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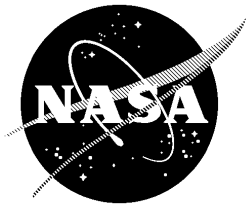
Earth Science Data and Information System (ESDIS) Level 1 Product Generation System (LPGS) Output Files Data Format Control Book

Volume 5, Book 2

Revision 1

June 5, 1998



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Earth Science Data and Information System (ESDIS)
Level 1 Product Generation System (LPGS)
Output Files Data Format Control Book

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Preface

This Data Format Control Book (DFCB) is maintained and controlled by the Level 1 Product Generation System (LPGS) Project Configuration Management Board (PCMB) and may be updated or revised only on approval by the PCMB. Comments and questions regarding this DFCB should be directed to

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Abstract

This Data Format Control Book (DFCB) presents detailed data formats of the output files generated by the Level 1 Product Generation System (LPGS). The LPGS produces Level 1 output files from Level 0R images based on user requests. The LPGS produces images in the following formats: Hierarchical Data Format (HDF), FAST-Landsat 7 (FAST-L7A), or Geographic Tagged Image File Format (GeoTIFF).

This document is based on the requirements contained in the *Earth Science Data and Information System (ESDIS) Level 1 Product Generation System (LPGS) Functional and Performance Requirements Specification* and the *Level 1 Product Generation System (LPGS*) *Operations Concept.*

Keywords*: Data Format Control Book (DFCB), Earth Observing System Data and Information System (EOSDIS), Earth Resources Observation System (EROS) Data Center Distributed Active Archive Center (EDC DAAC), EOSDIS Core System (ECS), FAST format, Geographic Tagged Image File Format (GeoTIFF), Hierarchical Data Format (HDF), Landsat 7, Level 1 Product, Level 1 Product Generation System (LPGS)*

Change Information Page

List of Effective Pages	
Page Number	**Issue**
Title page	Revision 1
iii through xii	Revision 1
1-1 through 1-3	Revision 1
2-1	Revision 1
3-1 through 3-4	Revision 1
4.1-1 through 4.1-25	Revision 1
4.2-1 through 4.2-4	Revision 1
4.3-1 through 4.3-45	Revision 1
5-1	Revision 1
6-1 through 6-2	Revision 1
A-1 through A-3	Revision 1
B-1 through B-3	Revision 1
AB-1 through AB-3	Revision 1

Document History			
Document Number	**Status/Issue**	**Publication Date**	**CCR Number**
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Contents

Section 5. Product Packaging

Section 6. Software Tools

Tables

Section 1. Introduction

1.1 Purpose

This Data Format Control Book (DFCB) defines in detail the formats of the output files generated by the Level 1 Product Generation System (LPGS). The LPGS generates Level 1(L1) products in response to L1 product generation requests received from the Level 1 Product Distribution System (LPDS).

1.2 Scope

This DFCB describes the formats and data contents of the LPGS output files. The formats discussed are Hierarchical Data Format (HDF), FAST-Landsat 7 (FAST-L7A), and Geographic Tagged Image File Format (GeoTIFF). These output file formats are based on the requirements contained in the *Earth Science Data and Information System (ESDIS) Level 1 Product Generation System (LPGS) Functional and Performance Requirements Specification (F&PRS)* (Applicable Document 1) and the *Level 1 Product Generation System (LPGS) Operations Concept* (Applicable Document 2).

The functional, performance, operational, and interface design details for the transfer of these files from the LPGS to the LPDS are contained in the *Interface Control Document (ICD) Between the Level 1 Product Generation System (LPGS) and the Level 1 Product Distribution System (LPDS)* (Applicable Document 3). The HDF L1 product formats are heavily derived from the formats of the Level 0R(L0R) products so as to cause less impact on the user community and to provide general consistency in output. The L0R product formats are described in the *Landsat 7 System Zero-R Distribution Product Data Format Control Book, Volume 5, Book 1* (Applicable Document 4). In addition, the output files defined in this DFCB are based on the already established FAST and GeoTIFF standards. Current Space Imaging Corporation Earth Observation Satellite (EOSAT) Landsat products are in the FAST-B format, and new EOSAT products will be in FAST-C format. The Landsat 7 L1 products will be in FAST-L7A format. This is the FAST-C format modified to accommodate the features of the Enhanced Thematic Mapper Plus (ETM+) instrument. Other remote-sensed images, from platforms such as SPOT, are in GeoTIFF.

The file formats contained in this DFCB are applicable to the interface between the LPDS and the LPGS.

1.3 Intended Users

This document is intended as a supplement to the *ICD Between the LPGS and the LPDS* (Applicable Document 3). Therefore, the LPGS project, the LPDS project, and the user community are the primary users of this document. This document contains detailed information on the LPGS output data file formats to allow users on both sides to proceed with independent development of the LPGS and the LPDS. It also provides detailed information on the delivery of the L1 product.

1.4 Definitions

Level 0R(L0R) digital image—Spatially reformatted, demultiplexed, and, unrectified subinterval data

Level 0R (L0R) product¾ L0R digital image plus radiometric, calibration, attitude, and ephemeris data, consisting of the following files in HDF:

- L0R digital image (one file per band)
- Internal calibrator (IC) data¾ Calibration data file containing all the calibration data received on a major frame basis subset to the product size ordered
- Mirror scan correction data (MSCD)¾ Scan direction and error information subset to the product size ordered
- Payload correction data (PCD)¾ Information on spacecraft attitude and ephemeris, including quality indicators for the entire subinterval from which the product is derived
- Metadata¾ Descriptive information about the L0R image and names of appended files associated with the image
- Calibration parameter file (CPF)¾ Formatted file containing radiometric and geometric correction parameters
- Scan line offsets—Information on actual starting and ending pixel positions for valid image data on a line-by-line basis
- Geolocation table—File containing scene corner coordinates and product-specific scene line numbers for bands
- HDF directory—File containing all the pointers, file size information, and data objects required to process the L0R product

Level 1R (L1R) digital image—Radiometrically corrected but not geometrically resampled

Level lR(L1R) product—L1 product packaged by the LPGS, distributed by the LPDS to the customer, and consisting of the following in HDF:

- L1R digital image (one image file per band)
- IC data—Calibration data file containing all the calibration data received on a major frame basis subset to the product size ordered
- Consensus MSCD—Scan direction and error information subset to the product size ordered
- Consensus PCD—Information on spacecraft attitude and ephemeris, including quality indicators for the entire subinterval from which the product is derived

- Metadata—Descriptive information about the L1 digital image and names of appended files associated with the image
- CPF—Formatted file containing radiometric and geometric correction parameters
- Scan line offsets—Information on actual starting and ending pixel positions for valid image data on a line-by-line basis.
- Geolocation table—File containing scene corner coordinates and product-specific scene line numbers for bands

Consensus File—A single file created from the two original files included with the L0R product and with errors corrected

Level 1G (L1G) digital image—Radiometrically corrected and resampled for geometric correction and registration to a geographic map projection

Level 1G (L1G) product—L1 product packaged by the LPGS and distributed by the LPDS to the customer; includes, for all requested bands, FAST-L7A or GeoTIFF format L1G image and associated data accommodated by the format; or HDF L1G image and metadata

Interval—Time duration between the start and stop of an imaging operation (observation) of the Landsat 7 ETM+ instrument

Subinterval—Segment of time corresponding to a portion of an observation within a single Landsat 7 contact period

Worldwide Reference System (WRS) scene—Digital image that covers an area equivalent to one of the 57,784 scene centers (233 paths by 248 rows areas) defined by the WRS structure

1.5 L0R Pre-Archive Processing

A basic knowledge of the pre-archive ground processing will enable the user to better understand the Level 1 product.

The Landsat Ground Station (LGS) acquires Enhanced Thematic Mapper Plus (ETM+) wideband data directly from the Landsat 7 spacecraft by way of two 150-megabit-per-second (Mbps) X-band return links, separates each X-band data into two 75-Mbps channels (I and Q), and transmits the acquired wideband data over four 75-Mbps LGS output channels to the LPS. The LPS records all wideband data, at real-time rates, into its wideband data stores. An I-Q channel pair represents a complete data set. One channel holds bands 1 through 6, and the second holds bands 7 and 8 and an low gain form of band 6.

The LPS retrieves and processes each channel of raw wideband data, at lower than real-time rates, into separate accumulations of Earth image data, calibration data, mirror scan correction data (MSCD), and payload correction data (PCD). Channel accumulations represented by bands 1 through 6 and 6 through 8 become formats 1 and 2, respectively. PCD and MSCD are generated twice, once for each format. Their contents should be identical.

LPS spatially reformats Earth imagery and calibration data into Level 0R data. This involves shifting pixels by integer amounts to account for the alternating forward-reverse scanning pattern

of the ETM+ sensor, the odd-even detector arrangement within each band, and the detector offsets inherent to the focal plane array engineering design. All LPS 0R corrections are reversible; the pixel shift parameters used are documented in the IAS CPF.

During LPS processing, format 1 bands are duplicated, radiometrically corrected, and used to assess cloud cover content and to generate browse. Cloud cover scores are generated on a scene-by-scene and quadrant-by-quadrant basis. Metadata are generated for the entire subinterval and on a scene-by-scene basis. The image data, PCD, MSCD, calibration data, and metadata are structured into HDF for each format and sent to the EDC DAAC for archiving in subinterval form. The two formats of data are united when a Landsat 7 0R product is ordered. The browse is sent to the EDC DAAC separately for use as an online aid to ordering.

