image. This depends on the nature of the landscape which is being imaged. The regular radiometric equalization cannot remove this artefact, and an additionnal special processing is applied, when necessary, in order to improve the quality of the final product.

4. BASIC SPOT DIGITAL PRODUCTS LAYOUT

4.1 GENERAL CHARACTERISTICS (SEE FIGURE 4.1.)

- The SPOT Digital Products delivered is designed to comply with the Standard CCT Family of Tape Formats as defined by the Technical Working Group (LTWG) of the LANDSAT Ground Station Operators' Working Group (LGSOWG) (see [1])..This Standard is maintained by the Comitee of Earth Observation Satellites (CEOS),

- Each record is a multiple of 180 bytes in length. It begins with 12 bytes of introductory data which are followed by the data themselves, as illustrated in Table 4.1.1.,

- The organization for the image data is Band Interleaved by Line (B.I.L.). In BIL organization, each line of a multispectral image is made of a succession of 3 *(or 4)* records, each record corresponding to one line for one spectral band. In panchromatic mode, there is only one record per line,

- The different records are identified by "Type" and "Subtypes" codes which are given in Table 4.1.2.,

- In a given file, all the records (including the "File Descriptor Record"). are of the same length,

- The Alphanumeric and Numeric data are encoded in "ASCII without parity" code. The character sets and the corresponding ASCII codes are listed in Table 4.1.3.,

- A Numeric data is right registered within the field. The field may be left filled indifferently either with ASCII zeros, or with ASCII blanks.

- The Binary data (in the first 12 bytes of each record) are right justified. The left-most bit is the most significant,

- The radiometric value of the image pixels (also named "pixel count") are encoded on 8 bits, irrespective of the transmission compression mode (DPCM for P*M or Xi* mode).

BYTE NUMBER	CONTENT
1 → 4	Record Number (binary encoded)
5	1st Record Sub-Type Code
6	Record Type Code
7	2nd Record Sub-Type Code
8	3rd Record Sub-Type Code
9 → 12	Record Length (binary encoded)
13 → 180*n	Data

Table 4.1.1

A current Digital Product record

RECORD	1st Sub-Type (byte 5)	Type (byte 6)	2nd Sub-Type (byte 7)	3rd Sub-Type (byte 8)
	(*)	(*)	(*)	(*)
Volume Descriptor	C0	C0	12	12
File Pointer	DB	C0	12	12
Text	12	3F	12	12
File Descriptor	3F	C0	12	12
Header	12	12	12	12
Ancillary (Ephemeris/Attitude)	F6	24	12	12
Ancillary (Radiometric Calibration)	3F	24	12	12
Ancillary (Modelization)	08	15	30	23
Ancillary (Ground Control Points)	09	24	12	12
Ancillary (Histogram)	C0	24	12	12
Ancillary (Map Projection)	24	24	12	12
Annotations	12	DB	12	12
Image Data	ED	ED	12	12
Trailer	12	F6	12	12
Null Volume Descriptor	C0	C0	3F	12

(*) Hexadecimal representation

Table 4.1.2

Record Type and Sub-Types Codes

Character	ASCII Code (Hexa)	Comment	Character	ASCII Code (Hexa)	Comment	Character	ASCII Code (Hexa)	Comment
CR	0D	Carriage-return	4	34		J	4A	
LF	0A	Line-feed	5	35		K	4B	
Ø	20	Space (=blank)*	6	36		L	4C	
!	21		7	37		M	4D	
"	22	Quote	8	38		N	4E	
#	23		9	39		O	4F	Letter
$	24	*	:	3A	Colon	P	50	
%	25		;	3B	Semi colon	Q	51	
&	26			3C		R	52	
'	27	Apostrophe	=	3D		S	53	
(	28			3E		T	54	
)	29		?	3F		U	55	
*	2A			40		V	56	
+	2B		A	41		W	57	
,	2C	Comma	B	42		X	58	
-	2D		C	43		Y	59	
.	2E	Period	D	44		Z	5A	
/	2F		E	45		[	5B	
0	30	Zero	F	46			5C	
1	31		G	47		]	5D	
2	32		H	48			5E	
3	33		I	49			5F	

Table 4.1.3

ASCII characters set table

* for the description of the various fields, in the following, the character “$” is used to represent the character “space”

4.2 SPOT LOGICAL VOLUME DEFINITIONS

In multispectral mode, the organization of data is "Band Interleaved by Lines" (BIL). For P*or M* mode, the organization of data is also called BIL, even if there is only one spectral band.

One SPOT scene corresponds to one "Logical Volume"

The Logical Volume definitions are based on the document referenced [2] in section 2.

The files in the Logical Volume are:

- the Volume Directory File,
- the Leader File,
- the Imagery File,
- the Trailer File,
- the Null Volume Directory File.

FILE NUMBER	CONTENT	FILE NAME
FILE 1	Volume Descriptor File Pointer for File 1 File Pointer for File 2 File Pointer for File 3 Text	VOLUME DIRECTORY FILE
FILE 2	LEADER File Descriptor Header record Ancillary records Annotation record	LEADER FILE
FILE 3	IMAGERY File Descriptor Imagery Data records	IMAGERY FILE
FILE 4	TRAILER File Descriptor Trailer records	TRAILER FILE
FILE 5	Null Volume Descriptor	NULL VOLUME DIRECTORY FILE

4.3 CCT's CHARACTERISTICS

4.3.1 GENERAL CHARACTERISTICS

One processed SPOT scene is recorded on simple or multiple Computer Compatible Tapes (CCT) with the density 6250 Bpi.

The tape is unlabelled.

4.3.2 CCT LOGICAL VOLUME DEFINITION

The preprocessed SPOT scene is recorded on CCT in a single logical volume for Panchromatic (P) *or Monospectral (M)* as well as for Multispectral *without SWIR* (Xs*) or Multispectral with SWIR (Xi)* mode. Whenever the volume of data makes it necessary, the Logical Volume may be split into several Physical Volumes (e.g. physical tapes). An indication of the number of tapes needed is given in Table 4.3.

The CCT logical volume definition is based on the SPOT logical volume definition described in Chap. 4.2. The following characterisics apply to the recording on the tape :

- the files are separated by End Of File (EOF) tape marks,
- the Null Volume Directory File is followed by three EOF (EOF is defined in document referenced [1] in section 2).
- the files are composed of sets of physical records, defined in Chap 5 and 6, separated by Inter Records Gap. (IRG is defined in the document referenced [1] in section 2).
- the number of records and their length are summarized in table 5.1.

SPATIAL COVERAGE	PRODUCT TYPE	SPECTRAL MODE	RECORD LENGTH	NUMBER OF 6250 Bpi TAPES
SCENE	STANDARD	P *or M* Xs *Xi*	8640 5400 5400	1 1 1
	P & Xs MERGE	Xs	8640	2
	M & Xi MERGE	*Xi*	*8640*	*2*
	M & Xs MERGE	*Xs*	*8640*	*2*
	OVER SAMPLING	P *or M* *Xs* *Xi*	12240 *8640* *8640*	1 *1* *2*
QUARTER SCENE	STANDARD	P Xs *Xi*	5400 5400 *5400*	1 1 *1*
	P & XS MERGE	Xs	5400	1
	M & Xi MERGE	*Xi*	5400	*1*
	M & Xs MERGE	*Xs*	*5400*	*1*
	OVER SAMPLING	P*or M* Xs *Xi*	8640 5400 *5400*	1 1 *1*

TABLE 4.3

Record size and number of tapes

4.4 CD-ROM'S CHARACTERISTICS

4.4.1 GENERAL CHARACTERISTICS

A single Compact Disk Read Only Memory (CD-ROM) contains one or more processed SPOT scenes.

4.4.2 CD-ROM PHYSICAL DESCRIPTION

A CD-ROM capacity is about 540 Megabytes. It complies with the ISO standard 9660 (see document [3]).
It may be used on every system (PC, Macintosh, Unix Systems, VMS systems, ...) which CD-ROM drive is conform to this standard.

4.4.3 CD-ROM LOGICIAL DESCRIPTION

A CD-ROM may be considered by every system as a classical magnetic disk. Therefore, it has a hierarchical directory structure.

The CD-ROM is organized with as many directories as processed SPOT scenes.

One processed SPOT scene is recorded in one directory, with ancillary data and image data included in this directory.

There are nn sub-directories named SCENEnn, nn varying from 01 to 99. In turn, the actual number of full scenes that can be recorded is usually limited to 10 (level 1A or 1B), or to 8 (level 2A).

The "root directory" contains a text file, named CD_DIR.FIL, which is used as a directory to identify the processed SPOT scenes recorded on the CD.

CD-DIR file description :

The CD_DIR.FIL file is a text file which contains the main information (in ASCII code) needed to identify the processed SPOT scenes included in the CD-ROM. There is one description per processed SPOT scene.

The CD_DIR.FIL file is made of a succession of nn records, each of which identifying one processed SPOT scene.

Each record contains the following information :

- SCENEnn : Scene Directory name ($01 \leq nn \leq 99$),

- Scene_ID : the scene identification, encoded as follows :

  SKKKJJJYYMMDDHHMMSSIX, where :

  - S : satellite number (1, 2, 3, *4, etc...*)
  - KKKJJJ : K,J designator of the scene,
  - YYMMDD : Imaging date (Year, Month, Day),
  - HHMMSS : Imaging time (Hour, Minute, Second),
  - I : HRV*(IR)* number,
  - X : Spectral mode of acquisition of the scene (P, X*M or I)*.

- Shift Along Track value : /N ($0 \leq N \leq 9$)
  (ex : /5),

- SPOT IMAGE Product Code,

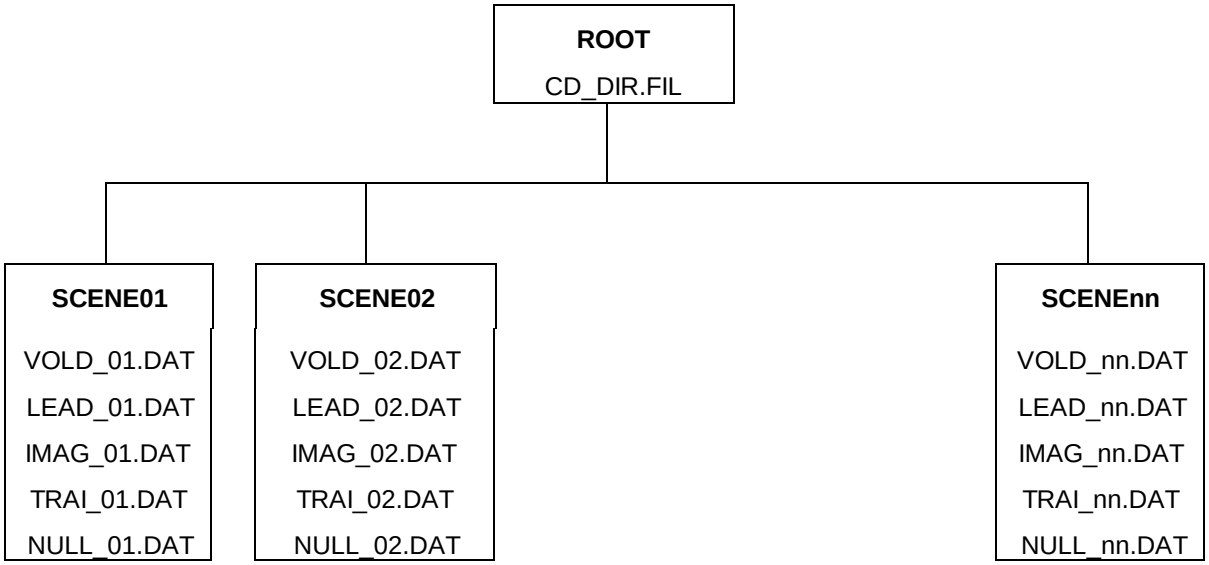
- SPOT IMAGE product code explanation.

Content of the sub-directories :

Each sub-directory contains 5 files which are identical to the files delivered on a CCT 6250 Bpi, as defined in the above chapter 4.2.

The names of the files which belong the sub-directory SCENEnn are as follows :

VOLD_nn.DAT for the Volume Directory file,
LEAD_nn.DAT for the Leader File,
IMAG_nn.DAT for the Imagery File,
TRAI_nn.DAT for the Trailer File,
NULL_nn.DAT for the Null Volume Directory file.



5. SPOT FILE DEFINITIONS

The numbers of records and their length are sumarized in the Table 5.1 below.

FILE	RECORD	NUMBER OF RECORDS	RECORD LENGTH (bytes)
VOLUME DIRECTORY	Volume Descriptor File Pointer Text	1 3 1	360 360 360
LEADER	Leader File Descriptor Header Ancillary (Ephemeris/Attitude) Ancillary (Radiometric Calibration) Ancillary (Modelization) Ancillary (Ground Control Point - not used) Ancillary (Histogram) Ancillary (Map Projection) Annotations	1 1 1 16 1 1 4 1 1	3960 3960 3960 3960 3960 3960 3960 3960 3960
IMAGERY	Imagery File Descriptor Image data (n=number of lines of the preprocessed scene)	1 n for P n*3 for Xs *n*4 for Xi*	5400 or 8640 or 10980 or 12240 5400 or 8640 or 10980 or 12240
TRAILER	Trailer file Decriptor Trailer	1 2	1080 1080
NULL	Null Volume Descriptor	1	360

TABLE 5.1.
Characteristics of the SPOT Digital Products Records

5.1 VOLUME DIRECTORY FILE (SEE FIGURE 5.1)

The volume directory file contains general informations regarding the Logical Volume, and allows the user to :

- get identification of the Digital Product content

- access to the data needed inside the other files.

It consists on five records of 360 bytes each :

- the Volume Descriptor Record,
- the Pointer Record for the Leader File,
- the Pointer Record for the Imagery File,
- the Pointer Record for the Trailer File,
- a Text Record.

5.1.1 The Volume Descriptor Record

identifies the logical volume, its documentation and its number of files. Its detailled content is described in section 6.1.

5.1.2 The Pointer Record

references one of the three data files in the logical volume. It indicates what is the file format and allows to prepare reading the file. Its detailled content is described in section 6.2.

5.1.3 The text record

contains informations in free format (like a "comment card") which can be displayed or printed out and which can help to identify the Digital Product. **The content of this record is not intended to be decoded by a computer for processing purpose.** Its detailled content is described in section 6.3.

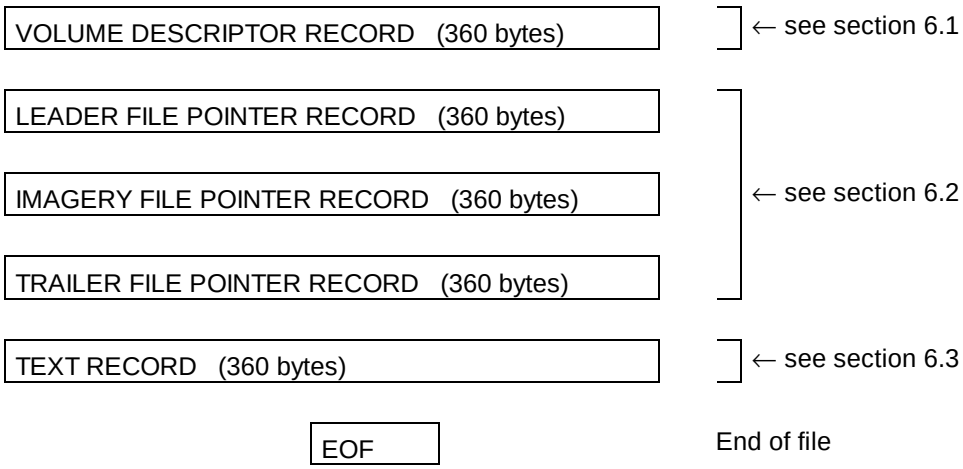


Figure 5.1.
The Volume Directory File

5.2 LEADER FILE

The LEADER file contains auxilliary informations related to the SPOT scene (identification parameters defining the geometry and the radiometry of the scene, preprocessing data, ...).

It consists of 27 records of 3960 bytes each :

- the LEADER File Descriptor one Header record,
- one Header record,
- one Ancillary "Ephemeris / Attitude" record,
- 16 Ancillary "Radiometric Calibration" records,
- one Ancillary "Modelization" record,
- one Ancillary "Ground Control Points" record (not used in this SPOT Format),
- 4 Ancillary "Histogram" records,
- one Ancillary "Map Projection",
- one Annotations record.

5.2.1 The File Descriptor record

is composed of two segments, a fixed and a variable segment. The fixed segment informs about how to read the file, and the variable one points out to particular key data within the file. This variable segment corresponds to what is defined for the "class" LEADER (see document [2]). This record is decribed in section 7.1.