Section 2. Applicable Documents

The following documents provide additional detail and reference information regarding the format of the LPGS output files.

1. National Aeronautics and Space Administration (NASA)/Goddard Space Flight Center (GSFC), 510-FPD/0196, *Earth Science Data and Information System (ESDIS) Level 1 Product Generation System (LPGS) Functional and Performance Requirements Specification*, January 1998

2. --, 510-3OCD/0196 (CSC 10034093), *Level 1 Product Generation System (LPGS) Operations Concept*, February 1998

3. --, 586-1ICD/0198 (CSC 10041004), *Interface Control Document (ICD) Between the Level 1 Product Generation System (LPGS) and the Level 1 Product Distribution System (LPDS)*, Draft May 1998

4. --, 430-11-06-007-0, *Landsat 7 System Zero-R Distribution Product Data Format Control Book, Volume 5, Book 1*, February 1998

5. --, 430-15-01-002-0, *Landsat-7 Calibration Parameter File Definition*, February 1998 (available at http://ltpwww.gsfc.nasa.gov/IAS/htmls/review.html)

6. --, 505-10-36, *Earth Science Data and Information System (ESDIS) Project Mission Specific Requirements for the Landsat 7 Mission Level 1 Processing*, July 1997

7. GeoTIFF Specification, Revision 1.0 (available at http://home.earthlink.net/~ritter/geotiff/spec/geotiffhome.html)

8. Space Imaging Corporation EOSAT, Technical Papers, FAST-C Format Specification (available at http://www.spaceimage.com/home/pubs/tech_papers/fstfmt_c.html)

9. Jet Propulsion Laboratory, California Institute of Technology, "Object Description Language Specification and Usage," Chapter 12 of *Planetary Data System Standards Reference*, Version 3.2, July 24, 1995 (available at http://pds.jpl.nasa.gov/stdref/chap12.htm)

Section 3. Overview of LPGS Output Files

The L1R digital image is very similar to the L0R digital image, except that the L1R image data are radiometrically corrected. In addition, the format 1 and format 2 PCD files are combined into one consensus file, as are the format 1 and format 2 MSCD files. The consensus file is a single file created from the two original files included with the L0R product and with errors corrected. The L1R product is available in HDF only. The L1G digital image is radiometrically and geometrically corrected and is available in three format options: FAST-L7A, GeoTIFF, and HDF. The product size can be as large as 3 full scene equivalents or as small as a 182-scan half scene.

Tables 3-1 through 3-3 detail the L1 product components for each format. The number of bands ordered by the user determines the number of components in a specific product.

Table 3-1. FAST-L7A Product Components

Component	L1G
Header file (for each requested band group)	X
L1 digital image (for each requested band)	X

Table 3-2. GeoTIFF Product Components

Component	L1G
File (for each requested band, contains both image data and metadata)	X

Table 3-3. HDF Product Components

Component	L1R	L1G
L1 digital image (for each requested band)	X	X
IC data—format 1 (for bands 1 through 6 low)	X	
IC data—format 2 (for bands 6 high through 8)	X	
Scan line offsets—format 1 (for bands 1 through 6 low)	X	
Scan line offsets—format 2 (for bands 6 high through 8)	X	
MSCD (consensus)	X	
PCD (consensus)	X	
CPF	X	
Metadata (LPS)—format 1	X	
Metadata (LPS)—format 2	X	
Metadata (LPGS)	X	X
Geolocation table	X	
HDF directory file	X	X

3.1 FAST-L7A

In the context of LPGS FAST format products, the term *volume* refers to online electronic storage, which assumes a single volume. Only the L1G product is available in this format. The file naming convention for the FAST-L7A product files is:

L7fpppprrr_rrrYYYYMMDD_aaa.FST

where
- L7 = Landsat 7 mission
- f = ETM+ format (1 or 2) (data not pertaining to a specific format defaults to 1)
- ppp = starting path of the product
- rrr_rrr = starting and ending rows of the product
- YYYYMMDD = acquisition date of the image
- aaa = file type:
  - HDR_pan = panchromatic band header file
  - HDR_ref = VNIR/ SWIR bands header file
  - HDR_thm = thermal bands header file
  - B10 = band 1
  - B20 = band 2
  - B30 = band 3
  - B40 = band 4
  - B50 = band 5
  - B61 = band 6L
  - B62 = band 6H
  - B70 = band 7
  - B80 = band 8
- FST = FAST file extension

3.1.1 Header File

The first file that should be read is a read-me-first file that contains header data in American Standard Code for Information Interchange (ASCII). Each band group [panchromatic, visible near infrared/shortwave infrared (VNIR/SWIR), and thermal] has a specific header file. Alphanumeric fields are left justified and numeric fields are right justified. All processing options and map projection information for the product are also contained in this file.

3.1.2 Image File

Each image file contains only one ETM+ band of image pixels. There are no header records within the image file, nor are there prefix or suffix data in the individual image records. Image data are unblocked. The image files are 8-bit unsigned integers.

3.2 GeoTIFF

GeoTIFF defines a set of public domain TIFF tags that describe all cartographic and geodetic information associated with geographic TIFF imagery. GeoTIFF is a means for tying a raster image to a known model space or map projection and for describing those projections. A metadata format provides geographic information to associate with the image data, but the TIFF file structure allows both the metadata and the image data to be encoded into the same file. The GeoTIFF file is grayscale, scanline, uncompressed, and 8-bit unsigned integers. The file naming convention for the GeoTIFF product is

L7fpppprrr_rrrYYYYMMDD_aaa.TIF

where
- L7 = Landsat 7 mission
- f = ETM+ format (always 1)
- ppp = starting path of the product
- rrr_rrr = starting and ending rows of the product
- YYYYMMDD = acquisition date of the image
- aaa = file type:
  - B10 = band 1
  - B20 = band 2
  - B30 = band 3
  - B40 = band 4
  - B50 = band 5
  - B61 = band 6L
  - B62 = band 6H
  - B70 = band 7
  - B80 = band 8
- TIF = GeoTIFF file extension

3.3 HDF

The L1R and L1G HDF products are packaged and distributed as a collection of external elements with an HDF directory. External elements are distinguished by the fact that they exist as separate files and contain only data. Information about their HDF structure and interrelationships can be found in the HDF directory. The file naming convention for the HDF product files is

L7fpppprrr_rrrYYYYMMDD_aaa.XXX

where

L7	=	Landsat 7 mission
f	=	ETM+ format (1 or 2) (data not pertaining to a specific format defaults to 1)
ppp	=	starting path of the product
rrr_rrr	=	starting and ending rows of the product
YYYYMMDD	=	acquisition date of the image
aaa	=	file type (as defined in LPGS metadata)
XXX	=	product type (L1R or L1G)

3.3.1 Image File

Each requested image band is self-contained in a single file. The L1R image files are in absolute units scaled to 16 bits. The L1G images are 8-bit unsigned integers that exploit the full 0-255 numeric range.

3.3.2 Ancillary Data

The remaining files included with the HDF product include the IC data, scan line offsets, MSCD, PCD, CPF, metadata, geolocation table, and HDF directory file. See Table 3-3 for a complete listing of which files are included with each product. These files are described in detail in Section 4.3

Section 4. LPGS Output File Formats

4.1 FAST-L7A File Formats

4.1.1 Header File

There is one header file for each band group in the product. The three possible band groups are panchromatic, VNIR/SWIR, and thermal. The header file for each band group contains three 1536-byte ASCII records: administrative, radiometric, and geometric. The administrative record, the first record in each header file, contains information that identifies the product, the image, and the data specifically needed to ingest the imagery for each particular band. To import the image data, it is necessary to read the entries in the administrative record.

The second record is the radiometric record that contains the coefficients needed to convert the image digital values into at-satellite spectral radiance for each particular band.

The third record is the geometric record that contains the image geodetic location information. To align the imagery to other data sources, it is necessary to read the entries in the geometric record for each particular band.

Tables 4.1-1 through 4.1-9 describe the formats of the three records for each of the three band groups (panchromatic, VNIR/SWIR, and thermal). The tables include the start and end bytes, the Fortran format statement, and a brief description of each field. In the Fortran format statements

A = character data

D = double precision data

F = floating data

All N/A fields are zero filled and are maintained in the records for historical consistency with the FAST-C format. The “b” in the descriptions indicates a space.

Fields 79, 81, 91, and 93 of the administrative record refer to products that span multiple tapes and are, therefore, not applicable to the L1 products produced by the LPGS,

Field 106 of the administrative record is the Bands Present field for each particular band group. It is necessary to count the number of non-blank entries in the Bands Present field to get the count of the number of bands. Each character (byte) in this field has an ASCII character with the band label, usually a number. For ETM+, the values are 8 for the panchromatic band; 1, 2, 3, 4, 5, and 7 for the VNIR/SWIR bands, and L and H for the thermal bands. The sequence terminates with blanks.

Table 4.1-1. Administrative Record for Panchromatic Band (1 of 4)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	8	A8	“REQbIDb=”
	2	9	28	A20	Request Number in “NNNYYMMDDSSSSUUUUbbb” format >where >NNNYYMMDDSSSS = 13-digit DORRAN order number > NNN = Node indicator > YY = Year > MM = Month > DD = Day > SSSS = Sequence number for the day >UUUU = 4-digit DORRAN unit number
	3	29	34	A6	“bLOCb=”
	4	35	51	A17	First product starting location in “ppp/rrrffssbbbbbb” format. path/row/fraction/subscene
	5	52	70	A19	“bACQUISITIONbDATEb=”
	6	71	78	A8	First product acquisition date in yyyyddmm format
	7	79	79	1X	Blank fill
	8	80	80	A1	Carriage return
2	9	81	91	A11	“SATELLITEb=”
	10	92	101	A10	First product satellite Name: LANDSAT7
	11	102	110	A9	“bSENSORb=”
	12	111	120	A10	First product sensor Name: ETM+
	13	121	134	A14	“bSENSORbMODEb=”
	14	135	140	A6	First product sensor Mode: NORMAL
	15	141	153	A13	“bLOOKbANGLEb=”
	16	154	159	F6.2	First product off-nadir angle in degrees: 0.0
	17	160	160	A1	Carriage return
3	18	161	183	23X	Blank fill
	19	184	194	A11	“bLOCATIONb=”
	20	195	211	A17	Second scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb” format: N/A
	21	212	230	A19	“bACQUISITIONbDATEb=”
	22	231	238	A8	Second scene acquisition date in yyyyddmm format: N/A
	23	239	239	1X	Blank fill
	24	240	240	A1	Carriage return
4	25	241	251	A11	“SATELLITEb=”
	26	252	261	A10	Second scene satellite Name: N/A
	27	262	270	A9	“bSENSORb=”
	28	271	280	A10	Second scene sensor Name: N/A
	29	281	294	A14	“bSENSORbMODEb=”
	30	295	300	A6	Second scene sensor Mode: N/A
	31	301	313	A13	“bLOOKbANGLEb=”
	32	314	319	F6.2	Second scene off-nadir angle in degrees: N/A
	33	320	320	A1	Carriage return
5	34	321	343	23X	Blank fill
	35	344	354	A11	“bLOCATIONb=”
	36	355	371	A17	Third scene location path/row/fraction/subscene in ppp/rrrffssbbbbbb format: N/A
	37	372	390	A19	“bACQUISITIONbDATEb=”
	38	391	398	A8	Third scene acquisition date in yyyyddmm format: N/A

Table 4.1-1. Administrative Record for Panchromatic Band (2 of 4)

Line	Field	Start Byte	End Byte	Format	Description
	39	399	399	1X	Blank fill
	40	400	400	A1	Carriage return
6	41	401	411	A11	“SATELLITEb=”
	42	412	421	A10	Third scene satellite Name: N/A
	43	422	430	A9	“bSENSORb=”
	44	431	440	A10	Third scene sensor Name: N/A
	45	441	454	A14	“bSENSORbMODEb=”
	46	455	460	A6	Third scene sensor Mode: N/A
	47	461	473	A13	“bLOOKbANGLEb=v
	48	474	479	F6.2	Third scene off-nadir angle in degrees: N/A
	49	480	480	A1	Carriage return
7	50	481	503	23X	Blank fill
	51	504	514	A11	“bLOCATIONb=”
	52	515	531	A17	Fourth scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb” format: N/A
	53	532	550	A19	“bACQUISITIONbDATEb=”
	54	551	558	A8	Fourth scene acquisition date in yyyyddmm format: N/A
	55	559	559	1X	Blank fill
	56	560	560	A1	Carriage return
8	57	561	571	A11	“SATELLITEb=”
	58	572	581	A10	Fourth scene satellite Name: N/A
	59	582	590	A9	“bSENSORb=”
	60	591	600	A10	Fourth scene sensor Name: N/A
	61	601	614	A14	“bSENSORbMODEb=”
	62	615	620	A6	Fourth scene sensor Mode: N/A
	63	621	633	A13	“bLOOKbANGLEb=”
	64	634	639	F6.2	Fourth scene off-nadir angle in degrees: N/A
	65	640	640	A1	Carriage return
9	66	641	654	A14	“PRODUCTbTYPEb=”
	67	655	672	A18	Product type: ‘MAPbORIENTEDbbbbbb’ , ‘ORBITbORIENTEDbbbb’
	68	673	687	A15	“bPRODUCTbSIZEb=“
	69	688	697	A10	Product size: ‘FULLbSCENE’, ‘SUBSCENEbb’, ‘MULTISCENE’
	70	698	719	22X	Blank fill
	71	720	720	A1	Carriage return
10	72	721	740	A20	“TYPEbOFbPROCESSINGb=”
	73	741	751	A11	Type of processing used: ‘SYSTEMATICb’ ,
	74	752	764	A13	“bRESAMPLINGb=”
	75	765	766	A2	Resampling algorithm used: ‘CC’, ‘NN’, ‘MF’
	76	767	799	33X	Blank fill
	77	800	800	A1	Carriage return
11	78	801	819	A19	“VOLUMEb#/#bINbSETb=”
	79	820	821	I2	Tape volume number in tape set (for multi-volume product): N/A
	80	822	822	A1	“/”
	81	823	824	I2	Number of volumes in tape set (for multi-volume product): N/A
	82	825	842	A18	“bPIXELSbPERbLINEb=”
	83	843	847	I5	Number of pixels per product line for pan band
	84	848	864	A17	“bLINESbPERbBANDb=”
	85	865	869	I5	Number of lines per pan band

Table 4.1-1. Administrative Record for Panchromatic Band (3 of 4)

Line	Field	Start Byte	End Byte	Format	Description
	86	870	870	A1	"/"
	87	871	875	I5	Number of lines in output product
	88	876	879	4X	Blank fill
	89	880	880	A1	Carriage return
12	90	881	894	A14	"STARTbLINEb#b="
	91	895	899	I5	First product line number on this volume (for multivolume product): N/A
	92	900	917	A18	"bBLOCKINGbFACTORb="
	93	918	919	I2	Tape blocking factor: N/A
	94	920	935	A16	"bRECORDbLENGTHb="
	95	936	940	I5	Length of physical file record in bytes per pan band
	96	941	953	A13	"bPIXELbSIZEb="
	97	954	959	F6.2	Pixel size in meters for pan band
	98	960	960	A1	Carriage return
13	99	961	983	A23	"OUTPUTbBITSbPERbPIXELb="
	100	984	985	I2	Output bits per pixel: 8
	101	986	1011	A26	"bACQUIREDbBITSbPERbPIXELb="
	102	1012	1013	I2	Acquired bits per pixel: 8
	103	1014	1039	26X	Blank fill
	104	1040	1040	A1	Carriage return
14	105	1041	1055	A15	"BANDSbPRESENTb="
	106	1056	1087	A32	Image bands present for the pan band group: 8
	107	1088	1119	32X	Blank fill
	108	1120	1120	A1	Carriage return
15	109	1121	1130	A10	"FILENAMEb="
	110	1131	1159	A29	Filename for first band
	111	1160	1169	A10	"FILENAMEb="
	112	1170	1198	A29	Filename for second band
	113	1199	1199	1X	Blank fill
	114	1200	1200	A1	Carriage return
16	115	1201	1210	A10	"FILENAMEb="
	116	1211	1239	A29	Filename for third band
	117	1240	1249	A10	"FILENAMEb="
	117	1250	1278	A29	Filename for fourth band
	119	1279	1279	1X	Blank fill
	120	1280	1280	A1	Carriage return
17	121	1281	1290	A10	"FILENAMEb="
	122	1291	1319	A29	Filename for fifth band
	123	1320	1329	A10	"FILENAMEb="
	124	1330	1358	A29	Filename for sixth band
	125	1359	1359	1X	Blank fill
	126	1360	1360	A1	Carriage return
18	127	1361	1439	79X	Blank fill
	128	1440	1440	A1	Carriage return
19	129	1441	1519	79X	Blank fill
	130	1520	1520	A1	Carriage return

Table 4.1-1. Administrative Record for Panchromatic Band (4 of 4)

Line	Field	Start Byte	End Byte	Format	Description
20	131	1521	1532	12X	“REVbbbbbbbbb”
	132	1533	1535	A3	Format version code: L7A
	133	1536	1536	A1	Carriage return

Table 4.1-2. Radiometric Record for Panchromatic Band (1 of 2)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	50	A50	“GAINSbANDbBIASESbINbASCENDINGbBANDbNUMBERbORDER bbb”
	2	51	79	29X	Blank fill
	3	80	80	A1	Carriage return
2	4	81	104	D24.15	Bias for first band
	5	105	105	1X	Blank fill
	6	106	129	D24.15	Gain for first band
	7	130	159	30X	Blank fill
	8	160	160	A1	Carriage return
3	9	161	184	D24.15	Bias for second band
	10	185	185	1X	Blank fill
	11	186	209	D24.15	Gain for second band
	12	210	239	30X	Blank fill
	13	240	240	A1	Carriage return
4	14	241	264	D24.15	Bias for third band
	15	265	265	1X	Blank fill
	16	266	289	D24.15	Gain for third band
	17	290	319	30X	Blank fill
	18	320	320	A1	Carriage return
5	19	321	344	D24.15	Bias for fourth band
	20	345	345	1X	Blank fill
	21	346	369	D24.15	Gain for fourth band
	22	370	399	30X	Blank fill
	23	400	400	A1	Carriage return
6	24	401	424	D24.15	Bias for fifth band
	25	425	425	1X	Blank fill
	26	426	449	D24.15	Gain for fifth band
	27	450	479	30X	Blank fill
	28	480	480	A1	Carriage return
7	29	481	504	D24.15	Bias for sixth band
	30	505	505	1X	Blank fill
	31	506	529	D24.15	Gain for sixth band
	32	530	559	30X	Blank fill
	33	560	560	A1	Carriage return
8	34	561	584	D24.15	Bias for seventh band
	35	585	585	1X	Blank fill
	36	586	609	D24.15	Gain for seventh band
	37	610	639	30X	Blank fill
	38	640	640	A1	Carriage return
9	39	641	664	D24.15	Bias for eighth band
	40	665	665	1X	Blank fill
	41	666	689	D24.15	Gain for eighth band
	42	690	719	30X	Blank fill
	43	720	720	A1	Carriage return
10	44	721	799	79X	Blank fill
	45	800	800	A1	Carriage return
11	46	801	879	79X	Blank fill