5.2.2 The header record

contains informations regarding the scene identification, the scene characteristics, the mission, the preprocessings which have been performed, and describes the organisation of the Ancillary Data records which follow. It is described in section 7.2.

5.2.3 The Ancillary "Ephemeris / Attitude" record

contains informations needed for bulk geometric preprocessing :

- the ephemeris of SPOT for this scene
- the measurements from on board gyroscopes (attitude velocities)
- the SPOT look angles for this particular scene
- the orbital bulletin.

It is described in section 7.3.

5.2.4 The Ancillary "Radiometric Calibration" records

contain, for levels 0 and 1A, the values of relative gains and offsets which have been applied to each CCD detector count to perform the radiometric normalisation of detectors.These records are not used in level 1B, and for mixed products, P+X, *M+I, M+X.*

These values are split into 16 records in the following way :

	P MODE		Xs MODE			*Xi MODE*		
RECORD NUMBER	TYPE	DETECTOR NUMBERS	TYPE	SPECTR. BAND	DETECTOR NUMBERS	*TYPE*	*SPECTR BAND*	*DETECTOR NUMBERS*
4	gains	1 → 1500	gains	1	1 → 1500	*gains*	*1*	*1 ® 1500*
5	gains	1501 → 3000	gains	1	1501 → 3000	*gains*	*1*	*1501 ® 3000*
6	gains	3001 → 4500	gains	2	1 → 1500	*gains*	*2*	*1 ® 1500*
7	gains	4501 → 6000	gains	2	1501 → 3000	*gains*	*2*	*1501 ® 3000*
8	offsets	1 → 1500	gains	3	1 → 1500	*gains*	*3*	*1 ® 1500*
9	offsets	1501 → 3000	gains	3	1501 → 3000	*gains*	*3*	*1501 ® 3000*
10	offsets	3001 → 4500	offsets	1	1 → 1500	*gains*	*4*	*1 ® 1500*
11	offsets	4501 → 6000	offsets	1	1501 → 3000	*gains*	*4*	*1501 ® 3000*
12	blank		offsets	2	1 → 1500	*offsets*	*1*	*1 ® 1500*
13	blank		offsets	2	1501 → 3000	*offsets*	*1*	*1501 ® 3000*
14	blank		offsets	3	1 → 1500	*offsets*	*2*	*1 ® 1500*
15	blank		offsets	3	1501 → 3000	*offsets*	*2*	*1501 ® 3000*
16	blank		blank			*offsets*	*3*	*1 ® 1500*
17	blank		blank			*offsets*	*3*	*1501 ® 3000*
18	blank		blank			*offsets*	*4*	*1 ® 1500*
19	blank		blank			*offsets*	*4*	*1501 ® 3000*

These records are detailled in section 7.4.

5.2.5 The Ancillary "Modelization" record

contains informations about the geometric model for level 1B, and the radiometric model for the MIR detectors registration. This record is described in section 7.5.

5.2.6 The Ancillary "Ground Control Points" record

is actually not used and reserved for further applications. This record is described in section 7.6

5.2.7 The Ancillary "Histogram" records

contain the values of the histograms computed over the preprocessed scene. These histograms are split into four records as follows :

RECORD NUMBER	P MODE	Xs MODE	*Xi MODE*
22	Histogram	Histogram Band 1	*Histogram Band 1*
23	Blank	Histogram Band 2	*Histogram Band 2*
24	Blank	Histogram Band 3	*Histogram Band 3*
25	Blank	Blank	*Histogram Band 4*

These records are described in section 7.7.

The nine coefficients of the deconvolution along the raw scene columns, and the nine coefficients of the deconvolution along the raw scene lines, are posted in these records. They correspond to the deconvolution which has been actually applied to get the data in the Imagery File. They depend on the spectral band number. They are provided for all processing levels with the exception of the merged products (P & XS, etc...). In addition, information regarding the radiometric characteristics of the instrument have been encoded (such as the points defining the "spectral sensitivity" or the "equivalent solar irradiance" in the considered spectral band).

5.2.8 The Ancillary "Map projection" record

contains the references of the Map Projection which has been used for a Level 2A product. It is blanked for Level 1 products. This record is described in section 7.6.

5.2.9 The "Annotations" record

contains characters strings which can be displayed when recording the scene on a photographic medium. It contains also the geographics tick marks, and indicates the place where to write them relatively to the image itself. It is described in section 7.9.

5.3 IMAGERY FILE

(see figure 5.3)
The imagery file contains the image data themselves, organised in a BIL form (1 record for one P line, 3 consecutive records for one Xs line, *4 consecutive records for one Xi line*).

For a given scene, the length of the records is constant for the whole file. Depending on the image size, this record length takes one out of the 4 following predefined values :

	5400 bytes	(		line length	≤	5300 pixels)
or	8640 bytes	(5301	≤	line length	≤	8540 pixels)
or	10980 bytes	(8541	≤	line length	≤	10880 pixels)
or	12240 bytes	(10881	≤	line length	≤	12140 pixels)

The different cases relatively to the spectral mode or to the processing levels are described on the diagram of Figure 5.4. (see also table 8.1.5.).

The Imagery File file consists in :

- 1 IMAGERY File Descriptor Record (repeated on each physical volume in case of multivolume),
- n (for P) or 3*n (for Xs) *or 4*n (for Xi)* Image data records, where "n" is the number of lines (the range of the value of "n" is given in table 3.1).

5.3.1 The IMAGERY File Descriptor record

is composed of two segments, a fixed and a variable segment. The fixed segment informs about how to read the file. The variable one points out to particular key data within the file. The variable segment gives the number and length of the imagery records, how the image pixels are packed within groups of bytes, the range and justification of pixels, the size of left, rigth, top and bottom margins, the size of the prefix and suffix data, and finally the nature of the packing of multispectral lines. This variable segment corresponds to what is defined for the "class" IMAGERY (see document [2]) . This record is described in section 8.1.

5.3.2 The Image Data records

contain the values of all pixels along one line in one spectral band; these data are preceded and followed by auxiliary data relative to the given line.

The pixel counts are encoded on one byte (SPOT Image Data Group is one pixel value per byte). The significant radiometric values are in the range 1 to 254 (the values 0 and 255 are reserved). All these data are binary encoded, right justified, with the left-most bit being the most significant one.

A pixel count set to zero corresponds to a non significant radiometric value (i.e. the radiometric value does not exist for the corresponding pixel in the raw image input of processing. This could occur in the following cases :

- margins around the useful image (padding pixels to fullfill the lines)
- lost raw image lines (in case of synchro lost) for level 1A, and for other levels if more than four consecutive lines are lost.
- dead detectors (leading to lost raw image columns) for level 1A, and for other levels if more than four consecutive detectors are dead.

Bad lines :
In general, bad lines are associated with a synchronization loss during the acquisition of the telemetry downlinked from the satellite and, sometimes, with inconsistency detected in the ancillary data. The "bad lines" are restored by interpolation between the neighbouring lines, provided that the number of consecutive bad lines does not exceed four (if not, they are set to zero).

Dead detectors :
Detectors, the characteristics of which are out of range, leading to an impossibility to apply successfuly the Radiometric Equalization algorithm. The columns corresponding to the "dead detectors" are restored by interpolation between the neighbouring columns, provided that the number of consecutive bad columns does not exceed four (if not, they are set to zero).

The Image Data record is described in section 8.2.

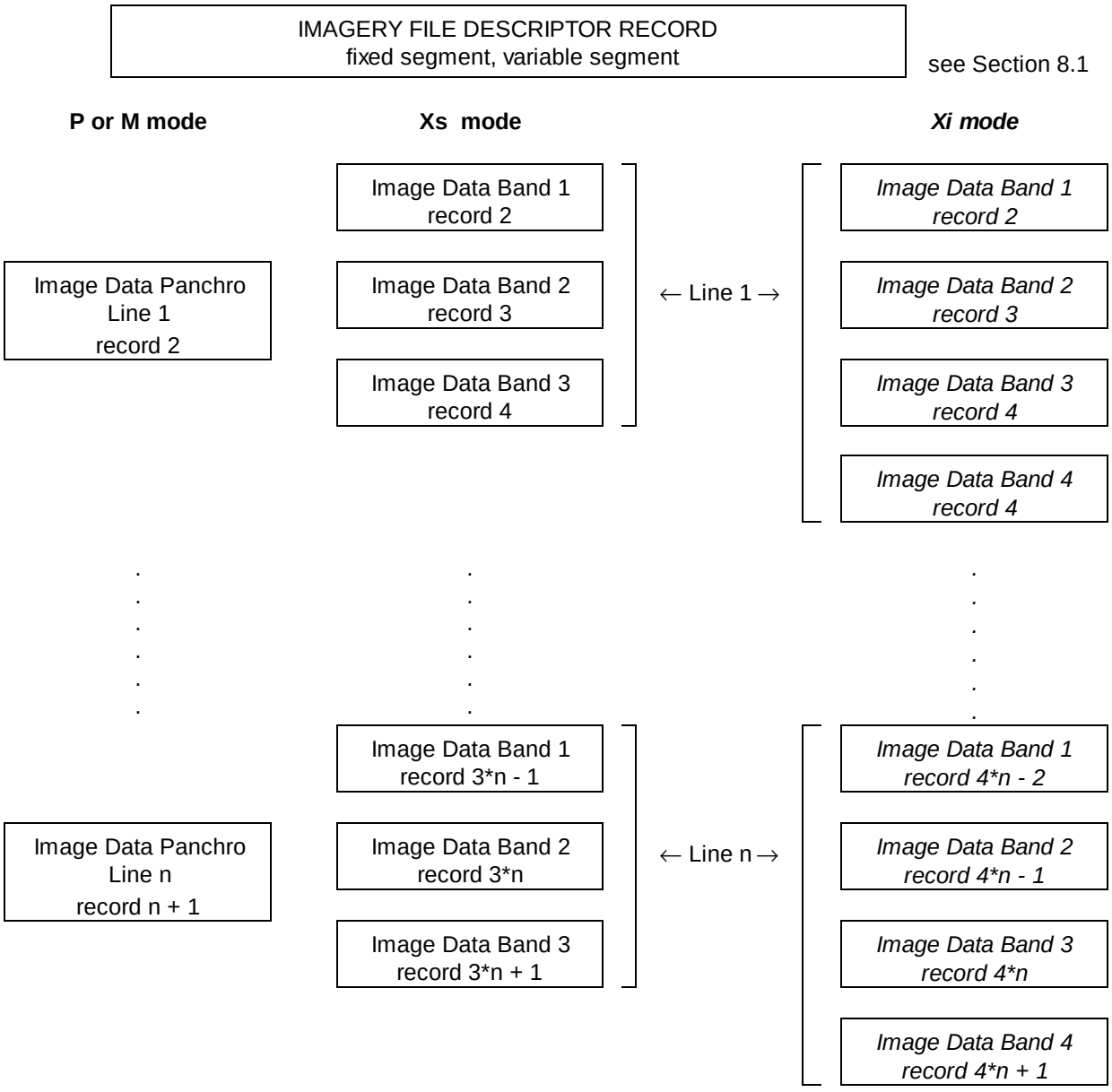
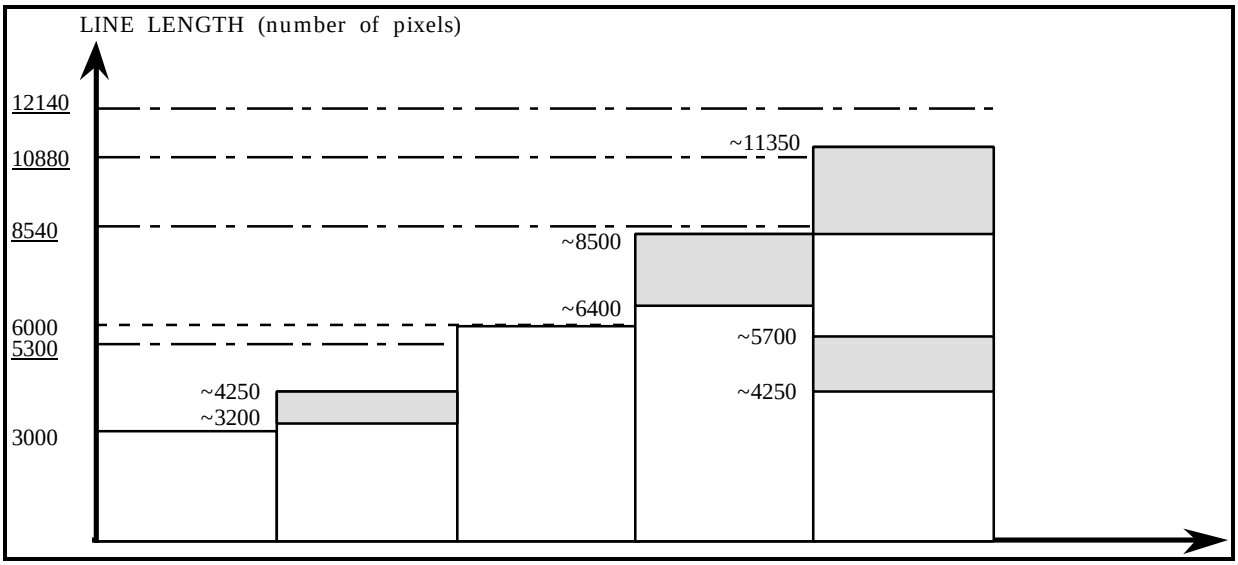


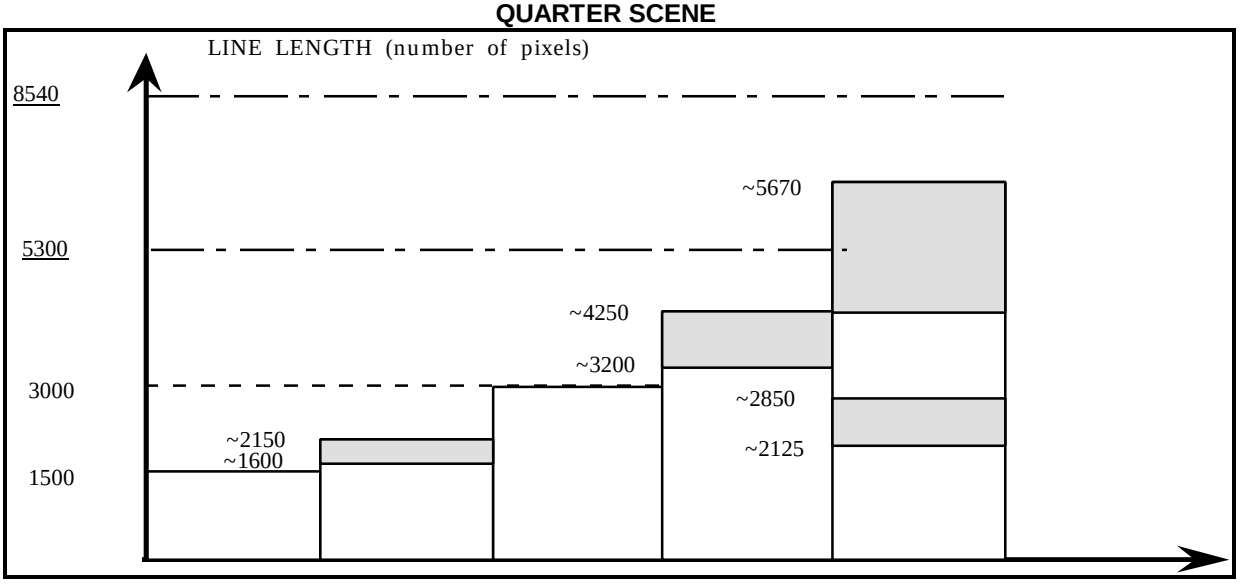
FIGURE 5.3
The Imagery File

FULL SCENE



Level of proc.→	1A	1B	1A P+Xs *M+Xi* *M+Xs*	1B P+Xs *M+Xi* *M+Xs*	OVERSAMPLING
Spectr. mode →	Xs, *Xi*	Xs, *Xi*	P, *M*	P, *M*	P, Xs, *M*, *Xi*

QUARTER SCENE



Level of proc.→	1A	1B	1A P+Xs *M+Xi* *M+Xs*	1B P+Xs *M+Xi* *M+Xs*	OVERSAMPLING
Spectr. mode →	Xs, *Xi*	Xs, *Xi*	P, *M*	P, *M*	P, Xs, *M*, *Xi*

FIGURE 5.4.
The SPOT scene line sizes versus Spectral Modes and Processing Levels

The numbers underlined along the y axis correspond to the limits for the record length change.

5.4 TRAILER FILE

(see Figure 5.5.)