Table 4.1-2. Radiometric Record for Panchromatic Band (2 of 2)

Line	Field	Start Byte	End Byte	Format	Description
	47	880	880	A1	Carriage return
12	48	881	959	79X	Blank fill
	49	960	960	A1	Carriage return
13	50	961	1039	79X	Blank fill
	51	1040	1040	A1	Carriage return
14	52	1041	1119	79X	Blank fill
	53	1120	1120	A1	Carriage return
15	54	1121	1199	79X	Blank fill
	55	1200	1200	A1	Carriage return
16	56	1201	1279	79X	Blank fill
	57	1280	1280	A1	Carriage return
17	58	1281	1359	79X	Blank fill
	59	1360	1360	A1	Carriage return
18	60	1361	1439	79X	Blank fill
	61	1440	1440	A1	Carriage return
19	62	1441	1519	79X	Blank fill
	63	1520	1520	A1	Carriage return
20	64	1521	1535	15X	Blank fill
	65	1536	1536	A1	Carriage return

Table 4.1-3. Geometric Record for Panchromatic Band (1 of 3)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	14	A14	“GEOMETRICbDATA”
	2	15	31	A17	“bMAPbPROJECTIONb=”
	3	32	35	A4	Map projection name (see Appendix A for list of mnemonics)
	4	36	47	A12	“bELLIPSOIDb=”
	5	48	65	A18	Earth ellipsoid used: WGS84
	6	66	73	A8	“bDATUMb=”
	7	74	79	A6	Datum name: WGS84
	8	80	80	A1	Carriage return
2	9	81	108	A28	“USGSbPROJECTIONbPARAMETERSb=”
	10	109	109	1X	Blank fill
	11	110	133	D24.15	USGS projection parameter #1: Semi-major axis
	12	134	134	1X	Blank fill
	13	135	158	D24.15	USGS projection parameter #2: Semi-minor axis
	14	159	159	1X	Blank fill
	15	160	160	A1	Carriage return
3	16	161	184	D24.15	USGS projection parameter #3
	17	185	185	1X	Blank fill
	18	186	209	D24.15	USGS projection parameter #4
	19	210	210	1X	Blank fill
	20	211	234	D24.15	USGS projection parameter #5
	21	235	239	5X	Blank fill
	22	240	240	A1	Carriage return
4	23	241	264	D24.15	USGS projection parameter #6
	24	265	265	1X	Blank fill
	25	266	289	D24.15	USGS projection parameter #7
	26	290	290	1X	Blank fill
	27	291	314	D24.15	USGS projection parameter #8
	28	315	319	5X	Blank fill
	29	320	320	A1	Carriage return
5	30	321	344	D24.15	USGS projection parameter #9
	31	345	345	1X	Blank fill
	32	346	369	D24.15	USGS projection parameter #10
	33	370	370	1X	Blank fill
	34	371	394	D24.15	USGS projection parameter #11
	35	395	399	5X	Blank fill
	36	400	400	A1	Carriage return
6	37	401	424	D24.15	USGS projection parameter #12
	38	425	425	1X	Blank fill
	39	426	449	D24.15	USGS projection parameter #13
	40	450	450	1X	Blank fill
	41	451	474	D24.15	USGS projection parameter #14
	42	475	479	5X	Blank fill
	43	480	480	A1	Carriage return
7	44	481	504	D24.15	USGS projection parameter #15
	45	505	505	A1	Carriage return
	46	506	520	A15	”USGSbMAPbZONEb=”
8	47	521	526	I6	Zone Number
	48	527	559	33X	Blank fill

Table 4.1-3. Geometric Record for Panchromatic Band (2 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	49	560	560	A1	Carriage return
8	50	561	564	A4	“ULb=”
	51	565	565	1X	Blank fill
	52	566	578	A13	Geodetic longitude of upper left corner of product. Longitude is expressed as degrees, minutes, seconds. For example, 5 degrees, 15 minutes, 13.2 seconds west of the prime meridian is expressed as “0051513.2000W”
	53	579	579	1X	Blank fill
	54	580	591	A12	Geodetic latitude of upper left corner of product. Latitude is expressed as degrees, minutes, seconds. For example, 9 degrees, 4 minutes, 24.2334 seconds north of the equator is expressed as “090424.2334N”
	55	592	592	1X	Blank fill
	56	593	605	F13.3	Easting of upper left corner of product in projection units
	57	606	606	1X	Blank fill
	58	607	619	F13.3	Northing of upper left corner of product in projection units
	59	620	639	20X	Blank fill
	60	640	640	A1	Carriage return
9	61	641	644	A4	“URb=”
	62	645	645	1X	Blank fill
	63	646	658	A13	Geodetic longitude of upper right corner of product
	64	659	659	1X	Blank fill
	65	660	671	A12	Geodetic latitude of upper right corner of product
	66	672	672	1X	Blank fill
	67	673	685	F13.3	Easting of upper right corner of product in projection units
	68	686	686	1X	Blank fill
	69	687	699	F13.3	Northing of upper right corner of product in projection units
	70	700	719	20X	Blank fill
	71	720	720	A1	Carriage return
10	72	721	724	A4	“LRb=”
	73	725	725	1X	Blank fill
	74	726	738	A13	Geodetic longitude of lower right corner of product
	75	739	739	1X	Blank fill
	76	740	751	A12	Geodetic latitude of lower right corner of product
	77	752	752	1X	Blank fill
	78	753	765	F13.3	Easting of lower right corner of product in projection units
	79	766	766	1X	Blank fill
	80	767	779	F13.3	Northing of lower right corner of product in projection units
	81	780	799	20X	Blank fill
	82	800	800	A1	Carriage return
11	83	801	804	A4	“LLb=”
	84	805	805	1X	Blank fill
	85	806	818	A13	Geodetic longitude of lower left corner of product
	86	819	819	1X	Blank fill
	87	820	831	A12	Geodetic latitude of lower left corner of product
	88	832	832	1X	Blank fill
	89	833	845	F13.3	Easting of lower left corner of product in projection units
	90	846	846	1X	Blank fill
	91	847	859	F13.3	Northing of lower left corner of product in projection units

Table 4.1-3. Geometric Record for Panchromatic Band (3 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	92	860	879	20X	Blank fill
	93	880	880	A1	Carriage return
12	94	881	888	A8	“CENTERb=”
	95	889	889	1X	Blank fill
	96	890	902	A13	Product center geodetic longitude expressed in degrees, minutes, seconds, as above. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside the product
	97	903	903	1X	Blank fill
	98	904	915	A12	Product center geodetic latitude expressed in degrees, minutes, seconds, as above. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside the product
	99	916	916	1X	Blank fill
	100	917	929	F13.3	Product center Easting in projection units
	101	930	930	1X	Blank fill
	102	931	943	F13.3	Product center Northing in projection units
	103	944	944	1X	Blank fill
	104	945	949	I5	Product center pixel number measured from the product upper left corner, rounded to nearest whole pixel
	105	950	950	1X	Blank fill
	106	951	955	I5	Product center line number measured from the product upper left corner, rounded to nearest whole pixel
	107	956	959	4X	Blank fill
	108	960	960	A1	Carriage return
13	109	961	968	A8	“OFFSETb=”
	110	969	974	I6	Horizontal offset of the true product from the nominal product center calculated in meters. Calculated as an average (may be negative).
	111	975	994	20A	“bORIENTATIONbANGLEb=”
	112	995	1000	F6.2	Orientation angle in degrees (may be negative)
	113	1001	1039	39X	Blank fill
	114	1040	1040	A1	Carriage return
14	115	1041	1061	21A	“SUNbELEVATIONbANGLEb=”
	116	1062	1065	F4.1	Sun elevation angle in degrees at product center
	117	1066	1085	A20	“bSUNbAZIMUTHbANGLEb=”
	118	1086	1090	F5.1	Sun azimuth in degrees at product center
	119	1091	1119	29X	Blank fill
	120	1120	1120	A1	Carriage return
15	121	1121	1199	79X	Blank fill
	122	1200	1200	A1	Carriage return
16	123	1201	1279	79X	Blank fill
	124	1280	1280	A1	Carriage return
17	125	1281	1359	79X	Blank fill
	126	1360	1360	A1	Carriage return
18	127	1361	1439	79X	Blank fill
	128	1440	1440	A1	Carriage return
19	129	1441	1519	79X	Blank fill
	130	1520	1520	A1	Carriage return
20	131	1521	1535	79X	Blank fill
	132	1536	1536	A1	Carriage return

Table 4.1-4. Administrative Record for VNIR and SWIR Bands (1 of 3)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	8	A8	“REQbIDb=”
	2	9	28	A20	Request number in “NNNYYMMDDSSSSUUUUbbb”format >where >NNNYYMMDDSSSS = 13-digit DORRAN order number > NNN = Node indicator > YY = Year > MM = Month > DD = Day > SSSS = Sequence number for the day >UUUU = 4-digit DORRAN unit number
	3	29	34	A6	“bLOCb=”
	4	35	51	A17	First product location path/row in “ppp/rrrffssbbbbbb” format path/row/fraction/subscene
	5	52	70	A19	“bACQUISITIONbDATEb=”
	6	71	78	A8	First product acquisition date in yyyyddmm format
	7	79	79	1X	Blank fill
	8	80	80	A1	Carriage return
2	9	81	91	A11	“SATELLITEb=”
	10	92	101	A10	First product satellite Name: LANDSAT7
	11	102	110	A9	“bSENSORb=”
	12	111	120	A10	First product sensor Name: ETM+
	13	121	134	A14	“bSENSORbMODEb=”
	14	135	140	A6	First product sensor Mode: NORMAL
	15	141	153	A13	“bLOOKbANGLEb=”
	16	154	159	F6.2	First product off-nadir angle in degrees: 0.0
	17	160	160	A1	Carriage return
3	18	161	183	23X	Blank fill
	19	184	194	A11	“bLOCATIONb=”
	20	195	211	A17	Second scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb” format: N/A
	21	212	230	A19	“bACQUISITIONbDATEb=”
	22	231	238	A8	Second scene acquisition date in yyyyddmm format: N/A
	23	239	239	1X	Blank fill
	24	240	240	A1	Carriage return
4	25	241	251	A11	“SATELLITEb=”
	26	252	261	A10	Second scene satellite Name: N/A
	27	262	270	A9	“bSENSORb=”
	28	271	280	A10	Second scene sensor Name: N/A
	29	281	294	A14	“bSENSORbMODEb=”
	30	295	300	A6	Second scene sensor Mode: N/A
	31	301	313	A13	“bLOOKbANGLEb=”
	32	314	319	F6.2	Second scene off-nadir angle in degrees: N/A
	33	320	320	A1	Carriage return
5	34	321	343	23X	Blank fill
	35	344	354	A11	“bLOCATIONb=”
	36	355	371	A17	Third scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb” format: N/A
	37	372	390	A19	“bACQUISITIONbDATEb=”
	38	391	398	A8	Third scene acquisition date in yyyyddmm format: N/A
	39	399	399	1X	Blank fill
	40	400	400	A1	Carriage return

6	41	401	411	A11	“SATELLITEb=”
	42	412	421	A10	Third scene satellite Name: N/A
	43	422	430	A9	“bSENSORb=”
	44	431	440	A10	Third scene sensor Name: N/A
	45	441	454	A14	“bSENSORbMODEb=”
	46	455	460	A6	Third scene sensor Mode: N/A
	47	461	473	A13	“bLOOKbANGLEb=”

Table 4.1-4. Administrative Record for VNIR and SWIR Bands (2 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	48	474	479	F6.2	Third scene off-nadir angle in degrees: N/A
	49	480	480	A1	Carriage return
7	50	481	503	23X	Blank fill
	51	504	514	A11	“bLOCATIONb=”
	52	515	531	A17	Fourth scene location path/row/fraction/subscene in ppp/rrrffssbbbbbb format: N/A
	53	532	550	A19	“bACQUISITIONbDATEb=”
	54	551	558	A8	Fourth scene acquisition date in yyyyddmm format: N/A
	55	559	559	1X	Blank fill
	56	560	560	A1	Carriage return
8	57	561	571	A11	“SATELLITEb=”
	58	572	581	A10	Fourth scene satellite Name: N/A
	59	582	590	A9	“bSENSORb=”
	60	591	600	A10	Fourth scene sensor Name: N/A
	61	601	614	A14	“bSENSORbMODEb=”
	62	615	620	A6	Fourth scene sensor Mode: N/A
	63	621	633	A13	“bLOOKbANGLEb=”
	64	634	639	F6.2	Fourth scene off-nadir angle in degrees: N/A
	65	640	640	A1	Carriage return
9	66	641	654	A14	“PRODUCTbTYPEb=”
	67	655	672	A18	Product type: ‘MAPbORIENTEDbbbbbb’, ‘ORBITbORIENTEDbbbb’
	68	673	687	A15	“bPRODUCTbSIZEb=”
	69	688	697	A10	Product size: ‘FULLbSCENE’, ‘SUBSCENEbb’, ‘MULTISCENE’
	70	698	719	22X	Blank fill
	71	720	720	A1	Carriage return
10	72	721	740	A20	“TYPEbOFbPROCESSINGb=”
	73	741	751	A11	Type of processing used: ‘SYSTEMATICb’
	74	752	764	A13	“bRESAMPLINGb=”
	75	765	766	A2	Resampling algorithm used: ‘CC’, ‘NN’, ‘MF’
	76	767	799	33X	Blank fill
	77	800	800	A1	Carriage return
11	78	801	819	A19	“VOLUMEb#/#bINbSETb=”
	79	820	821	I2	Tape volume number in tape set (for multivolume product): N/A
	80	822	822	A1	“/”
	81	823	824	I2	Number of volumes in tape set (for multivolume product): N/A
	82	825	842	A18	“bPIXELSbPERbLINEb=”
	83	843	847	I5	Number of pixels per product line for VNIR and SWIR bands
	84	848	864	A17	“bLINESbPERbBANDb=”
	85	865	869	I5	Number of lines per VNIR and SWIR bands
	86	870	870	A1	“/”
	87	871	875	I5	Number of lines in output product
	88	876	879	4X	Blank fill
	89	880	880	A1	Carriage return
12	90	881	894	A14	“STARTbLINEb#b=”
	91	895	899	I5	First product line number on this volume (for multivolume product): N/A
	92	900	917	A18	“bBLOCKINGbFACTORb=”
	93	918	919	I2	Tape blocking factor: N/A
	94	920	935	A16	“bRECORDbLENGTHb=”

Table 4.1-4. Administrative Record for VNIR and SWIR Bands (3 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	95	936	940	I5	Length of physical file record in bytes per VNIR and SWIR bands
	96	941	953	A13	“bPIXELbSIZEb=”
	97	954	959	F6.2	Pixel size in meters for VNIR and SWIR bands
	98	960	960	A1	Carriage return
13	99	961	983	A23	“OUTPUTbBITSbPERbPIXELb=”
	100	984	985	I2	Output bits per pixel: 8
	101	986	1011	A26	“bACQUIREDbBITSbPERbPIXELb=”
	102	1012	1013	I2	Acquired bits per pixel: 8
	103	1014	1039	26X	Blank fill
	104	1040	1040	A1	Carriage return
14	105	1041	1055	A15	“BANDSbPRESENTb=”
	106	1056	1087	A32	Image bands present for the VNIR and SWIR bands group:123457(or subset)
	107	1088	1119	32X	Blank fill
	108	1120	1120	A1	Carriage return
15	109	1121	1130	A10	“FILENAMEb=”
	110	1131	1159	A29	Filename for first band
	111	1160	1169	A10	“FILENAMEb=”
	112	1170	1198	A29	Filename for second band
	113	1199	1199	1X	Blank fill
	114	1200	1200	A1	Carriage return
16	115	1201	1210	A10	“FILENAMEb=”
	116	1211	1239	A29	Filename for third band
	117	1240	1249	A10	“FILENAMEb=”
	117	1250	1278	A29	Filename for fourth band
	119	1279	1279	1X	Blank fill
	120	1280	1280	A1	Carriage return
17	121	1281	1290	A10	“FILENAMEb=”
	122	1291	1319	A29	Filename for fifth band
	123	1320	1329	A10	“FILENAMEb=”
	124	1330	1358	A29	Filename for sixth band
	125	1359	1359	1X	Blank fill
	126	1360	1360	A1	Carriage return
18	127	1361	1439	79X	Blank fill
	128	1440	1440	A1	Carriage return
19	129	1441	1519	79X	Blank fill
	130	1520	1520	A1	Carriage return
20	131	1521	1532	12X	“REVbbbbbbbbb”
	132	1533	1535	A2	Format version code: L7A
	133	1536	1536	A1	Carriage return