The TRAILER file contains quality informations about the scene recorded in the IMAGERY file

It consists of three records of 1080 bytes each for levels 1A and 1B :

- The TRAILER File Descriptor
- One first Trailer records (Trailer "quality" record)
- One "geometric transformations" record.

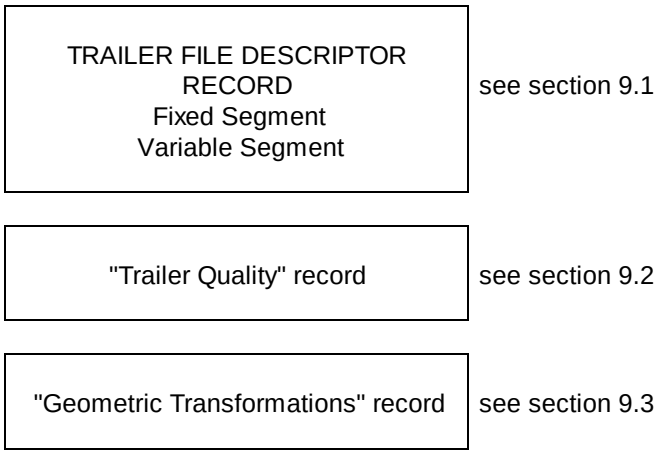


FIGURE 5.5.
The Trailer File

5.4.1 The File Descriptor Record

is composed of two segments, a fixed and a variable segment. The fixed segment informs about how to read the file, and the variable one points out to particular key data within the file. This variable segment corresponds to what is defined for the "class" "TRAILER" (see document [2]). This record is described in section 9.1.

5.4.2 The first trailer record

contains quality informations about the processing, and describes the organisation of the Trailer records which follow. This "Trailer quality" record is described in section 9.2.

5.4.3 The "Geometric transformation" record

is actually not used and reserved for further applications. This "Geometric transformation" record is described in section 9.3.

5.5 NULL VOLUME DIRECTORY FILE

(see Figure 5.6.)

The Null Volume Directory File contains only one 360 bytes record which has the same definition as the Volume Descriptor Record in the Volume Directory File.

The information in this record constitutes a subset of the data recorded in the Volume Descriptor Record.

It is described in section 10.

FIGURE 5.6.
The NULL Volume Directory File

TABLE 6.1 **VOLUME DIRECTORY File** **VOLUME DESCRIPTOR Record**

6. VOLUME DIRECTORY FILE'S RECORD

6.1 VOLUME DESCRIPTOR

The volume descriptor record is described in Table 6.1.below :

Bytes : 1 to 76

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 1
5	1	B	1st Record Sub-type Code (Volume Descriptor code) : = "C0" (Hexadecimal)
6	1	B	Record Type Code : = "C0" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 360 bytes).
13-14	2	A	Flag indicating that the alphanumeric information in this file is in ASCII (= "A$", where "$" denotes an ASCII blank).
15-16	2	A	Blanks (="$$").
17-28	12	A	Reference of the control document which specifies the format of the Superstructure (= "CCB-CCT-0002")
29-30	2	A	Revision letter of the Superstructure format control document (="$E").
31-32	2	A	Revision letter of the Superstrucure record format (="$E")
33-34	12	A	Release number of the software version which was used to write this logical volume (= "<AAAAAAAAAAAA>")
45-60	16	A	ID also written or printed externally on the physical volume, and used to uniquely reference a particular medium (for SPOT, only the 8 left characters are used, the 8 right ones being filled with blanks). This ID is the same for all logical volumes of a same physical volume (="<AAAAAAAA>$$$$$$$$") *Field to be updated in a repeated volume directory file*.
61-76	16	A	Identification of the Logical Volume. For SPOT, contains the reference of the Product Order (= "<AAAAAAAAAAAAAAAA>")

TABLE 6.1 **VOLUME DIRECTORY File** **VOLUME DESCRIPTOR Record**

Bytes : 77 to 128

Position	Length (bytes)	Type	Definitions, explanations and contents
77-92	16	A	Volume Set ID : ensures a unique way to reference a volume set consisting of multiple physical volume. = "<SSN> $ <M> $ <PPBBBB> $$$$" where : SS : Satellite name (= "SP" for SPOT) N : Satellite Number(= "1", "2", "3", "4", etc...) M : Spectral mode (= "P", "X", *"M" or "I")* PP : Preprocessing Level (= "1A", "1B", "2A") BBBB : Interleaving indicator (= "$BIL")
93-94	2	N	Number of physical volume in theset.If this number is not known at creation time then this field is blank ("$N")
95-96	2	N	Sequence number of the physical volume within a volume set, which contains the 1st record of the logical volume. If this number is not known at creation time, then this field is blank (="$1" to "$N")
97-98	2	N	Sequence number of the physical volume within a volume set, which contains the last record of the logical volume. If this number is not known at creation time, then this field is blank. (="$1" to "$N")
99-100	2	N	Sequence number within the volume set of the physical volume containing this volume directory file (="$1" to "$N"). *Field to be updated in a repeated volume Directory File.*
101-104	4	N	Number of the file within the logical volume which follows this Volume Directory file. (="$$$1" to "$$$3") *Field to be updated in a repeated volume Directory File.*
105-108	4	N	Sequence number of the present Logical Volume within a volume set (the same for the Volume Descriptor and the Null Volume Descriptor belonging to the same Logical Volume). (="$$$1" to "$$$L", where L is the number of logical volumes)
109-112	4	N	Sequence number of the present Logical Volume within this Physical Volume. (="$$$1" to "$$$L" where L is the number of logical volumes). *Field to be updated in a repeated volume Directory File.*
113-120	8	A	Date when the logical volume was recorded, (="<YYYYMMDD>" where "YYYY "is year," MM" is month and "DD" is day.
121-128	8	A	Time when the logical volume was recorded, (="<HHMMSS>$$", where HH is hours, MM is minutes, SS seconds. *Field to be updated in a repeated multiple logical volume .*

TABLE 6.1 **VOLUME DIRECTORY File** **VOLUME DESCRIPTOR Record**

Bytes 129 to 360

Position	Length (bytes)	Type	Definitions, explanations and contents
129-140	12	A	Logical volume generating country. ("AAAAAAAAAAAA")
141-148	8	A	Name of the laboratory or center responsible for the creation of this Logical Volume. ("AAAAAAAA")
149-160	12	A	Identification of the computer facility on which the Logical Volume was recorded. (" AAAAAAAAAAAA")
161-164	4	N	Number of Pointer Records in Volume Directory. (="$$$3")
165-168	4	N	Number of Records in Volume Directory. (=" $$$5")
169-260	92	A	Reserved for future revisions of this record format.(92 Blanks)
261-360	100	A	Reserved for local use. (100 blanks)

TABLE 6.2 **VOLUME DIRECTORY File** **FILE POINTER Records**

6.2 FILE POINTERS

There are three File Pointer Record. The first one points to the Leader File, the second one points to the Imagery File, and the third one points to the Trailer File.

The fields of the three File Pointer Record are explained in the Table 6.2 below.

Bytes : 1 to 100

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 2, 3 or 4
5	1	B	1st Record Sub-type Code (File Pointer code) : = "DB" (Hexadecimal)
6	1	B	Record Type : = "C0" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (360 bytes)
13-14	2	A	Flag indicating that the alphanumeric information in this fileis in ASCII. (="A$", where $ denotes an ASCII blank)
15-16	2	A	Blanks (="$$")
17-20	4	N	Sequence number of the file referenced by this pointer, within the Logical Volume. The first file following this Volume Directory file is file number 1. (= "$$$1" for Leader File, "$$$2" for Imagery File or "$$$3" for Trailer File)
21-36	16	A	Identification name of the file referenced by this pointer : = "SP<N>$<MPP>$LEADBIL$" for the Leader File, = "SP<N>$<MPP>$IMGYBIL$" for the Imagery File, or = "SP<N>$<MPP>$TRAIBIL$ " for the Trailer File, where : N : Satellite Number (= "1", "2", "3", "4", etc...) M : Spectral mode of the processed scene(= "P", "X",*"M", "I")* PP : Preprocessing Level (= "1A","1B", "2A")
37-64	28	A	Class the file belongs to : = "LEADER$FILE$$$$$$$$$$$$$$$$$$$", or = "IMAGERY$FILE$$$$$$$$$$$$$$$$$$", or = "TRAILER$FILE$$$$$$$$$$$$$$$$$".
65-68	4	A	Class code of the file : = "LEAD", or = "IMGY", or = "TRAI"
69-96	28	A	Type of encoding of the data contained in the referenced file : = "MIXED$BINARY$AND$ASCII $$$$$$" for the Leader File, or = "BINARY$ONLY$$$$$$$$$$$$$$$$$$$$" for the Imagery File, or = "MIXED$BINARY$AND$ASCII $$$$$$" for the Trailer File.
97-100	4	A	Code for the type of encoding defined above : = "MBAA", for the Leader File, or = "BINO", for the Imagery File, or = "MBAA", for the Trailer File.

TABLE 6.2 **VOLUME DIRECTORY File** **FILE POINTER Records**

BYTES : 101 to 360

Position	Length (bytes)	Type	Definitions, explanations and contents
101-108	8	N	Number of records in the file referenced (blank, if this number is unknown at creation time) : = "$$$$$$27" for the Leader File, or = "<nr. of records of the Imagery File>", or = "$$$$$$$3" for the Trailer File
109-116	8	N	Length (in number of bytes) of the first record of the referenced file : = "$$$$3960" for the Leader File, or = "$$$$5400", "$$$$8640", "$$$10980" or "$$$12240" for the Imagery File, or = "$$$$1080" for the Trailer File.
117-124	8	N	Maximum length (in nr. of bytes) of the rtecords of the referenced file : = "$$$$3960" for the Leader File, or = "$$$$5400", "$$$$8640", "$$$10980" or "$$$12240" for the Imagery File, or = "$$$$1080" for the Trailer File.
125-136	12	A	Record length type for the referenced file: = "FIXED$LENGTH" for the three files (all records within a file have the same length)
137-140	4	A	Record length type code for the referenced file : = "FIXD" for the 3 files.
141-142	2	N	Number of the Physical Volume which contains the first record of the referenced file. If this number is not known at creation time, then this field is blank. = "$1" to "$N", where N is the number of the physical volume within the volume set.
143-144	2	N	Number of the Physical Volume which contains thelast record of the referenced file. If this number is not known at creation time, then this field is blank. = "$1" to "$N", where N is the number of the physical volume within the volume set.
145-152	8	N	Record number of the first record of the referenced file to be recorded on this physical volume (when a portion of the referenced file is on a previous physical volume). = "$$$$$$$1" if single physical volume, or = "$$$$NNNN".
153-260	108	A	Pointer Spare Segment (reserved).
261-268	8	A	Number of Imagery File records in this Physical Volume. Blank for Leader File and Trailer File. = <NNNNNNNN> for Imagery File (same as bytes 101-108, when only one physical volume).
269-360	92	A	Local Use segment. (reserved)

TABLE 6.3 VOLUME DIRECTORY File TEXT Record

6.3 TEXT

The Text Record Structure is explained in table 6.3.

Bytes : 1 to 360

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 5
5	1	B	1st Record Sub-type Code (Text code) : = "12" (Hexadecimal)
6	1	B	Record Type : = 3F (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (360 bytes)
13-14	2	A	Flag indicating that the alphanumeric information in this file is in ASCII. (="A$", where $ denotes an ASCII blank)
15-16	2	A	Blanks (="$$")
17-80	64	A	**Text (product):** FOR PRINTOUT ONLY (subj. to changes without prior notice) "PRODUCT:$$$$$$$$$$$$SPOT$N$$ AAAAA$I $$MODE$XXXX$$BIL$$ LEVELPP<CRLF>"* where : N : SPOT Satellite number ("1", "2", "3", ...), AAAAA : "HRV$$" (for SPOT 1, 2, 3) or "HRVIR" for SPOT 4, I : HRV(IR) number ("1" or "2") XXXX : Spectral mode ("P$$$", "X$$$", *"M$$$", "I$$$")* "of acquisition" PP : Preprocessing level ("1A", "1B" or "2A")
81-100	20	A	**Text (area covered by the image) :** PRINTOUT ONLY (subj. to changes) "FULL$SCENE$$$$$$$$$$" "QUADRANT$$$$$$$$$$$$" "SHIFT$ALONG$TRACK $$$"
101-120	20	A	**Text (Preprocessing) :** FOR PRINTOUT ONLY (may be subject to changes) "RRR$$$DD$$$$XXX$$$$$", where : RRR = "RES" when an oversampling is applied, and "$$$" if not, DD = "DS" when a Dynamic Stretching is applied, and "$$$" if not, XXX = "PXS" when P & Xs merge, *or "MXS" when M & Xs merge, or "MXI" when M & Xi merge*, or "$$$" else.
121-138	18	A	**Text (Loc. of prod. facility)** FOR PRINTOUT ONLY (subj. to changes) "PROD.$SPOT$IMAGE$$" (for CAP-T, in Toulouse) "PROD.$SATIMAGE$$$$" (for CAP-K, in Kiruna)
139-180	42	A	**Text (Copyright, date-time of scene) :** PRINTOUT ONLY (subj. to changes) "COPYRIGHT$CNES$$$<DD>$<MM>$<YYYY>$-$<HH>H<MM>MN<SS> S<CRLF>"*
181-228	48	A	**Text (GRS, processing date) :** PRINTOUT ONLY (subj. to changes) "SCENE$$$$$$$$$$$$<KKK>-<JJJ>/<J>$$THE$$<DD>$$<MM>$$ <YYYY> $ <CRLF>"*
229-268	40	A	**Text (ID of physical vol.) :** PRINTOUT ONLY (subj. to changes) "VOL$:$<CCCCCCCC>$ORDER:$<XXXXXXXXXXXXXXXX><CRLF>"* where CC...CC = Volume ID, and XX.....XX = Reference of the order.
269-360	92	A	Not significant.

*** CRLF denotes "Carriage Return - Line Feed"**

TABLE 7.1 **LEADER File** **FILE DESCRIPTOR Record**

7. LEADER FILE'S RECORDS

7.1 LEADER FILE DESCRIPTOR

The File Descriptor Record for the Leader File is explained in in the following table.

BYTES : 1 to 76

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 1
5	1	B	1st Record Sub-type Code (File Descriptor Code) : = "3F" (Hexadecimal)
6	1	B	Record Type Code : = "C0" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-14	2	A	Flag indicating that the alphanumeric information in this file is in ASCII. (= "A$" where $ denotes an ASCII blank).
15-16	2	A	Blanks (="$$").
17-28	12	A	Reference of the document which specifies the format of this data file. (= "S4-ST-73-1SI")
29-30	2	A	Revision number of the document referenced in bytes 17 to 28.(= <NN>)
31-32	2	A	Revision letter of the file format (= <NN>)
33-44	12	A	Reference of the software version used to write the file.(= <AAA…..AAA>)
45-48	4	N	Sequence number of this file within the logical volume (excluding the Volume Directory file, the sequential number of which is 0).: = "$$$1"
49-64	16	A	Identification of the present file, as stated in bytes 21 to 36 of the File Pointer Record of the Volume Directory ; ="SP<N>$<MPP>$LEADBIL$" where, N : Satellite Number (= "1", "2", "3", "4", etc...) M : Spectral mode of the product ("P", "X", *"M" or "I"*) PP : Preprocessing Level ("1A", "1B" or "2A")
65-68	4	A	Indicates that the following records in the file have sequence numbers, also called "Record Numbers" (="FSEQ")
69-76	8	N	Byte number within the record, of the 1st byte of the field "Record Number" (= "$$$$$$$1")

TABLE 7.1 **LEADER File** **FILE DESCRIPTOR Record**

BYTES : 77 to 216

Position	Length (bytes)	Type	Definitions, explanations and contents
77-80	4	N	Length, in bytes, of the field "Record Number" (= "$$$4")
81-84	4	A	Indicates that the following records in the file have a "Record Type Code", and that the location of the code is fixed (="FTYP")
85-92	8	N	Byte number within the record, of the 1st byte of the field "Record Type Code" (= "$$$$$$$5")
93-96	4	N	Length, in bytes, of the field "Record Type Code" (= "$$$4")
97-100	4	A	Indicates that the "Record Length" of the records of the file is written at a fixed location in each record of the file (= "FLGT")
101-108	8	N	Byte number, within the record, of the 1st byte of the field "Record Length" (= "$$$$$$$9")
109-112	4	N	Length, in bytes, of the field "Record Length" (= "$$$4")
113	1	A	Indicates that data interpretation information is included in this File Descriptor Record (= "Y", for YES)
114	1	A	Indicates that data interpretration information is not included in the other records of this file (= "N" for NO)
115	1	A	Indicates that information necessary to display the file is not included in this File Descriptor Record (= "N" for NO).
116	1	A	Indicates that information necessary to display the file is not included in the other records of this file (="N" for NO)
117-180	64	A	Reserved (Not significant.)
181-186	6	N	Number of Header Records (= "$$$$$1")
187-192	6	N	Header Record Length (="$$3960")
193-198	6	N	Number of Ancillary Records (= "$$$$24")
199-204	6	N	Ancillary Record Length (= "$$3960")
205-210	6	N	Number of Annotation Records (= "$$$$$1")
211-216	6	N	Annotation Record Length (= "$$3960")

TABLE 7.1 **LEADER File** **FILE DESCRIPTOR Record**

BYTES : 217 to 3780

Position	Length (bytes)	Type	Definitions, explanations and contents
			FIELD LOCATORS : *The following fields are locator fields which point to the position in the file where various information may be found. The location of the desired field is given with 16 bytes, coded as follows:* *- 6 bytes: The record number of the record containing the field,.* *- 6 bytes: The number of the first byte of the field within the record,.* *- 3 bytes: Length of the field, in bytes,.* *- 1 byte : Type of data in the field ("A": alphanumeric, "B": binary, "N": numeric)*
217-232	16	A	Scene identification field locator.(="$$$$$2$$$$37$16A")
233-248	16	A	GRS identification field locator.(="$$$$$2$$$$21$16A")
249-264	16	A	Mission identification field locator.(="$$$$$2$$$613$16A")
265-280	16	A	Sensor identification field locator.(= "$$$$$2$$$629$16A")
281-296	16	A	Exposure date - time field locator.(= "$$$$$2$$$581$32A")
297-312	16	A	Geographic reference field locator.(= "$$$$$2$$$$85$32A")
313-328	16	A	Image processing performed field locator.(= "$$$$$2$$1317$64A")
329-344	16	A	Imagery format (Interleaving) indicator locator.(= "$$$$$2$$1029$16A")
345-360	16	A	Band indicator locator.(= "$$$$$2$$1061256A")
361-376	16	A	Subscene indicator locator.(= blanks).
377-3960	3584	A	Not significant..

TABLE 7.2 **LEADER File** **HEADER Record**

7.2 HEADER

The Header Record is defined in the following table.

BYTES : 1 to 68

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = "2"
5	1	B	1st Record Sub-type Code (Header code) : = "12" (Hexadecimal)
6	1	B	Record Type Code : = "12" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= "3960" bytes).
13-16	4	N	Header Record sequence number (= "$$$1")
17-20	4	A	Blanks.
			SCENE PARAMETERS
			(for a P & Xs merge, these parameters are those of the P scene)
21-36	16	A	GRS (K,J) designator of the input scene and the value of the shift in 1/10 of scene = "<KKK><JJJ>/<j>$$$$$$$$" where : KKK is a column number (related to a path number), JJJ is a row number, j is the value of the shift (in 1/10 of scene truncated to the lowest integer)
37-52	16	A	Parameters used for the identification of the scene : ou "S<N>I<J><YY><MM><DD><HH><MM><SS>", where : N is the satellite number ("1", "2", "3",*"4",* etc...) I is the instrument ID ("H" for HRV*and for HRVIR*) J is the instrument number YYMMDDHHMMSS is the time of the top GRS scene center.
			Scene center : *In the following, the "Scene Center" is the point, within the processed image, which corresponds to the center of the raw scene.*
53-68	16	A	Deviation between the GRS node (K,J) and the Scene Center (latitude) : = "<X><DDD><MM><SS>$$$$$$$$", with X equals "N" or "S" according to whether the scene center is offset to the North or South relative to the GRS node.

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 69 to 436

Position	Length (bytes)	Type	Definitions, explanations and contents
69-84	16	A	Deviation between GRS node (K,J) and the Scene Center (longitude) : ="<X><DDD><MM><SS>$$$$$$$$", with X equals "E" or "W" according to whether the scene center is offset to the East or West relative to the GRS node
85-100	16	N	Latitude of the Scene Center : = "<X><DDDMMSS>$$$$$$$$", with X equals "N" (north) or "S" (south).
101-116	16	N	Longitude of the Scene Center : = "<X><DDDMMSS>$$$$$$$$", with X equals "E" (east) or "W" (west).
117-132	16	A	Number of the line containing the Scene Center ="$$$$$$$$$$±<LLLLL>"
133-148	16	A	Pixel number of the Scene Center within the line = "$$$$$$$$$$±<PPPPP>"
			Scene corner coordinates: *1st corner (C1) : 1st pixel, 1st line in the raw scene.* *2nd corner (C2) : last pixel, 1st line in the raw scene.* *3rd corner (C3) : 1st pixel, last line in the raw scene.* *4th corner (C4) : last pixel, last line in the raw scene.*
149-164	16	A	Latitude of the 1st scene corner (C1) (same format as bytes 85 to 100).
165-180	16	A	Longitude of the 1st scene corner (C1) (same format as bytes 101 to 116)
181-196	16	N	Line number of the 1st scene corner (C1) (same format as bytes 117 to 132).
197-212	16	N	Pixel number of the 1st scene corner (C1) (same format as bytes 133 to 148).
213-276	64	A,N	Same as above (bytes 149 to 212) for the 2nd scene corner.
277-340	64	A,N	Same as above (bytes 149 to 212) for the 3rd scene corner.
341-404	64	A,N	Same as above (bytes 149 to 212) for the 4th scene corner.
405-420	16	A	Latitude of the Nadir for the central line (same format as bytes 85 to 100)
421-436	16	A	Longitude of the Nadir for the central line (same format as bytes 101 to 116)

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 437 to 628

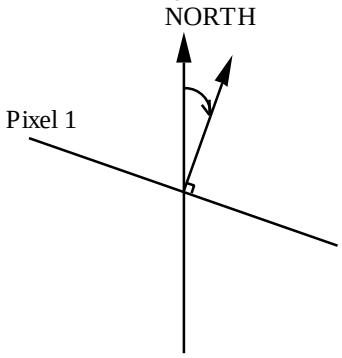
Position	Length (bytes)	Type	Definitions, explanations and contents
437-452	16	N	Scene orientation angle :  Complement of the angle between the center line of the raw scene and the meridian passing through the center of the raw scene. This angle is expressed in degrees with the orientation indicated in the figure. = "$$$$$$$$$$$<AAA.A>" (between 0° and 360°)
453-468	16	A	Angle of incidence (in degrees). This is the angle between the normal to the referenced ellipsoïd passing through the Scene Center, and the instrument look direction for the same point = "<X><AA.A>$$$$$$$$$$" with X equals "R" (for right) or "L" (for left) according to whether the path of the sub-satellite point passes to the East (R) or West (L) of the center of the raw scene (except for scene taken during ascending orbit).
469-484	16	N	Sun azimuth : = "$$$$$$$$$$<AAA.A>" (between 0 and 3608)
485-500	16	N	Sun elevation : = "$$$$$$$$$$<EEE.E>"
501-508	8	N	Satellite altitude (distance to the ellipsoïd surface in meters) = "<NNNNNN.N>"
509-580	72	A	Not significant.
			IMAGING PARAMETERS
581-612	32	A	Date and time of the center of this scene : = "<YYYY><NN><DD><HH><MM><SS><FFF>$$$$$$$$$$$$$$" where YYYY= year, NN = month, DD = day, HH = hours (0 to 23), MM = minutes (0 to 59), SS = seconds (0 to 59), FFF = milliseconds
613-628	16	A	Identification of the satellite : = "SPOT<N>$$$$$$$$$$", where N is the satellite number ("1", "2", "3", *"4",* etc...)

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 629 to 996

Position	Length (bytes)	Type	Definitions, explanations and contents
629-644	16	A	Identification of the instrument : = "HRV$$<N>$$$$$$$$$$ " for SPOT 1, 2, or 3 *or* = *"HRVIR<N>$$$$$$$$$$" for SPOT 4, where N is the Instrument number ("1" or "2").*
645-660	16	A	Spectral mode of acquisition: = "<MMM>$$$$$$$$$$$$$", where MMM equals "PAN" (panchro), "XS$" (multispectral),*"M$$" (SPOT 4 monospectral) or "XI$" (SPOT 4 multispectral with SWIR).*
661-676	16	N	Revolution number within the cycle : = "$$$$$$$$$$$$$<NNN>" with NNN between 1 and 369.
677-692	16	N	Pointing miror step value : = "$$$$$$$$$$$$$$<NN>" (from 3 to 93)
693-708	16	A	Compression mode for transmission : = "LINEAR$$$$$$$$$$" for Xs, and for P, *M or Xi* in linear mode, = "DPCM$$$$$$$$$$$$" for P, *M or Xi* in compressed mode
709-724	16	A	Direct / Play-back indicator : ="<XX>$$$$$$$$$$$$$$", where XX equals "DT" (for direct mode via 8 Ghz), or "E1" (for 1st O.B. recorder play-back), or "E2" (for 2nd O.B. recorder play-back), *or "PL" (for direct mode via PASTEL), or "MX" (for Memory dump via 8 GHZ), or "MP" (for Memory dump via PASTEL).*
725-740	16	A	On board gain numbers (filled with Xs*or Xi* values for merged products) : = "<N>$$$$$$$$$$$$$$$$" (N = 1 to 8) for panchro, = "<N>$$$<M>$$$<P>$$$$$$$" (N, M, P = 1 to 8) for Xs, with N for Xs1, M for Xs2, and P for Xs 3, *= "<N>$$$<M>$$$<P>$$$<Q>$$$" (N, M, P, Q = 1 to 6) for Xi, with N for Xs1, M for Xs2, P for Xs3, and Q for Xs4.*
741-744	4	N	Refocusing mecanism step number : = "$$<NN>"
745-746	2	A	Indicates if the same HRV*(IR)* operates in both mode P*(or M)* and Xs *(or Xi*) : ="$Y" for yes , or "$N" for no.
747-996	250	A	Not significant.

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 997 to 1460

Position	Length (bytes)	Type	Definitions, explanations and contents
			IMAGE DATA PARAMETERS
997-1012	16	N	Number of image pixels per line (same as bytes [249 - 256] in the Imagery File Descriptor Record (Table 8.1) : = "$$$$$$$$$$$<NNNNN>"
1013-1028	16	N	Number of lines (same as bytes [237 - 244] in Table 8.1) : = "$$$$$$$$$$$<NNNNN>"
1029-1044	16	A	Interleaving Indicator (same as bytes [269 - 272]. in the Imagery File Descriptor (Table 8.1) : = "BIL$$$$$$$$$$$$$", for "Band Interleaved by lines".
1045-1060	16	N	Number of spectral bands : = "$$$$$$$$$$$$$$$<N>", where N equals "1" (P*or M* mode), or "3" (Xs mode), *or "4" (Xi mode).*
1061-1316	256	A	Spectral bands identification : = "PAN$$$$$$$$$$$$", or "XS2$$$$$$$$$$$$$", or "XS1$XS2$XS3$$$$$", *or "XS1$XS2$XS3$XS4$ ",* followed by 240 blanks.
			CORRECTION PARAMETERS
1317-1332	16	A	Preprocessing level : "1A$$$$$$$$$$$$$$", or "1B$$$$$$$$$$$$$$", or "2A$$$$$$$$$$$$$$".
1333-1348	16	A	Radiometric equalization correction designator : = "1$$$$$$$$$$$$$$$" (means "correction applied")
1349-1364	16	A	Deconvolution designator : "1$$$$$$$$$$$$$$$" (if deconvolution applied) or "0$$$$$$$$$$$$$$$" if not.
1365-1380	16	A	Resampling designator : ="<XX>$$$$$$$$$$$$$$", where XX equals "$$" (level 1A, i.e. no resampling), or "CC" (level 1B, 2A, Cubic Convolution), or "NN" (level 1B, 2A, Nearest Neighbour).
1381-1396	16	N	Pixel size along lines (in meters) : = "$$$$$$$$$$$<PP.PP>" (level 1B or level 2A). Blanks for level 1A.
1397-1412	16	N	Pixel size along columns (in meters) : = "$$$$$$$$$$$<PP.PP>" (level 1B, or level 2A). Blanks for level 1A.
1413-1444	32	A	Map projection identifier (32 characters for level 2A ; blanks for other levels).
1445-1460	16	N	Image size, in meters, along the y axis : = "$$$$$$$$$$<YYYYYY>" (level 2A) Blanks for other levels.

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 1461 to 2788

Position	Length (bytes)	Type	Definitions, explanations and contents
1461-1476	16	N	Image size, in meters, along the x axis : = "$$$$$$$$$$<XXXXXX>" (level 2A) Blanks for other levels.
1477-1485	9	N	Altitude of the geoid which has been used for the Level 2A modelization : = "$$$$$<HHHH> (in meters). Blanks, for Level 1A and 1B.
1486-1620	135	A	Not significant.
1621-1652	32	A	Cartographic coordinates of the first pixel of the first line of the Level 2A scene (in meters) : = "$$$$$$$$±<XXXXXXXXXX>±<YYYYYYYYYY>" Blanks for Level 1A or 1B.
1653-1668	16		Not significant.
1669-1684	16	N	Number of lines of the input raw image which have been lost before preprocessing (synch loss, for example) : = "$$$$$$$$$$$$<NNNN>"
1685-1700	16	N	Number of dead detectors : = "$$$$$$$$$$$$<NNNN>"
1701-1732	32	A	Not significant.
1733-1748	16	A	The starting date of validity of the radiometric eqalization coefficients which have been applied to this scene: ="<YYYYMMDD>$$$$$$$$"
1749-1764	16	A	The starting date of validity of the absolute calibration coefficients provided with this scene : "<YYYYMMDD>$$$$$$$$"
			ABSOLUTE CALIBRATION COEFFICIENTS *Allows to compute the "equivalent radiance", L, at the input of the HRV from the "radiance count", X, of a pixel as follows :* $L = \frac{X}{A} + B$, *where :* *- A is the absolute calibration gain, in* $W^{-1} m^2 . sr . micrometers$, *- B is the absolute calibration offset in* $W.m^{-2} . sr^{-1} . micrometer^{-1}$. *These coefficients are recomputed to take into account the on board gain used for imaging this SPOT scene, as well as the possible digital dynamic streching which has been applied to the data.*
1765-2276	512	A	Absolute calibration gains (filled with *X or I* values for merged products) : = "<AA.AAAAA>" followed by 504 blanks for P *or M* mode, = "<AA.AAAAA><BB.BBBBB><CC.CCCCC> plus 488 blanks for Xs, *= "<AA.AAAAA><BB.BBBBB><CC.CCCCC><DD.DDDDD> plus 480 blanks for Xi mode.*
2277-2788	512	A	Absolute calibration offsets (filled with X or *I* values for mixed products). Same coding as for the Absolute clibration gains (bytes 1765 to 2276).

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 2789 to 2944

Position	Length (bytes)	Type	Definitions, explanations and contents
			PRODUCTS PARAMETERS
2789-2804	16	A	Spatial covering identifier : = "FULL$SCENE$$$$$$ ", or "SUB$SCENE$$$$$$$" for a Quarter scene "REDECOUPAGE$$$$$" for a Shift Along the Track
2805-2820	16	A	Parameters used to identify the "top scene", when "shift along track" (same description as bytes 37 to 52 of this Header Record)
2821-2836	16	A	K - J identifier of the "top scene" , when "shift along track" scene (same description as bytes 21 to 36 of this Header Record)
2837-2868	32	A	Not significant.
			SUB-SCENE PARAMETERS *(applies to Quarter scene products)*
2869-2876	8	N	Pixel coordinate in the raw scene, of the pixel (1,1) of the sub-scene : = "$$$$<PPPP>", with PPPP equals pixel number within the raw line.
2877-2884	8	N	Pixel coordinate in the raw scene, of the pixel (1,1) of the sub-scene : = "$$$$<LLLL>", with LLLLequals line number within the raw full scene.
2885-2892	8	N	Sub-sampling factor for pixels, for a sub-scene : = "$$$$$$<NN>" (blanks when no sub-sampling is applied)
2893-2900	8	N	Sub-sampling factor for lines, for a sub-scene : = "$$$$$$<NN>" (blanks when no sub-sampling is applied)
2901-2908	8	N	Sub-scene line length (in number of pixels) : ="$$$$<NNNN>"
2909-2916	8	N	Number of lines of the sub-scene : = "$$$$<NNNN>"
2917-2924	8	N	Shift value, expressed in number of lines of the raw scene : ="$$$$<NNNN>" (NNNN = 0 or blanks for a GRS scene).
2925-2944	20	A	Additional processing indicator : = "<RRR>$$$<DD>$$$$<XXX>$$$$$", where RRR = "RES" when a oversampling is applied, "$$$" if not, DD = "DS" when a Dynamic Stretching is applied, "$$" if not, XXX = "PXS" when P & X merge, *"MXS" when M & X merge, "MXI" when M & I merge*, or "$$$" else.