Table 4.1-5. Radiometric Record for VNIR and SWIR Bands (1 of 2)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	50	A50	“GAINSbANDbBIASESbINbASCENDINGbBANDbNUMBERbORDER bbb
	2	51	79	29X	Blank fill
	3	80	80	A1	Carriage return
2	4	81	104	D24.15	Bias for first band
	5	105	105	1X	Blank fill
	6	106	129	D24.15	Gain for first band
	7	130	159	30X	Blank fill
	8	160	160	A1	Carriage return
3	9	161	184	D24.15	Bias for second band
	10	185	185	1X	Blank fill
	11	186	209	D24.15	Gain for second band
	12	210	239	30X	Blank fill
	13	240	240	A1	Carriage return
4	14	241	264	D24.15	Bias for third band
	15	265	265	1X	Blank fill
	16	266	289	D24.15	Gain for third band
	17	290	319	30X	Blank fill
	18	320	320	A1	Carriage return
5	19	321	344	D24.15	Bias for fourth band
	20	345	345	1X	Blank fill
	21	346	369	D24.15	Gain for fourth band
	22	370	399	30X	Blank fill
	23	400	400	A1	Carriage return
6	24	401	424	D24.15	Bias for fifth band
	25	425	425	1X	Blank fill
	26	426	449	D24.15	Gain for fifth band
	27	450	479	30X	Blank fill
	28	480	480	A1	Carriage return
7	29	481	504	D24.15	Bias for sixth band
	30	505	505	1X	Blank fill
	31	506	529	D24.15	Gain for sixth band
	32	530	559	30X	Blank fill
	33	560	560	A1	Carriage return
8	34	561	584	D24.15	Bias for seventh band
	35	585	585	1X	Blank fill
	36	586	609	D24.15	Gain for seventh band
	37	610	639	30X	Blank fill
	38	640	640	A1	Carriage return
9	39	641	664	D24.15	Bias for eighth band
	40	665	665	1X	Blank fill
	41	666	689	D24.15	Gain for eighth band
	42	690	719	30X	Blank fill
	43	720	720	A1	Carriage return
10	44	721	799	79X	Blank fill
	45	800	800	A1	Carriage return
11	46	801	879	79X	Blank fill
	47	880	880	A1	Carriage return

Table 4.1-5. Radiometric Record for VNIR and SWIR Bands (2 of 2)

Line	Field	Start Byte	End Byte	Format	Description
12	48	881	959	79X	Blank fill
	49	960	960	A1	Carriage return
13	50	961	1039	79X	Blank fill
	51	1040	1040	A1	Carriage return
14	52	1041	1119	79X	Blank fill
	53	1120	1120	A1	Carriage return
15	54	1121	1199	79X	Blank fill
	55	1200	1200	A1	Carriage return
16	56	1201	1279	79X	Blank fill
	57	1280	1280	A1	Carriage return
17	58	1281	1359	79X	Blank fill
	59	1360	1360	A1	Carriage return
18	60	1361	1439	79X	Blank fill
	61	1440	1440	A1	Carriage return
19	62	1441	1519	79X	Blank fill
	63	1520	1520	A1	Carriage return
20	64	1521	1535	15X	Blank fill
	65	1536	1536	A1	Carriage return

Table 4.1-6. Geometric Record for VNIR and SWIR Bands (1 of 3)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	14	A14	“GEOMETRICbDATA”
	2	15	31	A17	“bMAPbPROJECTIONb=”
	3	32	35	A4	Map projection name (see Appendix A for list of mnemonics)
	4	36	47	A12	“bELLIPSOIDb=”
	5	48	65	A18	Earth ellipsoid used: WGS84
	6	66	73	A8	“bDATUMb=”
	7	74	79	A6	Datum name: WGS84
	8	80	80	A1	Carriage return
2	9	81	108	A28	“USGSbPROJECTIONbPARAMETERSb=“
	10	109	109	1X	Blank fill
	11	110	133	D24.15	USGS projection parameter #1: Semi-major axis
	12	134	134	1X	Blank fill
	13	135	158	D24.15	USGS projection parameter #2: Semi-minor axis
	14	159	159	1X	Blank fill
	15	160	160	A1	Carriage return
3	16	161	184	D24.15	USGS projection parameter #3
	17	185	185	1X	Blank fill
	18	186	209	D24.15	USGS projection parameter #4
	19	210	210	1X	Blank fill
	20	211	234	D24.15	USGS projection parameter #5
	21	235	239	5X	Blank fill
	22	240	240	A1	Carriage return
4	23	241	264	D24.15	USGS projection parameter #6
	24	265	265	1X	Blank fill
	25	266	289	D24.15	USGS projection parameter #7
	26	290	290	1X	Blank fill
	27	291	314	D24.15	USGS projection parameter #8
	28	315	319	5X	Blank fill
	29	320	320	A1	Carriage return
5	30	321	344	D24.15	USGS projection parameter #9
	31	345	345	1X	Blank fill
	32	346	369	D24.15	USGS projection parameter #10
	33	370	370	1X	Blank fill
	34	371	394	D24.15	USGS projection parameter #11
	35	395	399	5X	Blank fill
	36	400	400	A1	Carriage return
6	37	401	424	D24.15	USGS projection parameter #12
	38	425	425	1X	Blank fill
	39	426	449	D24.15	USGS projection parameter #13
	40	450	450	1X	Blank fill
	41	451	474	D24.15	USGS projection parameter #14
	42	475	479	5X	Blank fill
	43	480	480	A1	Carriage return
7	44	481	504	D24.15	USGS projection parameter #15
	45	505	505	A1	Carriage return
	46	506	520	A15	”USGSbMAPbZONEb=”
8	47	521	526	I6	Zone Number
	48	527	559	33X	Blank fill

Table 4.1-6. Geometric Record for VNIR and SWIR Bands (2 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	49	560	560	A1	Carriage return
8	50	561	564	A4	“ULb=”
	51	565	565	1X	Blank fill
	52	566	578	A13	Geodetic longitude of upper left corner of product. Longitude is expressed as degrees, minutes, seconds. For example, 5 degrees, 15 minutes, 13.2 seconds west of the prime meridian is expressed as “0051513.2000W”
	53	579	579	1X	Blank fill
	54	580	591	A12	Geodetic latitude of upper left corner of product. Latitude is expressed as degrees, minutes, seconds. For example, 9 degrees, 4 minutes, 24.2334 seconds north of the equator is expressed as “090424.2334N”
	55	592	592	1X	Blank fill
	56	593	605	F13.3	Easting of upper left corner of product in projection units
	57	606	606	1X	Blank fill
	58	607	619	F13.3	Northing of upper left corner of product in projection units
	59	620	639	20X	Blank fill
	60	640	640	A1	Carriage return
9	61	641	644	A4	“URb=”
	62	645	645	1X	Blank fill
	63	646	658	A13	Geodetic longitude of upper right corner of product
	64	659	659	1X	Blank fill
	65	660	671	A12	Geodetic Latitude of upper right corner of product
	66	672	672	1X	Blank fill
	67	673	685	F13.3	Easting of upper right corner of product in projection units
	68	686	686	1X	Blank fill
	69	687	699	F13.3	Northing of upper right corner of product in projection units
	70	700	719	20X	Blank fill
	71	720	720	A1	Carriage return
10	72	721	724	A4	“LRb=”
	73	725	725	1X	Blank fill
	74	726	738	A13	Geodetic longitude of lower right corner of product
	75	739	739	1X	Blank fill
	76	740	751	A12	Geodetic latitude of lower right corner of product
	77	752	752	1X	Blank fill
	78	753	765	F13.3	Easting of lower right corner of product in projection units
	79	766	766	1X	Blank fill
	80	767	779	F13.3	Northing of lower right corner of product in projection units
	81	780	799	20X	Blank fill
	82	800	800	A1	Carriage return
11	83	801	804	A4	“LLb=”
	84	805	805	1X	Blank fill
	85	806	818	A13	Geodetic longitude of lower left corner of product
	86	819	819	1X	Blank fill
	87	820	831	A12	Geodetic latitude of lower left corner of product
	88	832	832	1X	Blank fill
	89	833	845	F13.3	Easting of lower left corner of product in projection units
	90	846	846	1X	Blank fill
	91	847	859	F13.3	Northing of lower left corner of product in projection units
	92	860	879	20X	Blank fill
	93	880	880	A1	Carriage return

Table 4.1-6. Geometric Record for VNIR and SWIR Bands (3 of 3)

Line	Field	Start Byte	End Byte	Format	Description
12	94	881	888	A8	"CENTERb="
	95	889	889	1X	Blank fill
	96	890	902	A13	Product center geodetic longitude expressed in degrees, minutes, seconds, as above. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside the product
	97	903	903	1X	Blank fill
	98	904	915	A12	Product center geodetic latitude expressed in degrees, minutes, seconds, as above. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside the product
	99	916	916	1X	Blank fill
	100	917	929	F13.3	Product center Easting in projection units
	101	930	930	1X	Blank fill
	102	931	943	F13.3	Product center Northing in projection units
	103	944	944	1X	Blank fill
	104	945	949	I5	Product center pixel number measured from the product upper left corner, rounded to nearest whole pixel
	105	950	950	1X	Blank fill
	106	951	955	I5	Product center line number measured from the product upper left corner, rounded to nearest whole pixel
	107	956	959	4X	Blank fill
	108	960	960	A1	Carriage return
13	109	961	968	A8	"OFFSETb="
	110	969	974	I6	Horizontal offset of the true product from the nominal product center calculated in meters. Calculated as an average (may be negative).
	111	975	994	20A	"bORIENTATIONbANGLEb="
	112	995	1000	F6.2	Orientation angle in degrees (may be negative)
	113	1001	1039	39X	Blank fill
	114	1040	1040	A1	Carriage return
14	115	1041	1061	21A	"SUNbELEVATIONbANGLEb="
	116	1062	1065	F4.1	Sun elevation angle in degrees at product center
	117	1066	1085	A20	"bSUNbAZIMUTHbANGLEb="
	118	1086	1090	F5.1	Sun azimuth in degrees at product center
	119	1091	1119	29X	Blank fill
	120	1120	1120	A1	Carriage return
15	121	1121	1199	79X	Blank fill
	122	1200	1200	A1	Carriage return
16	123	1201	1279	79X	Blank fill
	124	1280	1280	A1	Carriage return
17	125	1281	1359	79X	Blank fill
	126	1360	1360	A1	Carriage return
18	127	1361	1439	79X	Blank fill
	128	1440	1440	A1	Carriage return
19	129	1441	1519	79X	Blank fill
	130	1520	1520	A1	Carriage return
20	131	1521	1535	79X	Blank fill
	132	1536	1536	A1	Carriage return

Table 4.1-7. Administrative Record for Thermal Bands (1 of 3)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	8	A8	“REQbIDb=”
	2	9	28	A20	Request number in “NNNYYMMDDSSSSUUUUbbb”format >where >NNNYYMMDDSSSS = 13-digit DORRAN order number > NNN = Node indicator > YY = Year > MM = Month > DD = Day > SSSS = Sequence number for the day >UUUU = 4-digit DORRAN unit number
	3	29	34	A6	“bLOCb=”
	4	35	51	A17	First product location path/row in “ppp/rrrffssbbbbbb” format path/row/fraction/subscene
	5	52	70	A19	“bACQUISITIONbDATEb=”
	6	71	78	A8	First product acquisition date in yyyyddmm format
	7	79	79	1X	Blank fill
	8	80	80	A1	Carriage return
2	9	81	91	A11	“SATELLITEb=”
	10	92	101	A10	First product satellite Name: LANDSAT7
	11	102	110	A9	“bSENSORb=”
	12	111	120	A10	First product sensor Name: ETM+
	13	121	134	A14	“bSENSORbMODEb=”
	14	135	140	A6	First product sensor Mode: NORMAL
	15	141	153	A13	“bLOOKbANGLEb=”
	16	154	159	F6.2	First product off-nadir angle in degrees: 0.0
	17	160	160	A1	Carriage return
3	18	161	183	23X	Blank fill
	19	184	194	A11	“bLOCATIONb=”
	20	195	211	A17	Second scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb” format: N/A
	21	212	230	A19	“bACQUISITIONbDATEb=”
	22	231	238	A8	Second scene acquisition date in yyyyddmm format: N/A
	23	239	239	1X	Blank fill
	24	240	240	A1	Carriage return
4	25	241	251	A11	“SATELLITEb=”
	26	252	261	A10	Second scene satellite Name: N/A
	27	262	270	A9	“bSENSORb=”
	28	271	280	A10	Second scene sensor Name: N/A
	29	281	294	A14	“bSENSORbMODEb=”
	30	295	300	A6	Second scene sensor Mode: N/A
	31	301	313	A13	“bLOOKbANGLEb=”
	32	314	319	F6.2	Second scene off-nadir angle in degrees: N/A
	33	320	320	A1	Carriage return
5	34	321	343	23X	Blank fill
	35	344	354	A11	“bLOCATIONb=”
	36	355	371	A17	Third scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb “format: N/A
	37	372	390	A19	“bACQUISITIONbDATEb=”
	38	391	398	A8	Third scene acquisition date in yyyyddmm format: N/A
	39	399	399	1X	Blank fill
	40	400	400	A1	Carriage return

6	41	401	411	A11	“SATELLITEb=”
	42	412	421	A10	Third scene satellite Name: N/A
	43	422	430	A9	“bSENSORb=”
	44	431	440	A10	Third scene sensor Name: N/A
	45	441	454	A14	“bSENSORbMODEb=”
	46	455	460	A6	Third scene sensor Mode: N/A
	47	461	473	A13	“bLOOKbANGLEb=”

Table 4.1-7. Administrative Record for Thermal Bands (2 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	48	474	479	F6.2	Third scene off-nadir angle in degrees: N/A
	49	480	480	A1	Carriage return
7	50	481	503	23X	Blank fill
	51	504	514	A11	“bLOCATIONb=”
	52	515	531	A17	Fourth scene location path/row/fraction/subscene in “ppp/rrrffssbbbbbb” format: N/A
	53	532	550	A19	“bACQUISITIONbDATEb=”
	54	551	558	A8	Fourth scene acquisition date in yyyyddmm format: N/A
	55	559	559	1X	Blank fill
	56	560	560	A1	Carriage return
8	57	561	571	A11	“SATELLITEb=”
	58	572	581	A10	Fourth scene satellite Name: N/A
	59	582	590	A9	“bSENSORb=”
	60	591	600	A10	Fourth scene sensor Name: N/A
	61	601	614	A14	“bSENSORbMODEb=”
	62	615	620	A6	Fourth scene sensor Mode: N/A
	63	621	633	A13	“bLOOKbANGLEb=”
	64	634	639	F6.2	Fourth scene off-nadir angle in degrees: N/A
	65	640	640	A1	Carriage return
9	66	641	654	A14	“PRODUCTbTYPEb=”
	67	655	672	A18	Product type: ‘MAPbORIENTEDbbbbbb’, ‘ORBITbORIENTEDbbbb’
	68	673	687	A15	“bPRODUCTbSIZEb=”
	69	688	697	A10	Product size: ‘FULLbSCENE’, ‘SUBSCENEbb’, ‘MULTISCENE’
	70	698	719	22X	Blank fill
	71	720	720	A1	Carriage return
10	72	721	740	A20	“TYPEbOFbPROCESSINGb=”
	73	741	751	A11	Type of processing used: ‘SYSTEMATICb’
	74	752	764	A13	“bRESAMPLINGb=”
	75	765	766	A2	Resampling algorithm used: ‘CC’, ‘NN’, ‘MF’
	76	767	799	33X	Blank fill
	77	800	800	A1	Carriage return
11	78	801	819	A19	“VOLUMEb#/#bINbSETb=”
	79	820	821	I2	Tape volume number in tape set (for multivolume product): N/A
	80	822	822	A1	“/”
	81	823	824	I2	Number of volumes in tape set (for multivolume product): N/A
	82	825	842	A18	“bPIXELSbPERbLINEb=”
	83	843	847	I5	Number of pixels per product line for thermal band
	84	848	864	A17	“bLINESbPERbBANDb=”
	85	865	869	I5	Number of lines per thermal band
	86	870	870	A1	“/”
	87	871	875	I5	Number of lines in output product
	88	876	879	4X	Blank fill
	89	880	880	A1	Carriage return
12	90	881	894	A14	“STARTbLINEb#b=”
	91	895	899	I5	First product line number on this volume (for multivolume product): N/A
	92	900	917	A18	“bBLOCKINGbFACTORb=”
	93	918	919	I2	Tape blocking factor: N/A
	94	920	935	A16	“bRECORDbLENGTHb=”

Table 4.1-7. Administrative Record for Thermal Bands (3 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	95	936	940	I5	Length of physical file record in bytes per thermal band
	96	941	953	A13	“bPIXELbSIZEb=”
	97	954	959	F6.2	Pixel size in meters for thermal band
	98	960	960	A1	Carriage return
13	99	961	983	A23	“OUTPUTbBITSbPERbPIXELb=”
	100	984	985	I2	Output bits per pixel: 8
	101	986	1011	A26	“bACQUIREDbBITSbPERbPIXELb=”
	102	1012	1013	I2	Acquired bits per pixel: 8
	103	1014	1039	26X	Blank fill
	104	1040	1040	A1	Carriage return
14	105	1041	1055	A15	“BANDSbPRESENTb=”
	106	1056	1087	A32	Image bands present for the thermal band group: LH (or subset)
	107	1088	1119	32X	Blank fill
	108	1120	1120	A1	Carriage return
15	109	1121	1130	A10	“FILENAMEb=”
	110	1131	1159	A29	Filename for first band
	111	1160	1169	A10	“FILENAMEb=”
	112	1170	1198	A29	Filename for second band
	113	1199	1199	1X	Blank fill
	114	1200	1200	A1	Carriage return
16	115	1201	1210	A10	“FILENAMEb=”
	116	1211	1239	A29	Filename for third band
	117	1240	1249	A10	“FILENAMEb=”
	117	1250	1278	A29	Filename for fourth band
	119	1279	1279	1X	Blank fill
	120	1280	1280	A1	Carriage return
17	121	1281	1290	A10	“FILENAMEb=”
	122	1291	1319	A29	Filename for fifth band
	123	1320	1329	A10	“FILENAMEb=”
	124	1330	1358	A29	Filename for sixth band
	125	1359	1359	1X	Blank fill
	126	1360	1360	A1	Carriage return
18	127	1361	1439	79X	Blank fill
	128	1440	1440	A1	Carriage return
19	129	1441	1519	79X	Blank fill
	130	1520	1520	A1	Carriage return
20	131	1521	1532	12X	“REVbbbbbbbbb”
	132	1533	1535	A2	Format version code: L7A
	133	1536	1536	A1	Carriage return