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 2945 to 3531

Position	Length (bytes)	Type	Definitions, explanations and contents
2945-2960	16	N	Position of the quarter scene within the full scene : = "QUARTER$Q1$$$$$$ ", or " QUARTER$Q2$$$$$$ ", or "QUARTER$Q3$$$$$$", or "QUARTER$Q4$$$$$$", or "FLOATING$QUARTER", or blanks
2961-2968	8	N	Pixel coordinates, in level 1B scene, of the pixel (1,1) of the sub-scene (pixel nr. within the line) : = "$$$<NNNNN> (blank if not 1B, or if full scene)
2969-2976	8	N	Pixel coordinates, in level 1B scene, of the pixel (1,1) of the sub-scene (line number) : = "$$$<NNNNN>" (blank if not level 1B, or if full scene)
2977-2984	8	N	In case of resampling process, the resampling factor for pixels (e.g. : Panchromatic data with the pixel size = 7,5 m will have a resampling factor of $\frac{10}{7,5}$ = 1,33) : = "$$$<PP.PP>". Blanks if no resampling, i.e. Level 1A.
2985-2992	8	N	When resampling process, the resampling factor for lines (see example for bytes 2977 to 2984) : = "$$$<LL.LL>" (blanks if no resampling).
2993-3000	8	N	The minimum of the lower thresholds applied in the different spectral bands, when digital dynamic stretching : ="$$$$$<LLL>" (or blanks)
3001-3008	8	N	The maximum of the upper thresholds applied in the different spectral bands, when digital dynamic stretching : = "$$$$$<UUU>" (or blanks)
3009-3016	8	N	*Value of the coefficient a for M&X, or M&I merge Products : = "<X.XX>$$$$"*
3017-3024	8	N	*Value of the coefficient b for M&X, or M&I merge Products : = "<X.XX>$$$$"*
3025-3040	16	A	*SWIR band registration flag : = "<F>$$$$$$$$$$$$$$$$", where F="1" for "registered", F = "0" for "no registered"..*
3041-3499	459	A	Not significant.
			SIMPLIFIED LOCATION MODEL *Model :* $l = a + b*i + c*j + d*i*j + e*i^2 + f*j^2$ $j = a' + b'*i + c'*j + d'*i*j + e'*i^2 + f'*j^2$, *where :* *(i,j) : pixel coordinates within the processed image (line nr., pixel nr.)* *(j , l) : latitude and longitude of the point (i,j) (in decimal degrees)*
3500-3515	16	N	Coefficient a : = "$$$±<N.NNNNNN>E±<XX>
3516-3531	16	N	Coefficient b : same as bytes 3500-3515

TABLE 7.2 **LEADER File** **HEADER Record**

BYTES : 3532 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
3532-3547	16	N	Coefficient c : same as bytes 3500-3515
3548-3563	16	N	Coefficient d : same as bytes 3500-3515
3564-3579	16	N	Coefficient e : same as bytes 3500-3515
3580-3595	16	N	Coefficient f : same as bytes 3500-3515
3596-3691	96	N	Coefficient a', b', c', d', e', f' : 6 times as bytes 3500-3515
3692-3788	97	A	Not significant.
			DEFINITION OF THE ANCILLARY DATA RECORD
3789-3804	16	N	Number of "Ephemeris/Attitudes" records : ="$$$$$$$$$$$$$$$1"
3805-3820	16	N	Length of these records : = "$$$$$$$$$$$$3960"
3821-3836	16	N	Number of "Radiometric Calibration" records : = "$$$$$$$$$$$$$$$16"
3837-3852	16	N	Length of these records : ="$$$$$$$$$$$$3960"
3853-3868	16	N	Number of "Modelization" records : = "$$$$$$$$$$$$$$$$1"
3869-3884	16	N	Length of these records : = "$$$$$$$$$$$$3960"
3885-3900	16	N	Number of "Histogram" records : = "$$$$$$$$$$$$$$$4"
3901-3916	16	N	Length of these records : = "$$$$$$$$$$$$3960"
3917-3932	16	N	Number of "Annotations" records : = "$$$$$$$$$$$$$$$1"
3933-3948	16	N	Length of these records : = "$$$$$$$$$$$$3960"
3949-3960	12	A	Not significant..

TABLE 7.3 **LEADER File** **EPHEMERIS / ATTITUDE Record**

7.3 ANCILLARY "EPHEMERIS / ATTITUDE"

The ancillary "Ephemeris / Attitude" Record is defined in the following table :

BYTES : 1 to 420

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 3
5	1	B	1st Record Sub-type Code (Ephemeris/Attitude code) : = "F6" (Hexadecimal)
6	1	B	Record Type Code : = "24" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	Ephemeris-Attitude Record sequence number : = "$$$1"
17-20	4	A	Blanks.
			EPHEMERIS DATA Ephemeris pointnumber 1:
21-56	36	A	Satellite position. : coordinates (X, Y, Z) of the satellite position at the time given in bytes 93 to 120. The coordinates are expressed in kilometers, in a terrestrial reference frame defined as follows: Z axis along the earth polar axis, X axis in the equatorial plane, crossing the Greenwich meridian, Y axis perpendicular to the X and Z axes, in the equatorial plane : = "±<XXXX.XXXX>$$±<YYYY.YYYY>$$±< ZZZZ.ZZZZ>$$"
57-92	36	A	Velocity vector : the 3 components ($\dot{X}$, $\dot{Y}$, $\dot{Z}$) of the inertial velocity vector, in kilometers/second, and relative to the terrestrial reference frame defined above: = "±< $\dot{X}$ .XXXXXXX >$$ ±< $\dot{Y}$ .YYYYYYY >$$ ±< $\dot{Z}$ .ZZZZZZZ >$$"
93-120	28	A	Universal time corresponding to this satellite position, expressed with two values as follows : "<DDDDD><SSSSS.SSSSSS>$$$$$$$$$$$$" - "DDDDD" = Julian day number since January, 1st, 1950 (day number 0), - "SSSSS.SSSSSS" = time within the day, in seconds.
121-220	100	A	Ephemeris point number 2.
221-320	100	A	Ephemeris point number 3.
321-420	100	A	Ephemeris point number 4.

TABLE 7.3 **LEADER File** **EPHEMERIS / ATTITUDE Record**

BYTES : 421 to 1019

Position	Length (bytes)	Type	Definitions, explanations and contents
421-520	100	A	Ephemeris point number 5.
521-620	100	A	Ephemeris point number 6.
621-720	100	A	Ephemeris point number 7.
721-820	100		Ephemeris point number 8.
821-920	100		Ephemeris point number 9 (may be blanked if only 8 points).
921-922	2	A	*Flag indicating wether DORIS data were used to calculate ephemeris data (for SPOT 4) : = "$Y" for Yes , "$N" for No,* or may be"$$" if SPOT 1, 2 or 3
923-946	24	A	Not significant.
947-958	12	A	Line period (in milliseconds) : ="<N.NNNNNNNNN>$"
959-960	2	A	Flag indicating if the attitude has been out of range when imaging the scene : = "$Y" for Yes, or "$N" for No.
961-964	4	A	Not significant..
965-994	30	A	Time of the Scene Center : = "$$$$$$$$$$$$<DDDDD><SSSSS.SSSSSS>$"
995-1000	6	A	Not significant..
			ATTITUDE DATA ***(of the P or M scene for the mixed products)*** Attitude number 1:
1001-1004	4	N	Line number in the raw input scene to which the following attitude data correspond : = "<LLLL>"
1005-1009	5	N	Averaged rotation speed around the yaw axis (expressed in 10^6 degrees per second) : = "±<YYYY >"
1010-1014	5	N	Averaged rotation speed around the roll axis (same unit as for bytes 1005 to 1009) : = "±< RRRR>"
1015-1019	5	N	Averaged rotation speed around the pitch axis (same unit as for bytes 1005 to 1009) : = "±< PPPP>"

TABLE 7.3 **LEADER File** **EPHEMERIS / ATTITUDE Record**

BYTES : 1020 to 3000

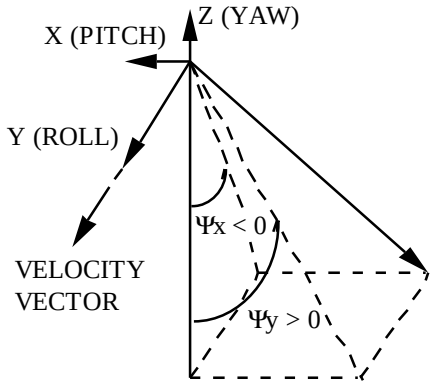
Position	Length (bytes)	Type	Definitions, explanations and contents
1020	1	A	Blank.
1021-2460			As for bytes 1001 to 1020 (repeated 72 or 73 times). The bytes 2441 to 2460 are blanked in case ofonly 72 attitude data available.
			HRV LOOK ANGLES ***(those of the P or M scene when merged products)***
2461-2468	8	A	Ψ_X angle for first detector of the CCD array.  Ψ_X angle for the look direction corresponding to the last pixel of the scan line expressed in degrees, minutes and seconds in the local orbitalreference (roll, pitch and yaw axis) : = "±<DDD><MM><SS>" These angles may be found with improved accuracy in bytes 3057 to 3104
2469-2476	8	A	Ψ_X angle for the last detector of the CCD array (= first pixel of the scan line) : = "±< DDD><MM><SS> (same conventions as above)
2477-2484	8	A	Ψ_y angle for the first detector of the CCD array (= last pixel of the scan line) : = "±< DDD><MM><SS> (same conventions as above)
2485-2492	8	A	Ψ_y angle for the last detector of the CCD array (= first pixel of the scan line) : = "±< DDD><MM><SS> (same conventions as above)
2493-3000	508	A	Not significant.

TABLE 7.3 **LEADER File** **EPHEMERIS / ATTITUDE Record**

BYTES : 3001 to 3148

Position	Length (bytes)	Type	Definitions, explanations and contents
			Angular values of attitude at the beginning of the scene (those of the P or M scene when merged products). These values may be blanked when produced from an isolate level zero scene from a Direct Receiving Station.
3001-3008	8	A	Number of the line, within the raw scene, to which the following attitude data corresponds : = "$$$ ±<LLLL>; or blanked (see above).
3009-3016	8	A	Averaged rotation angle around the yaw axis (expressed in 10^{-6} degrees) : = "±<YYYYYY>$"; or blanked (see above).
3017-3024	8	A	Averaged rotation angle around the roll axis (same unit as for bytes 3009 to 3016) : = "±<RRRRRR>$"; or blanked (see above).
3025-3032	8	A	Averaged rotation angle around the pitch axis (same unit as for bytes 3009 to 3016) : = "± <PPPPPP>$" ; or blanked (see above).
			Angular value of attitude at the end of the scene (those of the P or M scene when merged products)
3033-3064	32	A	Same as bytes 3001 to 3032
			HRV LOOK ANGLES with improved accuracy (those of the P or M scene when merged products)
3065-3076	12	A	Ψ_X angle for the first detector of the CCD array (= last pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).
3077-3088	12	A	Ψ_X angle for the last detector of the CCD array (= first pixel of the scan line) : = "±< DDD><MM><SS.SS>$" (same conventions as bytes 2461 to 2468).
3089-3100	12	A	Ψ_y angle for the first detector of the CCD array (= last pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).
3101-3112	12	A	Ψ_y angle for the last detector of the CCD array (= first pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).
3113-3124	12	A	*Y_X angle for first detector of the odd SWIR CCD array (= last pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).*
3125-3136	12	A	*Y_X for the last detector of the odd SWIR CCD array (=first pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).*
3137-3148	12	A	*Y_y angle for first detector of the odd SWIR CCD array (=last pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).*

TABLE 7.3 **LEADER File** **EPHEMERIS / ATTITUDE Record**

BYTES : 3149 to 3300

Position	Length (bytes)	Type	Definitions, explanations and contents
3149-3160	12	A	*Y_y angle for last detector of the odd SWIR CCD array (=first pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same conventionas bytes 2461 to 2468).*
3161-3172	12	A	*Y_X angle for the first detector of the even SWIR CCD array if level 0 or 1A not registered, else filled with blanks (=last pixel of the scan line) : = "±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).*
3173-3184	12	A	*Y_X angle for the last detector of the even SWIR CCD array if level 0 or 1A not registered, else filled with blanks (=first pixel of the scan line) : = " ±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).*
3185-3196	12	A	*Y_y angle for the first detector of the even SWIR CCD array if level 0 or 1A not registered, else filled with blanks (=last pixel of the scan line) : = " ±<DDD><MM><SS.SS>$" (same convention as bytes 2461 to 2468).*
3197-3208	12	A	*Y_y angle for the last detector of the even SWIR CCD array if level 0 or 1A not registered, else filled with blanks (=first pixel of the scan line) : = " ±<DDD><MM><SS.SS>$" (same conventionas bytes 2461 to 2468).*
			ORBITAL BULLETIN (blanks for SPOT 1, 2, 3)
3209-3220	12	N	*Date in Julian days and seconds : = "$$<JJJJJ><SSSSS>*
3221-3232	12	N	*Semi major axis (in meters) of the ellipse : = "$$<XXXXXXX . XX>"*
3233-3248	16	N	*E_X component of the ellipse eccentricity vector : = "$$±<. XXXXXXXX>E±<YY>"*
3249-3264	16	N	*E_Y component of the ellipse eccentricity vector : = "$$±<. XXXXXXXX>E±<YY>"*
3265-3276	12	N	*Inclination of the ellipse(expressed in radians) : = "$$<X . XXXXXXXX>"*
3277-3288	12	N	*Right ascension of ascending node (in radians) : = "$$<X . XXXXXXXX>"*
3289-3300	12	N	*Lattitude argument (expressed in radians) : = "$$<X . XXXXXXXX>"*

TABLE 7.3 **LEADER File** **EPHEMERIS / ATTITUDE Record**

BYTES : 3301 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
			P7, P8, P9, P10 allow to compute the atmospheric density at time T:
3301-3316	16	N	*P7 (expressed in m $^{-1}$) : = "$$±<. XXXXXXXX>E±<YY>"*
3317-3332	16	N	*P8 (expressed in $^{-1}$) : = "$$±<. XXXXXXXX>E±<YY>"*
3333-3344	12	N	*P9 (expressed in radians) : = "$$<X . XXXXXXXX>"*
3345-3360	16	N	*P10 (expressed in $^{-1}$) : = "$$±<. XXXXXXXX>E±<YY>"*
3361-3368	8	N	Major frame counter value at the beginning of the segment : = "$<NNNNNNN>"
3369-3376	8	N	Major frame counter value at the beginning of the scene : = "$<NNNNNNN>"
3377-3384	8	N	Major frame counter value at the end of the segment : = "$<NNNNNNN>"
			Relation between board time and U.T. :
			For SPOT 1,2 or 3, the following parameters are optional and, when available, the "UT date" is rounded to one second, leading to a loss of accuracy.
			For SPOT 4, these parameters are extracted from the telemetry received from the satellite, and the "UT date" is given for an actual integer second, with the accuracy of one millisecond.
3385-3396	12	N	U.T. date, in Julian days and seconds : = "$$<JJJJJ><SSSSS>"
3397-3408	12	N	Value of the On Board Clock at the date above : = "$$<XXXXXXXXXX>"
3409-3420	12	N	On Board Clock period (in pico seconds) : = "<XXXXXXXXXXX>"
3421-3432	12	N	On Board time for the current scene : = "$$<XXXXXXXXXX>"
3433-3960	528	N	Not significant.

TABLE 7.4 **LEADER File** **RADIOMETRIC CALIBRATION Record**

7.4 ANCILLARY "RADIOMETRIC CALIBRATION"

The 16 ancillary "Radiometric Calibration" Records are explained in the following Table 7.4.

In P *or M* mode:

1	:	Gains for pixels	1	to	1500	of the scan line
2	:	Gains for pixels	1501	to	3000	of the scan line
3	:	Gains for pixels	3001	to	4500	of the scan line
4	:	Gains for pixels	4501	to	6000	of the scan line
5	:	Offsets (or "dark current") for pixels	1	to	1500	of the scan line
6	:	Offsets (or "dark current") for pixels	1501	to	3000	of the scan line
7	:	Offsets (or "dark current") for pixels	3001	to	4500	of the scan line
8	:	Offsets (or "dark current") for pixels	4501	to	6000	of the scan line
9-16	:	Not significant.				

In X mode:

1	:	Gains for pixels	1	to	1500	band 1
2	:	Gains for pixels	1501	to	3000	band 1
3	:	Gains for pixels	1	to	1500	band 2
4	:	Gains for pixels	1501	to	3000	band 2
5	:	Gains for pixels	1	to	1500	band 3
6	:	Gains for pixels	1501	to	3000	band 3
7	:	Offsets (or "dark current") for pixels	1	to	1500	band 1
8	:	Offsets (or "dark current") for pixels	1501	to	3000	band 1
9	:	Offsets (or "dark current") for pixels	1	to	1500	band 2
10	:	Offsets (or "dark current") for pixels	1501	to	3000	band 2
11	:	Offsets (or "dark current") for pixels	1	to	1500	band 3
12	:	Offsets (or "dark current") for pixels	1501	to	3000	band 3
13-16	:	Not significant.				

In I mode:

1	*:*	*Gains for pixels*	*1*	*to*	*1500*	*band 1*
2	*:*	*Gains for pixels*	*1501*	*to*	*3000*	*band 1*
3	*:*	*Gains for pixels*	*1*	*to*	*1500*	*band 2*
4	*:*	*Gains for pixels*	*1501*	*to*	*3000*	*band 2*
5	*:*	*Gains for pixels*	*1*	*to*	*1500*	*band 3*
6	*:*	*Gains for pixels*	*1501*	*to*	*3000*	*band 3*
7	*:*	*Gains for pixels*	*1*	*to*	*1500*	*band 4*
8	*:*	*Gains for pixels*	*1501*	*to*	*3000*	*band 4*
9	*:*	*Offsets (or "dark current") for pixels*	*1*	*to*	*1500*	*band 1*
10	*:*	*Offsets (or "dark current") for pixels*	*1501*	*to*	*3000*	*band 1*
11	*:*	*Offsets (or "dark current") for pixels*	*1*	*to*	*1500*	*band 2*
12	*:*	*Offsets (or "dark current") for pixels*	*1501*	*to*	*3000*	*band 2*
13	*:*	*Offsets (or "dark current") for pixels*	*1*	*to*	*1500*	*band 3*
14	*:*	*Offsets (or "dark current") for pixels*	*1501*	*to*	*3000*	*band 3*
15	*:*	*Offsets (or "dark current") for pixels*	*1*	*to*	*1500*	*band 4*
16	*:*	*Offsets (or "dark current") for pixels*	*1501*	*to*	*3000*	*band 4*

The 16 records are blanks for mixed products (P+X, *M+X, M+I*).

TABLE 7.4 **LEADER File** **RADIOMETRIC CALIBRATION Record**

BYTES : 1 to 16

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 4 to 19
5	1	B	1st Record Sub-type Code (Radiometric Calib. code) : = "3F" (Hexadecimal)
6	1	B	Record Type Code : = "24" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	Radiometric calibration record sequence number := "$$<NN >", where NN equals: for P *or M* mode: 1 for gains for pixels 1 to 1500 2 for gains for pixels 1501 to 3000 3 for gains for pixels 3001 to 4500 4 for gains for pixels 4501 to 6000 5 for dark current for pixels 1 to 1500 6 for dark current for pixels 1501 to 3000 7 for dark current for pixels 3001 to 4500 8 for dark current for pixels 4501 to 6000 9 to 16, for blank records for X mode: 1 for gains for pixels 1 to 1500 band 1 2 for gains for pixels 1501 to 3000 band 1 3 for gains for pixels 1 to 1500 band 2 4 for gains for pixels 1501 to 3000 band 2 5 for gains for pixels 1 to 1500 band 3 6 for gains for pixels 1501 to 3000 band 3 7 for dark current for pixels 1 to 1500 band 1 8 for dark current for pixels 1501 to 3000 band 1 9 for dark current for pixels 1 to 1500 band 2 10 for dark current for pixels 1501 to 3000 band 2 11 for dark current for pixels 1 to 1500 band 3 12 for dark current for pixels 1501 to 3000 band 3 13 to 16 for blank records

TABLE 7.4 **LEADER File** **RADIOMETRIC CALIBRATION Record**

BYTES : 16 to 32

Position	Length (bytes)	Type	Definitions, explanations and contents
			for I mode: *1 for gains for pixels 1 to 1500 band 1* *2 for gains for pixels 1501 to 3000 band 1* *3 for gains for pixels 1 to 1500 band 2* *4 for gains for pixels 1501 to 3000 band 2* *5 for gains for pixels 1 to 1500 band 3* *6 for gains for pixels 1501 to 3000 band 3* *7 for gains for pixels 1 to 1500 band 4* *8 for gains for pixels 1501 to 3000 band 4* *9 for dark current for pixels 1 to 1500 band 1* *10 for dark current for pixels 1501 to 3000 band 1* *11 for dark current for pixels 1 to 1500 band 2* *12 for dark current for pixels 1501 to 3000 band 2* *13 for dark current for pixels 1 to 1500 band 3* *14 for dark current for pixels 1501 to 3000 band 3* *15 for dark current for pixels 1 to 1500 band 4* *16 for dark current for pixels 1501 to 3000 band 4*
17-20	4	A	Blanks
21-24	4	A	Spectral band number corresponding to the gains or dark currents in this record. = "<N>$$$" (N = "0" if P *or M* mode)
25-28	4	A	Indicates whether this record contains "gains" or "dark current". = "1$$$" for "gains", = "2$$$ " for "dark current".
29-32	4	N	Pixel number within the scan line corresponding to the first value of gain (or dark current) in this record : For P *or M* mode : $$$1 if record sequence number = 1 or 5 1501 if record sequence number = 2 or 6 3001 if record sequence number = 3 or 7 4501 if record sequence number = 4 or 8 $$$$ if record sequence number = 9, 10, 11, 12, 13, 14, 15, 16 For X mode : $$$1 if record sequence number = 1,3, 5, 7, 9, 11 1501 if record sequence number = 2, 4, 6, 8, 10, 12 $$$$ if record sequence number = 13, 14, 15, 16 *For I mode :* *$$$1 if record sequence number = 1,3, 5, 7, 9, 11, 13, 15* *1501 if record sequence number = 2, 4, 6, 8, 10, 12, 14, 16*

TABLE 7.4 **LEADER File** **RADIOMETRIC CALIBRATION Record**

BYTES : 33 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
33-36	4	A	Not significant.
37-40	4	N	Pixel number within the scan line corresponding to the last value of gain (or dark current) in this record : For P *or M* mode : 1500 if record sequence number = 1 or 5 3000 if record sequence number = 2 or 6 4500 if record sequence number = 3 or 7 6000 if record sequence number = 4 or 8 $$$$ if record sequence number = 9, 10, 11, 12, 13, 14, 15, 16 For X mode : 1500 if record sequence number = 1,3, 5, 7, 9, 11 3000 if record sequence number = 2, 4, 6, 8, 10, 12 $$$$ if record sequence number = 13, 14, 15, 16 *For I mode :* *1500 if record sequence number = 1,3, 5, 7, 9, 11, 13, 15* *3000 if record sequence number = 2, 4, 6, 8, 10, 12, 14, 16*
41-44	4	A	Not significant.
45-48	4	N	Number of out of range detectors : = "<NNNN>"
49-56	8	A	Relative calibration date for that spectral band. : ="<DD><MM><YYYY>"
57-60	4	A	Not significant.
61-3060	3000	B	1500 values of the gains or dark currents for the gain number used for this spectral band of this SPOT scene. These coefficients are those which have been used to perform the equalization correction for this spectral band of this SPOT scene. Each of them corresponds to one pixel in the raw image scan line. They are arranged in increasing pixel number order. Each of them is binary encoded as a positive integer number on a 16 bits word after having been multiplied by : 10 for a dark current c 10^4 for a gain g **The gain values corresponding to out of order detectors are set to zero**. Each binary value is right justified within the 16 bits word, the leftmost bit being the most significant. The radiance count after radiometric equalization correction, X is given by the following formula : $X = \frac{x-c}{g}$ where x is the raw value in input.
3061-3960	900	A	Not significant.

TABLE 7.5 **LEADER File** **MODELIZATION Record**

7.5 ANCILLARY "MODELIZATION"

This record is explained in the following Table 7.5.

BYTES : 1 to 240

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 20
5	1	B	1st Record Sub-type Code (Modelization code) : = "08" (Hexadecimal)
6	1	B	Record Type Code : = "15" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "30" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "23" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	Modelization Record sequence number : = "$$$1"
			Scene position in the segment
17-24	8	N	First pixel of the raw scene in the raw segment : = "$<XXXXXXX>
25-32	8	N	First line of the raw scene in the raw segment : = "$<XXXXXXXXX>
33-40	8	N	First pixel of the level 1B scene in the level 1B segment : = "$<XXXXXXX>"
41-48	8	N	First line of the level 1B scene in the level 1B segment : = "$<XXXXXXX>"
49 - 80	32	A	Not significant.
			Attitude Model *The attitude model is :* $Dl = a_l * a(l) + b_l * b(l) + c_l * g(l)$ $Dp = a_p * a(l) + b_p * b(l) + c_p * g(l)$ *where* $a_l, b_l, c_l, a_p, b_p, c_p$ *are constant for all the segment and where* $a(l), b(l), g(l)$ *are the values of the attitude for the line number l.*
81-96	16	N	Coefficient a_l : = "$±<X.XXXXXXXX>E±<XX>"
97 - 112	16	A	Coefficient b_l : = "$±<X.XXXXXXXX>E±<XX>"
113-128	16	N	Coefficient c_l : = "$±<X.XXXXXXXX>E±<XX>"
129-144	16	N	Coefficient a_p : = "$±<X.XXXXXXXX>E±<XX>"
145-160	16	N	Coefficient b_p : = "$±<X.XXXXXXXX>E±<XX>"
161-176	16	N	Coefficient c_p : = "$±<X.XXXXXXXX>E±<XX>"
177-192	16	A	Not significant.
			Coefficients for coordinates normalization *All the variables (i, j, l, p) are centered and normalized, like :* $i' = \frac{i - i_m}{\Delta_i}$ *where :* i_m *: mean value for the viewing segment for variable i* D_i *: interval half-width for variable i*
193 - 208	16	N	Mean value for lines (i_m) : = "$$$$$$<XXXXXX . XXX>"
209-224	16	N	Interval half-width for lines (Δ_i) : = "$$$$$$<XXXXXX . XXX>"
225-240	16	N	Mean value for column (j_m) : = "$$$$$$<XXXXXX . XXX>"

TABLE 7.5 **LEADER File** **MODELIZATION Record**

BYTES : 241 to 688

Position	Length (bytes)	Type	Definitions, explanations and contents
241-256	16	N	Interval half-width for column (Δ_j) : = "$$$$$$<XXXXXX . XXX>"
257-272	16	N	Mean value for line l_m : = "$$$$$$<XXXXXX . XXX>"
273-288	16	N	Interval half-width for lines (Δ_l) : = "$$$$$$<XXXXXX . XXX>"
289-304	16	N	Mean value for column (p_m) : = "$$$$$$<XXXXXX . XXX>"
305-320	16	N	Interval half-width for column (Δ_p) : = "$$$$$$<XXXXXX . XXX>"
321-336	16	N	Not significant.
			Direct Level 1B models *Allow to transform coordinates in raw scene to coordinates in level 1B scene.* *Models are :* $i' = I(l')$ $j' = \frac{J(p') + B(i')}{A(i')}$ *These models are used on centered and normalized coordinates.* *I, J : respectively 5,3 degree polynomial* *A,B : respectively 4,5 degree polynomial*
337-352	16	N	Constant term of I : = "±<XX . XXX XXX XXX XX>$"
353-368	16	N	Coefficient of the 1srt degree term of I : = "±<XX . XXX XXX XXX XX>$"
369-384	16	N	Coefficient of the 2nd degree term of I : = "±<XX . XXX XXX XXX XX>$"
385-400	16	N	Coefficient of the 3rd degree term of I : = "±<XX . XXX XXX XXX XX>$"
401-416	16	N	Coefficient of the 4th degree term of I : = "±<XX . XXX XXX XXX XX>$"
417-432	16	N	Coefficient of the 5th degree term of I : = "±<XX . XXX XXX XXX XX>$"
433-448	16	N	Constant term of J : = "±<XX . XXX XXX XXX XX>$"
449-464	16	N	Coefficient of the 1srt degree term of J : = "±<XX . XXX XXX XXX XX>$"
465-480	16	N	Coefficient of the 2nd degree term of J : = "±<XX . XXX XXX XXX XX>$"
481-496	16	N	Coefficient of the 3rd degree term of J : = "±<XX . XXX XXX XXX XX>$"
497-512	16	N	Constant term of A : = "±<XX . XXX XXX XXX XX>$"
513-528	16	N	Coefficient of the 1srt degree term of A : = "±<XX . XXX XXX XXX XX>$"
529-544	16	N	Coefficient of the 2nd degree term of A : = "±<XX . XXX XXX XXX XX>$"
545-560	16	N	Coefficient of the 3rd degree term of A : = "±<XX . XXX XXX XXX XX>$"
561-576	16	N	Coefficient of the 4th degree term of A : = "±<XX . XXX XXX XXX XX>$"
577-592	16	N	Constant term of B : = "±<XX . XXX XXX XXX XX>$"
593-608	16	N	Coefficient of the 1st degree term of B : = "±<XX . XXX XXX XXX XX>$"
609-624	16	N	Coefficient of the 2nd degree term of B : = "±<XX . XXX XXX XXX XX>$"
625-640	16	N	Coefficient of the 3rd degree term of B : = "±<XX . XXX XXX XXX XX>$"
641-656	16	N	Coefficient of the 4th degree term of B : = "±<XX . XXX XXX XXX XX>$"
657-672	16	N	Coefficient of the 5th degree term of B : = "±<XX . XXX XXX XXX XX>$"
673-688	16	A	Not significant.

TABLE 7.5 **LEADER File** **MODELIZATION Record**

BYTES : 689 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
			Reverse Level 1B models
			Allow to transform coordinates in level 1B scene to coordinates in raw scene.
			Models are : $l' = L(i')$
			$p' = P (A(i') * j' - B(i'))$
			These models are used on centered and normalized coordinates.
			L,P : respectively 5, 3 degree polynomial
			A,B : (Same as for Direct level 1B model)
689-704	16	N	Constant term of L : = "±<XX . XXX XXX XXX XX>$"
705-720	16	N	Coefficient of the 1srt degree term of L : = "±<XX . XXX XXX XXX XX>$"
721-736	16	N	Coefficient of the 2nd degree term of L : = "±<XX . XXX XXX XXX XX>$"
737-752	16	N	Coefficient of the 3rd degree term of L : = "±<XX . XXX XXX XXX XX>$"
753-768	16	N	Coefficient of the 4th degree term of L : = "±<XX . XXX XXX XXX XX>$"
769-784	16	N	Coefficient of the 5th degree term of L : = "±<XX . XXX XXX XXX XX>$"
785-800	16	N	Constant term of P : = "±<XX . XXX XXX XXX XX>$"
801-816	16	N	Coefficient of the 1srt degree term of P : = "±<XX . XXX XXX XXX XX>$"
817-832	16	N	Coefficient of the 2nd degree term of P : = "±<XX . XXX XXX XXX XX>$"
833-848	16	N	Coefficient of the 3rd degree term of P : = "±<XX . XXX XXX XXX XX>$"
849-864	16	A	Not significant.
			SWIR registration model
			This model represents the shift in raw scene of odd SWIR pixels relative to even SWIR pixels.
			$Dl = a_l + b_l * l + c_l * p$
			$Dp = a_p + b_p * l + c_p * p$
			$a_l, b_l, c_l, a_p, b_p, c_p$ *are constant for all the segment.*
865-880	16	N	*Coefficient* a_l *: = "$±<X.XXXXXXXX> E±<XX>"*
881-896	16	N	*Coefficient* b_l *: = "$±<X.XXXXXXXX > E±<XX>"*
897-912	16	N	*Coefficient* c_l *: = "$±<X.XXXXXXXX > E±<XX>"*
913-928	16	N	*Coefficient* a_p *: = "$±<X.XXXXXXXX > E±<XX>"*
929-944	16	N	*Coefficient* b_p *: = "$±<X.XXXXXXXX > E±<XX>"*
945-960	16	N	*Coefficient* c_p *: = "$±<X.XXXXXXXX > E±<XX>"*
961-976	16	A	Not significant.
			Reverse Simplified Location Model
			$i = a + b* f + c* l + d* f* l + e* f^2 + f* l^2$
			$j = a' + b'* f + c'* l + d'* f* l + e'* f^2 + f'* l^2$
			(i,j): pixel coordinates within the processed image (line nr., pixel nr.)
			(j , l) : latitude and longitude of the pixel (i,j) (in decimal degrees).
977-992	16	N	Coefficient a : =”$$$±<N.NNNNNN>E±<XX>
993-1008	16	N	Coefficient b : same as bytes 977 - 992
1009-1024	16	N	Coefficient c : same as bytes 977 - 992
1025-1040	16	N	Coefficient d : same as bytes 977 - 992
1041-1056	16	N	Coefficient e : same as bytes 977 - 992
1057-1072	16	N	Coefficient f : same as bytes 977 - 992
1073-1168	96	N	Coefficients a’, b’, c’, d’, e’, f’ : same as bytes 977 to 1072
1169-3960	2792	A	Not significant

TABLE 7.6 **LEADER File** **GROUND CONTROL POINT Record**

7.6 ANCILLARY "GROUND CONTROL POINTS"

Only the fields describing the record type are explained in the following table 7.6.

BYTES : 1 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 21
5	1	B	1st Record Sub-type Code (Ground Control Point code) : = "09" (Hexadecimal)
6	1	B	Record Type Code : = "24" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	G.C.P. Record sequence number : = "$$$1"
17-3960	3944	A	Not significant .

TABLE 7.7 **LEADER File** **HISTOGRAM Record**

7.7 ANCILLARY "HISTOGRAM"

The 4 ancillary "Histogram" records are explained in the following Table 7.7.

In P *or M* mode:
1 - Histogram of the panchromatic scene
2 - Not significant.
3 - Not significant.
4 - Not significant.

In X mode :
1 - Histogram of the band 1 image
2 - Histogram of the band 2 image
3 - Histogram of the band 3 image
4 - Not significant.

In I mode :
1 - Histogram of the band 1 image
2 - Histogram of the band 2 image
3 - Histogram of the band 3 image
4 - Histogram of the band 4 image.

BYTES : 1 to 24

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 22 to 25
5	1	B	1st Record Sub-type Code (Histogram code) : = "C0" (Hexadecimal)
6	1	B	Record Type Code : = "24" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	Histogram record sequence number : = "$$$<N>" where: for P *or M* mode: N = 1 for histogram N = 2 for blank record N = 3 for blank record N = 4 for blank record for X mode: N = 1 for histogram of band 1 N = 2 for histogram of band 2 N = 3 for histogram of band 3 N = 4 for blank record *for I mode: N = 1 for histogram of band 1* *N = 2 for histogram of band 2* *N = 3 for histogram of band 3* *N = 4 for histogram of band 4*
17-20	4	A	Blanks.
21-24	4	A	Spectral band number : ="<N>$$$" ("0" for P*or M* ; "1", "2", "3" *or "4* " for X *or I*)

TABLE 7.7 **LEADER File** **HISTOGRAM Record**

BYTES : 25 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
25-26	2	N	Rate of sub-sampling along columns ,when computing the histogram : one line every NN lines : = "<NN>"
27-28	2	A	Not significant.
29-30	2	N	Rate of sub-sampling along lines when computing the histogram : one pixel every PP pixels : = "<PP>"
31-32	2	A	Not significant.
33-2080	2048	N	256 values of the histogram. Each value contains the amount of sub-sampled image pixels having a given count. Each = "<HHHHHHHH>"
2081-2102	22	A	Not significant.
2103-2174	72	N	The 9 coefficients for deconvolution along the line. Each = "$$ ± <C.CCC>"
2175-2246	72	N	The nine coefficients for deconvolution along the raw columns. Same coding as bytes 2103 to 2174. *<u>Remark</u> : These coefficients are given for every processing levels. Except for merged products, they correspond to the deconvolution which has been actually applied to get the data in the IMAGERY FILE. They are related to the spectral band referenced in bytes 21 to 24.*
2247-2470	224	A	Not significant.
2471-2478	8	N	Lower threshold for Dynamic Stretched Product : ="$$$$$< LLL>"
2479-2486	8	N	Upper threshold for Dynamic Stretched Product : = "$$$$$ <UUU>"
			SPECTRAL SENSITIVITIES *The spectral sensitivities of instrument HRV, corresponding to the current scene, are given for the current spectral band, starting from the smallest wave-length, with a sampling rate given in bytes 2487 to2490 (Not significant. for merged products).*
2487-2494	8	N	Value of the first wave-lentgh (in micrometers) : ="$$$<N.NNN>"
2495-2498	4	N	Wave-length step (in nanometers) : = "<N.NN>"
2499-2503	5	N	First value of spectral sensitivities : = "<X.XXX>"
2504-2818	63*5	N	Spectral Sensitivities for the 63 others coefficients
			NORMAL SOLAR EQUIVALENT IRRADIANCE *Thoses values are given for instrument HRV, corresponding to the current scene, for the current spectral band (Not significant. for merged products).*
2819 - 2822	4	N	Normal solar equivalent irradiance for the current spectral band : = "<NNNN>"
2823-3960	1138	A	Not significant.

TABLE 7.7 **LEADER File** **MAP PROJECTION Record**

7.8 ANCILLARY "MAP PROJECTION"

The fields of the "Map Projection" record are explained in the following Table 7.8.

BYTES : 1 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 26
5	1	B	1st Record Sub-type Code (Map Projection code) : = "24" (Hexadecimal)
6	1	B	Record Type Code : = "24" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	MAP PROJECTION Record sequence number : = "$$$1"
17-20	4	A	Not significant.
21-52	32	A	A 32 character string identifying the Map Projection used for Level 2A (Not significant. for other levels)
53-56	4	A	Not significant.
57-88	32	A	A 32 character string identifying the reference Ellipsoid used for the Level 2A map projection (Not significant. for other levels).
89-92	4	A	Not significant.
93-98	6	N	The rectification altitude above IAG-GRS-80 which has been used for the rectification : ="<AAAA.A>" (for level 2A, Not significant. for other levels).
99-100	2	A	Not significant.
101-132	32	A	A 32 character string identifying the geodetic system used in the map projection for the level 2A (Not significant. for other levels).
133-3960	3828	A	Not significant.

TABLE 7.9 **LEADER File** **ANNOTATIONS Record**

7.9 ANNOTATIONS

The annotation record is explained in Table 7.9.

BYTES : 1 to 592

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 27
5	1	B	1st Record Sub-type Code (Annotations code) : = "12" (Hexadecimal)
6	1	B	Record Type Code : = "DB" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 3960 bytes).
13-16	4	N	ANNOTATION Record sequence number : = "$$$1"
17-20	4	N	Number of annotations segments in this record : = "$$$3"
21-52	32	A	Not significant.
			TITLE DEFINITION ***(For precision film recorder)***
53-56	4	N	Number of bytes of this segment : ="$180"
57-60	4	N	Number of bytes in the "TITLE" character string : ="$$36"
61-64	4	A	Identifier for this segment : ="VT$$"
65-120	56	A	Not significant.
121-156	36	A	A 36 character string containing the "Title" on the film.
157-232	76	A	Not significant.
			LINE 1 FOR PRECISION FILM RECORDER
233-236	4	N	Number of bytes of this segment : ="$360"
237-240	4	N	Number of bytes in this line character string : ="$$98"
241-244	4	A	Identifier for this segment : = "VZ1$"
245-300	56	A	Not significant.
301-398	98	A	A 98 character string containing the 1st line of film annotations.
399-592	194	A	Not significant.

TABLE 7.9 **LEADER File** **ANNOTATIONS Record**

BYTES : 593 to 2264

Position	Length (bytes)	Type	Definitions, explanations and contents
			LINE 2 FOR PRECISION FILM RECORDER
593-596	4	N	Number of bytes of this segment : = "$540"
597-600	4	N	Number of bytes in this line character string : = "$$60"
601-604	4	A	Identifier for this segment : = "VZ2$"
605-660	56	A	Not significant.
661-720	60	A	A 60 character string containing the 2nd line of film annotations.
721-1132	412	A	Not significant.
1133-1716	584	A	Not significant.
			GEOGRAPHIC REFERENCE MARKS (General)
1717-1720	4	N	Number of segments "Geographic Reference Marks" in this record : = "$$$4"
1721-1722	2	N	Number of bytes in the geographic character string : = "$8"
1723-1724	2	A	Not significant.
			TOP GEOGRAPHIC REFERENCE MARK
1725-1728	4	A	Type of mark identifier : = "HAUT" (for TOP)
1729-1730	2	N	Number of Top marks : = "<NN>"
			First Top Mark
1731-1735	5	N	Position (line number) : = "<LLLLL>" (may be positive or negative)
1736-1740	5	N	Position (column number) : = "<CCCCC>" (may be positive or negative)
1741-1748	8	A	Geographic annotation (8 character string).
			Second Top Mark
1749-1753	5	N	Same as for bytes 1731 to 1735
1754-1758	5	N	Same as for bytes 1736 to 1740
1759-1766	8	A	Same as for bytes 1741 to 1748
1767	.	.	***Others Top Mark***
to 2252	.	.	Same as for bytes 1731 to 1735, 1736 to 1740, and 1741 to 1748
2253-2264	12	A	Not significant.

TABLE 7.9 **LEADER File** **ANNOTATIONS Record**

BYTES : 2265 to 3960

Position	Length (bytes)	Type	Definitions, explanations and contents
			LEFT GEOGRAPHIC REFERENCE MARK
2265-2268	4	A	Type of mark identifier : "GAUC" (for LEFT)
2269-2270	2	N	Number of Left marks : = "<NN>"
2271-2792	522	A	**Left Marks** : Same as for bytes 1731 to 1735, 1736 to 1740, and 1741 to 1748
2793-2804	12	A	Reserved
			RIGHT GEOGRAPHIC REFERENCE MARK
2805-2808	4	A	Type of mark identifier : "DROI" (for RIGHT)
2809-2810	2	A	Number of Right marks : = "<NN>"
2811-3332	522	A	**Right Marks** : Same as for bytes 1731 to 1735, 1736 to 1740, and 1741 to 1748
3333-3344	12	A	Reserved
			BOTTOM GEOGRAPHIC REFERENCE MARK
3345-3348	4	A	Type of mark identifier : "BAS$" (for BOTTOM)
3349-3350	2	N	Number of Bottom marks : = "<NN>"
3351-3872	522	A	**Bottom Marks** : Same as for bytes 1731 to 1735, 1736 to 1740, and 1741 to 1748
3873-3884	12	A	Reserved
3885-3960	76	A	Not significant.

TABLE 8.1 **IMAGERY File** **FILE DESCRIPTOR Record**

8. IMAGERY FILE'S RECORD

8.1 IMAGERY FILE DESCRIPTOR

The File Descriptor Record for the Imagery File is explained in the following Table 8.1.

BYTES : 1 to 76

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 1
5	1	B	1st Record Sub-type Code (File Descriptor code) : = "3F" (Hexadecimal)
6	1	B	Record Type Code : = "C0" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 5400, 8640, 10980 or 12240 bytes).
13-14	2	A	Flag indicating that the alphanumeric information in this file is in ASCII. (= "A$" where $ denotes an ASCII blank).
15-16	2	A	Blanks (="$$").
17-28	12	A	Reference of the document which specifies the format of this data file. (= "S4-ST-73-1-SI")
29-30	2	A	Revision number of the document referenced in bytes 17 to 28.(= <NN>)
31-32	2	A	Revision letter of the file format (= <NN>)
33-44	12	A	Reference of the software version used to write the file.(=<AAAAAAAAAAAA>)
45-48	4	N	Sequence number of this file within the logical volume (excluding the Volume Directory file, the sequential number of which is 0).: = "$$$2"
49-64	16	A	Identification of the present file, as stated in bytes 21 to 36 of the File Pointer Record of the Volume Directory ; ="SP<N>$<MPP>$IMGYBIL$" where, N : Satellite Number (= "1", "2", "3", "4", etc...) M : Spectral mode of the product ("P", "X", *"M" or "I"*) PP : Preprocessing Level ("1A", "1B" or "2A")
65-68	4	A	Indicates that the following records in the file have sequence numbers, also called "Record Numbers" (="FSEQ")
69-76	8	N	Byte number within the record, of the 1st byte of the field "Record Number" (= "$$$$$$$1")

TABLE 8.1 **IMAGERY File** **FILE DESCRIPTOR Record**

BYTES : 77 to 216

Position	Length (bytes)	Type	Definitions, explanations and contents
77-80	4	N	Length, in bytes, of the field "Record Number" (= "$$$4")
81-84	4	A	Indicates that the following records in the file have a "Record Type Code", and that the location of the code is fixed (="FTYP")
85-92	8	N	Byte number within the record, of the 1st byte of the field "Record Type Code" (= "$$$$$$$5")
93-96	4	N	Length, in bytes, of the field "Record Type Code" (= "$$$4")
97-100	4	A	Indicates that the "Record Length" of the records of the file is written at a fixed location in each record of the file (= "FLGT")
101-108	8	N	Byte number, within the record, of the 1st byte of the field "Record Length" (= "$$$$$$$9")
109-112	4	N	Length, in bytes, of the field "Record Length" (= "$$$4")
113	1	A	Indicates that data interpretation information is included in this File Descriptor Record (= "Y", for YES)
114	1	A	Indicates that data interpretration information is not included in the other records of this file (= "N" for NO)
115	1	A	Indicates that information necessary to display the file is included in this File Descriptor Record (= "Y" for Yes).
116	1	A	Indicates that information necessary to display the file is not included in the other records of this file (="N" for NO)
117-180	64	A	Not significant.
181-186	6	N	Number of image records (Number of lines X Number of spectral bands) : = "<NNNNNN>"
187-192	6	N	Image record length : = "$$5400" or "$$8640" or "$10980" or "$12240"
193-216	24	A	Not significant.

TABLE 8.1 **IMAGERY File** **FILE DESCRIPTOR Record**

BYTES : 217 to 268

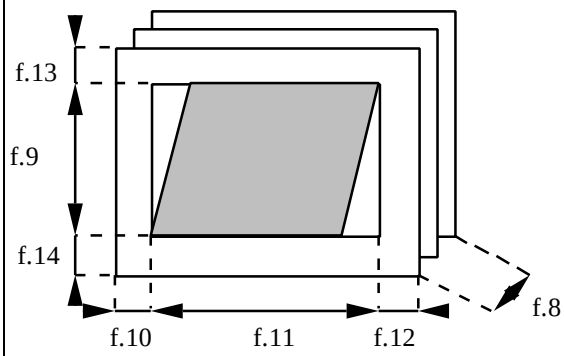
Position	Length (bytes)	Type	Definitions, explanations and contents
			PIXEL GROUP DATA
217-220	4	N	Number of bits per pixel : = "$$$8"
221-224	4	N	Number of pixel per data group : = "$$$1"
225-228	4	N	Number of bytes per data group : = "$$$1"
229-232	4	A	Justification and order of pixels within data group : = "$$$$", i.e. pixel value length fall on byte boundaries).
			IMAGE DATA  *This diagram, used as an example to explain the data parameters, represents a scene of three bands of level 1B corrected image data with borders.* *The numbers f8 to f14 point respectively to the following fields.*
233-236	4	N	(f8) : Number of images (bands) in this file : = "$$$<N>", with N equals with N equals "1" (P*or M*), or "3" (X), *or "4" (I)*.
237-244	8	N	(f9) : Number of lines per image in one band : = "$$$<LLLLL>"
245-248	4	N	(f10) : Number of left border pixels per line : = "$$$0"
249-256	8	N	(f11) : Number of image pixels per line : = "$$$<CCCCC>"
257-260	4	N	(f12) : Number of border pixels to the right of the image. (These pixels set to "zero" pad the image line so that the number of bytes of image data per record remains equal to the value given in bytes 281 to 288 of this record) : = "<NNNN>"
261-264	4	N	(f13) : Number of top border lines : = "$$$0"
265-268	4	N	(f14) : Number of bottom border lines : = "$$$0"

TABLE 8.1 **IMAGERY File** **FILE DESCRIPTOR Record**

BYTES : 269 to 312

Position	Length (bytes)	Type	Definitions, explanations and contents
269-272	4	A	Type of band interleaving : = "BIL$" (for "Band Interleaved by Line")
			RECORD DATA IN THIS FILE
273-274	2	N	Number of physical records per monospectral line = "$1"
275-276	2	N	Number of physical records per multispectral line : = "$1" (P*or M*), or "$3" (X), *or "$4" (I).*
277-280	4	N	Number of bytes of prefix data per record : = "$$20"
281-288	8	N	Number of bytes of image data per record : corresponds to the number of pixels obtained by adding the content of bytes [245-248], [249-256] and [257-260] of this record. For this SPOT Format, this number depends on the "Image Record Length" given in bytes [187-192] of this record : = "$$$$5300" when IM. Rec. Length = 5400 = "$$$$8540" when IM. Rec. Length = 8640 = "$$$10880" when IM. Rec. Length = 10980 = "$$$12140" when IM. Rec. Length = 12240
289-292	4	N	Number of bytes of suffix support data field following the Image data of a record : = "$$28"
293-296	4	A	This flag indicates that Prefix and Suffix are not repeated when the scan line requires more than one physical record : = "$$$$"
			PREFIX / SUFFIX DATA LOCATOR *The following fields are locator fields which point to the position of the data within the image record prefix or suffix. The location is given in 8 bytes coded as follows:* *- 4 bytes : the number of the first byte of the field within the prefix or suffix* *- 2 bytes : gives the field length,* *- 1 byte : "P" or "S" indicates that the information is in the Prefix or in the Suffix,* *- 1 byte : "A" = alphanumeric, "B" = binary, "N" = numeric.*
297-304	8	a	Scan line number locator : = "$$$1$4PB"
305-312	8	A	Spectral band number locator : = "$$$5$4PB"

TABLE 8.1 **IMAGERY File** **FILE DESCRIPTOR Record**

BYTES : 313 to N*

Position	Length (bytes)	Type	Definitions, explanations and contents
313-320	8	A	Major Frame count locator : = "$$$9$4PB" for 1A, "$$$$$$$$" for 1B, 2A
321-328	8	A	Left fill count locator : = "$$13$4PB"
329-336	8	A	Right fill count locator : = "$$17$4PB"
337-368	32	A	Not significant.
369-376	8	A	Scan line quality code locator : = "$$$1$2PB" for 1A, "$$$$$$$$" for 1B, 2A
377-400	24	A	Not significant.
401-432	32	A	Not significant.
			PIXEL DATA DESCRIPTION
433-436	4	N	Number of left-fill bits within pixel : = "$$$0"
437-440	4	N	Number of right-fill bits within pixel : = "$$$0"
441-448	8	N	Maximum data range of pixel (starting from 0) : = "$$$$$254"
449-N*	L**	A	Not significant.

** N = 5400, or 8640 or 10980, or 12240, depending on the image size.*

***L = 4952, or 8192, or 10532, or 11792*

TABLE 8.2 **IMAGERY File** **IMAGE DATA Record**

8.2 IMAGE DATA

One Image line is composed of:

- one image data record, in P or M mode
  or
- three consecutive image data records in X mode
  or
- four consecutive image data records in I mode.

One image data record is organized as described in Figure 8.2.

The image data records are described in Table 8.2.

Nature :	Record ID	Prefix data	Image Data			Suffix data
Bytes :	1 → 12	13 → 32	33	→	5332 8572 10912 12172	5333 → 5400 8573 → 8640 10913 → 10980 12173 → 12240

Figure 8.2

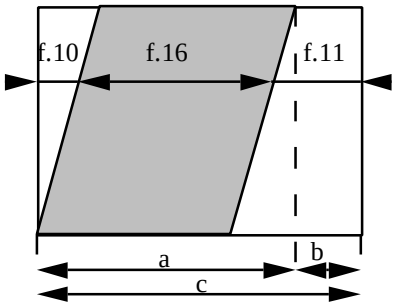
THE IMAGE DATA RECORD LAYOUT

BYTES : 1 to 24

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 2 to R, with R = (number of lines) x (number of spectral bands) + 1
5	1	B	1st Record Sub-type Code (Image Data code) : = "ED" (Hexadecimal)
6	1	B	Record Type Code : = "ED" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 5400, 8640, 10980 or 12240 bytes).
			PREFIX DATA
13-16	4	B	Line number
17-18	2	B	Reserved
19-20	2	B	Spectral band sequence number : = 1 (P*or M*), 1, 2 or 3 (X), *1, 2, 3 or 4 (I)*
21-24	4	B	Major frame counter value, coded on 20 bits, right justified. This counter is reset at the beginning of each Imaging Sequence

TABLE 8.2 **IMAGERY File** **IMAGE DATA Record**

BYTES : 25 to N*+68

Position	Length (bytes)	Type	Definitions, explanations and contents
			 *This figure representing a level 1B scene is used as an example for the data parameters. The numbers f10, f16 and f11 point respectively to the bytes [25-28], [n+25, n+28], [29-32] in this image data record. The values of a, b and c correspond to the contents of bytes [249-256], [257-260] and [281-288] in the Imagery File Descriptor Record. Notice that : (content of f10) + (contents of f16)+ (content of f11)* $= a + b = c = 5300$, *or 8540, or 10880, or 12140.*
25-28	4	B	(f 10) Number of left pixel margin which have no correspondant inside the raw image (they are set to zero).
29-32	4	B	(f 11) Number of right pixel margin which have no correspondant inside the raw image (they are set to zero).
			IMAGE DATA
33-N*			Pixel count values. Each value is binary encoded on a byte. The significant values are in the range "1 to 254". A pixel set to zero corresponds to a non significant radiometric (i.e. the radiometric value does not exist for the corresponding pixel in the raw image). The value "255" is reserved for further application.
			SUFFIX DATA
N*+1	1	B	Synchro loss flag : indicates that the corresponding line belongs to a telemetry frame which has been lost or probably degraded at acquisition level. This flag is significant only for the level 1A : = 0 if "ok", = 1 if synchro loss, = 2 if degraded. For the levels 1B and 2A, this flag is set to FF (Hexa.)
N*+2	1	B	Out of range attitude flag : indicates that the corresponding line has been acquired when the satellite attitude was out of range (angular velocities greater than 2.10^{-3} degrees / second). Significant only for the level 1A : = 0 if "ok", = 1 if attitude out of range. Set to FF (Hexa) for the levels 1B and 2A.
N*+3,N*+24	22	B	Reserved (set to zero).
N*+25,N*+28	4	B	(f 16) Line length (number of pixels in the line, which have a corresponding point inside the raw image).
N*+29,N*+68	40	B	Reserved (set to zero).

** N = 5332, or 8572, or 10912, or 12172.*

TABLE 9.1 **TRAILER File** **FILE DESCRIPTOR Record**

9. TRAILER FILE'S RECORDS

9.1 TRAILER FILE DESCRIPTOR

The file descriptor record for the Trailer File is defined in the following Table 9.1.

BYTES : 1 to 84

Position	Length (byte)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 1
5	1	B	1st Record Sub-type Code (File Descriptor code) : = "3F" (Hexadecimal)
6	1	B	Record Type Code : = "C0" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 1080 bytes).
13-14	2	A	Flag indicating that the alphanumeric information in this file is in ASCII. (= "A$" where $ denotes an ASCII blank).
15-16	2	A	Blanks (="$$").
17-28	12	A	Reference of the document which specifies the format of this data file. (= "S4-ST-73-1-SI")
29-30	2	A	Revision number of the document referenced in bytes 17 to 28.(= <NN>)
31-32	2	A	Revision letter of the file format (= <NN>)
33-44	12	A	Reference of the software version used to write the file.(=<AAAAAAAAAAAA>)
45-48	4	N	Sequence number of this file within the logical volume (excluding the Volume Directory file, the sequential number of which is 0).: = "$$$3"
49-64	16	A	Identification of the present file, as stated in bytes 21 to 36 of the File Pointer Record of the Volume Directory ; ="SP<N>$<MPP>$TRAIBIL$" where, N : Satellite Number (= "1", "2", "3", "4", etc...) M : Spectral mode of the product("P", "X", *"M" or "I"*) PP : Preprocessing Level ("1A","1B" or "2A")
65-68	4	A	Indicates that the following records in the file have sequence numbers, also called "Record Numbers" (="FSEQ")
69-76	8	N	Byte number within the record, of the 1st byte of the field "Record Number" (= "$$$$$$$1")
77-80	4	N	Length, in bytes, of the field "Record Number" (= "$$$4")
81-84	4	A	Indicates that the following records in the file have a "Record Type Code", and that the location of the code is fixed (="FTYP")

TABLE 9.1 **TRAILER File** **FILE DESCRIPTOR Record**

BYTES : 85 to 1080

Position	Length (byte)	Type	Definitions, explanations and contents
85-92	8	N	Byte number within the record, of the 1st byte of the field "Record Type Code" (= "$$$$$$$5")
93-96	4	N	Length, in bytes, of the field "Record Type Code" (= "$$$4")
97-100	4	A	Indicates that the "Record Length" of the records of the file is written at a fixed location in each record of the file (= "FLGT")
101-108	8	N	Byte number, within the record, of the 1st byte of the field "Record Length" (= "$$$$$$$9")
109-112	4	N	Length, in bytes, of the field "Record Length" (= "$$$4")
113	1	A	Indicates that data interpretation information is included in this File Descriptor Record (= "Y", for YES)
114	1	A	Indicates that data interpretration information is not included in the other records of this file (= "N" for NO)
115	1	A	Indicates that information necessary to display the file is included in this File Descriptor Record (= "N" for NO).
116	1	A	Indicates that information necessary to display the file is not included in the other records of this file (="N" for NO)
117-180	64	A	Not significant.
181-184	4	N	Number of Trailer Records : = "$$$3"
185-192	8	N	Trailer records length (in bytes) : = "$$$$1080"
193-216	24	A	Not significant.
			The 2 following fields are locator fields which point to the position in the file where various informations may be found. The location of the desired field is given in 16 bytes coded as follows: *-6 bytes : the record number of the record containing the field.* *-6 bytes : the record byte number of the first byte of the field.* *-3 bytes : length of the field, in bytes.* *-1 byte : type of data in the field ("A": alphanumeric, "B": binary, "N": numeric).*
217-232	16	A	Parity error count field locator : = "$$$$$2$$$$21$$4N"
233-248	16	A	Quality code summary map field locator : = "$$$$$2$$$$35200A"
249-1080	832	A	Not significant.

TABLE 9.2 **TRAILER File** **TRAILER-QUALITY Record**

9.2 TRAILER "QUALITY"

The Trailer Record "Quality" is defined in the followingTable 9.2.

BYTES : 1 to 1080

Position	Length (byte)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 2
5	1	B	1st Record Sub-type Code (Trailer code) : = "12" (Hexadecimal)
6	1	B	Record Type Code : = "F6" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 1080 bytes).
13-16	4	N	Trailer record sequence number : = "$$$1"
17-20	4	A	Blanks.
21-24	4	N	Number of write parity errors which have been recovered, when recording the CCT.
25-234	210	A	Not significant.
235-238	4	N	Number of "Geometric Transformation" trailer records : = "$$$1"
239-244	6	N	Length of these records : = "$$1080"
245-274	30	A	Not significant.
275-284	10	A	Not significant.
285-294	10	A	Not significant.
295-1080	786	A	Not significant.

TABLE 9.3 TRAILER File GEOMETRIC TRANSFORMATIONS Record

9.3 GEOMETRIC TRANFORMATIONS

The "Geometric Transformation" record is defined in the following Table 9.3.

BYTES : 1 to 1080

Position	Length (byte)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 3
5	1	B	1st Record Sub-type Code (Trailer code) : = "12" (Hexadecimal)
6	1	B	Record Type Code : = "F6" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "12" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 1080 bytes).
13-16	4	A	Record sequence number within "Geometric Transformations" records:="$$$1"
17-20	4	A	Not significant.
21-1080	1060	A	Not significant.

TABLE 10.1 NULL VOLUME DIRECTORY File NULL VOLUME DESCRIPTOR Record

10. NULL VOLUME DIRECTORY FILE'S RECORD

10.1. NULL VOLUME DESCRIPTOR RECORD

The Null volume descriptor record is described in the following Table 10.1.

BYTES : 1 to 94

Position	Length (bytes)	Type	Definitions, explanations and contents
1-4	4	B	Record Number of this record within the file : = 1
5	1	B	1st Record Sub-type Code (File Descriptor Code) : = "C0" (Hexadecimal)
6	1	B	Record Type Code : = "C0" (Hexadecimal)
7	1	B	2nd Record Sub-type Code : = "3F" (Hexadecimal)
8	1	B	3rd Record Sub-type Code : = "12" (Hexadecimal)
9-12	4	B	Length of this record (= 360 bytes).
13-14	2	A	Flag indicating that the alphanumeric information in this file is in ASCII (= "A$", where "$" denotes an ASCII blank).
15-16	2	A	Blanks (="$$").
17-28	12	A	Reference of the control document which specifies the format of the Superstructure (= "CCB-CCT-0002")
29-30	2	A	Revision letter of the Superstructure format control document (="$E").
31-32	2	A	Revision letter of the Superstrucure record format (="$E")
33-44	12	A	Release number of the software version which was used to write this logical volume (= "<AAAAAAAAAAAA>")
45-60	16	A	ID also written or printed externally on the physical volume, and used to uniquely reference a particular medium (for SPOT, only the 8 left characters are used, the 8 right ones being filled with blanks). This ID is the same for all logical volumes of a same physical volume (="<AAAAAAAA>$$$$$$$$") *Field to be updated in a repeated volume directory file*.
61-76	16	A	Not significant.
77-92	16	A	Not significant.
93-94	2	N	Number of physical volume in theset.If this number is not known at creation time then this field is blank ("$N")

TABLE 10.1 NULL VOLUME DIRECTORY File NULL VOLUME DESCRIPTOR Record

BYTES : 95 to 360

Position	Length (bytes)	Type	Definitions, explanations and contents
95-96	2	N	Sequence number of the physical volume within a volume set, which contains the 1st record of the logical volume. If this number is not known at creation time, then this field is blank (="$1" to "$N")
97-98	2	N	Sequence number of the physical volume within a volume set, which contains the last record of the logical volume. If this number is not known at creation time, then this field is blank. (="$1" to "$N")
99-100	2	N	Sequence number within the volume set of the physical volume containing this volume directory file. (Blanks)
101-104	4	N	Number of the file within the logical volume which follows this Volume Directory file. (Blanks)
105-108	4	N	Sequence number of the present Logical Volume within a volume set (the same for the Volume Descriptor and the Null Volume Descriptor belonging to the same Logical Volume). (="$$$1" to "$$$L", where L is the number of logical volumes)
109-112	4	N	Sequence number of the present Logical Volume within this Physical Volume. (="$$$1" to "$$$L" where L is the number of logical volumes). *Field to be updated in a repeated volume Directory File.*
113-120	8	A	Not significant.
121-128	8	A	Not significant.
129-140	12	A	Not significant.
141-148	8	A	Not significant.
149-160	12	A	Not significant.
161-164	4	N	Not significant.
165-168	4	N	Not significant.
169-260	92	A	Reserved for future revisions of this record format.(92 Blanks)
261-360	100	A	Reserved for local use.

GLOSSARY

ASCII : The code used to encode the characters (see table4.1.3)

BPI : Bit Per Inch (recording density on a magnetic tape. Only 6250 BPI density is used).

CAP : The preprocessing center, in Toulouse or in Kiruna, where the product has been made (stands for "Centre d'Archivage et de Prétraitement").

CCT : Computer Compatible Tape (the naming for the regular magnetic tapes).

DPCM : Differential Pulse Code Modulation

The regular mode of compression (as opposed to "linear"), for :

- the Panchromatic data, for SPOT 1, 2 or 3 ;
- *the Monospectral data (M) or Multispectral data with SWIR (Xi) for SPOT 4.*

EOF : End of File (tape mark on a CCT).

GRS : SPOT reference Grid (Grille de Référence SPOT).

HRV : High Resolution Visible (the SPOT 1, 2, or 3 imaging instruments. There are two HRVs on SPOT 1 → 3, named HRV 1 and HRV 2).

HRVIR *: High Resolution Visible and Infra Red (The SPOT 4 imaging instruments. There are two HRVIR on SPOT 4, named HRVIR 1 and HRVIR 2).*

I (or Xi) *: Multispectral mode with SWIR (Bands 1, 2, 3 and 4 with a 20 m resolution on SPOT 4).*

IRG : Inter Record Gap (Physical Gap between two consecutive records on a CCT).

M *: Monospectral mode (Band 2 with a 10 m resolution on SPOT 4).*

MTF : Modulation Transfer Function.

O.B. : "On Board" the satellite (used in the expressions such as : O.B. recorder, O.B. clock, O.B. time, ...)

P (or Pan) : Panchromatic mode (10 m resolution on SPOT 1, 2, or 3).

SPOT : The name of the earth observation satellite (stands for Satellite Probatoire d'Observation de la Terre"). Three identical satellites (SPOT 1, SPOT 2 and SPOT 3 have already been launched. *A fourth satellite, SPOT 4, with an additionnal Short Wave Infra Red band is expected to be launched by 1997)* .

SWIR : *Short Wave Infra Red band : the fourth SPOT 4 band, with a 20 m resolution.*

U.T. : Universal Time (=GMT).

X (or Xs) : Multispectral mode (Band 1, 2, or 3 with a 20 m resolution on SPOT 1, 2, or 3, *or SPOT 4 without SWIR).*

Xi (or I) *: Multispectral mode with SWIR (Bands 1, 2, 3 and 4 with a 20 m resolution on SPOT 4).*

$: An ASCII blank, when required in a character string description.

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