Table 4.1-8. Radiometric Record for Thermal Bands (1 of 2)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	50	A50	“GAINSbANDbBIASESbINbASCENDINGbBANDbNUMBERbORDER bbb
	2	51	79	29X	Blank fill
	3	80	80	A1	Carriage return
2	4	81	104	D24.15	Bias for first band
	5	105	105	1X	Blank fill
	6	106	129	D24.15	Gain for first band
	7	130	159	30X	Blank fill
	8	160	160	A1	Carriage return
3	9	161	184	D24.15	Bias for second band
	10	185	185	1X	Blank fill
	11	186	209	D24.15	Gain for second band
	12	210	239	30X	Blank fill
	13	240	240	A1	Carriage return
4	14	241	264	D24.15	Bias for third band
	15	265	265	1X	Blank fill
	16	266	289	D24.15	Gain for third band
	17	290	319	30X	Blank fill
	18	320	320	A1	Carriage return
5	19	321	344	D24.15	Bias for fourth band
	20	345	345	1X	Blank fill
	21	346	369	D24.15	Gain for fourth band
	22	370	399	30X	Blank fill
	23	400	400	A1	Carriage return
6	24	401	424	D24.15	Bias for fifth band
	25	425	425	1X	Blank fill
	26	426	449	D24.15	Gain for fifth band
	27	450	479	30X	Blank fill
	28	480	480	A1	Carriage return
7	29	481	504	D24.15	Bias for sixth band
	30	505	505	1X	Blank fill
	31	506	529	D24.15	Gain for sixth band
	32	530	559	30X	Blank fill
	33	560	560	A1	Carriage return
8	34	561	584	D24.15	Bias for seventh band
	35	585	585	1X	Blank fill
	36	586	609	D24.15	Gain for seventh band
	37	610	639	30X	Blank fill
	38	640	640	A1	Carriage return
9	39	641	664	D24.15	Bias for eighth band
	40	665	665	1X	Blank fill
	41	666	689	D24.15	Gain for eighth band
	42	690	719	30X	Blank fill
	43	720	720	A1	Carriage return
10	44	721	799	79X	Blank fill
	45	800	800	A1	Carriage return
11	46	801	879	79X	Blank fill
	47	880	880	A1	Carriage return

Table 4.1-8. Radiometric Record for Thermal Bands (2 of 2)

Line	Field	Start Byte	End Byte	Format	Description
12	48	881	959	79X	Blank fill
	49	960	960	A1	Carriage return
13	50	961	1039	79X	Blank fill
	51	1040	1040	A1	Carriage return
14	52	1041	1119	79X	Blank fill
	53	1120	1120	A1	Carriage return
15	54	1121	1199	79X	Blank fill
	55	1200	1200	A1	Carriage return
16	56	1201	1279	79X	Blank fill
	57	1280	1280	A1	Carriage return
17	58	1281	1359	79X	Blank fill
	59	1360	1360	A1	Carriage return
18	60	1361	1439	79X	Blank fill
	61	1440	1440	A1	Carriage return
19	62	1441	1519	79X	Blank fill
	63	1520	1520	A1	Carriage return
20	64	1521	1535	15X	Blank fill
	65	1536	1536	A1	Carriage return

Table 4.1-9. Geometric Record for Thermal Bands (1 of 3)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	14	A14	“GEOMETRICbDATA”
	2	15	31	A17	“bMAPbPROJECTIONb=”
	3	32	35	A4	Map projection name (see Appendix A for list of mnemonics)
	4	36	47	A12	“bELLIPSOIDb=”
	5	48	65	A18	Earth ellipsoid used: WGS84
	6	66	73	A8	“bDATUMb=“
	7	74	79	A6	Datum name: WGS84
	8	80	80	A1	Carriage return
2	9	81	108	A28	“USGSbPROJECTIONbPARAMETERSb=”
	10	109	109	1X	Blank fill
	11	110	133	D24.15	USGS projection parameter #1: Semi-major axis
	12	134	134	1X	Blank fill
	13	135	158	D24.15	USGS projection parameter #2: Semi-minor axis
	14	159	159	1X	Blank fill
	15	160	160	A1	Carriage return
3	16	161	184	D24.15	USGS projection parameter #3
	17	185	185	1X	Blank fill
	18	186	209	D24.15	USGS projection parameter #4
	19	210	210	1X	Blank fill
	20	211	234	D24.15	USGS projection parameter #5
	21	235	239	5X	Blank fill
	22	240	240	A1	Carriage return
4	23	241	264	D24.15	USGS projection parameter #6
	24	265	265	1X	Blank fill
	25	266	289	D24.15	USGS projection parameter #7
	26	290	290	1X	Blank fill
	27	291	314	D24.15	USGS projection parameter #8
	28	315	319	5X	Blank fill
	29	320	320	A1	Carriage return
5	30	321	344	D24.15	USGS projection parameter #9
	31	345	345	1X	Blank fill
	32	346	369	D24.15	USGS projection parameter #10
	33	370	370	1X	Blank fill
	34	371	394	D24.15	USGS projection parameter #11
	35	395	399	5X	Blank fill
	36	400	400	A1	Carriage return
6	37	401	424	D24.15	USGS projection parameter #12
	38	425	425	1X	Blank fill
	39	426	449	D24.15	USGS projection parameter #13
	40	450	450	1X	Blank fill
	41	451	474	D24.15	USGS projection parameter #14
	42	475	479	5X	Blank fill
	43	480	480	A1	Carriage return
7	44	481	504	D24.15	USGS projection parameter #15
	45	505	505	A1	Carriage return
	46	506	520	A15	”USGSbMAPbZONEb=”
	47	521	526	I6	“ ZONE Number
	48	527	559	33X	Blank fill

Table 4.1-9. Geometric Record for Thermal Bands (2 of 3)

Line	Field	Start Byte	End Byte	Format	Description
	49	560	560	A1	Carriage return
8	50	561	564	A4	“ULb=”
	51	565	565	1X	Blank fill
	52	566	578	A13	Geodetic longitude of upper left corner of product. Longitude is expressed as degrees, minutes, seconds. For example, 5 degrees, 15 minutes, 13.2 seconds west of the prime meridian is expressed as “0051513.2000W”
	53	579	579	1X	Blank fill
	54	580	591	A12	Geodetic latitude of upper left corner of product. Latitude is expressed as degrees, minutes, seconds. For example, 9 degrees, 4 minutes, 24.2334 seconds north of the equator is expressed as “090424.2334N”
	55	592	592	1X	Blank fill
	56	593	605	F13.3	Easting of upper left corner of product in projection units
	57	606	606	1X	Blank fill
	58	607	619	F13.3	Northing of upper left corner of product in projection units
	59	620	639	20X	Blank fill
	60	640	640	A1	Carriage return
9	61	641	644	A4	“URb=”
	62	645	645	1X	Blank fill
	63	646	658	A13	Geodetic longitude of upper right corner of product
	64	659	659	1X	Blank fill
	65	660	671	A12	Geodetic latitude of upper right corner of product
	66	672	672	1X	Blank fill
	67	673	685	F13.3	Easting of upper right corner of product in projection units
	68	686	686	1X	Blank fill
	69	687	699	F13.3	Northing of upper right corner of product in projection units
	70	700	719	20X	Blank fill
	71	720	720	A1	Carriage return
10	72	721	724	A4	“LRb=”
	73	725	725	1X	Blank fill
	74	726	738	A13	Geodetic longitude of lower right corner of product
	75	739	739	1X	Blank fill
	76	740	751	A12	Geodetic latitude of lower right corner of product
	77	752	752	1X	Blank fill
	78	753	765	F13.3	Easting of lower right corner of product in projection units
	79	766	766	1X	Blank fill
	80	767	779	F13.3	Northing of lower right corner of product in projection units
	81	780	799	20X	Blank fill
	82	800	800	A1	Carriage return
11	83	801	804	A4	“LLb=”
	84	805	805	1X	Blank fill
	85	806	818	A13	Geodetic longitude of lower left corner of product
	86	819	819	1X	Blank fill
	87	820	831	A12	Geodetic latitude of lower left corner of product
	88	832	832	1X	Blank fill
	89	833	845	F13.3	Easting of lower left corner of product in projection units
	90	846	846	1X	Blank fill
	91	847	859	F13.3	Northing of lower left corner of product in projection units
	92	860	879	20X	Blank fill
	93	880	880	A1	Carriage return

Table 4.1-9. Geometric Record for Thermal Bands (3 of 3)

Line	Field	Start Byte	End Byte	Format	Description
12	94	881	888	A8	“CENTERb=”
	95	889	889	1X	Blank fill
	96	890	902	A13	Product center geodetic longitude expressed in degrees, minutes, seconds, as above. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside the product
	97	903	903	1X	Blank fill
	98	904	915	A12	Product center geodetic latitude expressed in degrees, minutes, seconds, as above. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside the product
	99	916	916	1X	Blank fill
	100	917	929	F13.3	Product center easting in projection units
	101	930	930	1X	Blank fill
	102	931	943	F13.3	Product center northing in projection units
	103	944	944	1X	Blank fill
	104	945	949	I5	Product center pixel number measured from the product upper left corner, rounded to nearest whole pixel
	105	950	950	1X	Blank fill
	106	951	955	I5	Product center line number measured from the product upper left corner, rounded to nearest whole pixel
	107	956	959	4X	Blank fill
	108	960	960	A1	Carriage return
13	109	961	968	A8	“OFFSETb=”
	110	969	974	I6	Horizontal offset of the true product from the nominal product center calculated in meters Calculated as an average (may be negative) .
	111	975	994	20A	“bORIENTATIONbANGLEb=”
	112	995	1000	F6.2	Orientation angle in degrees (may be negative)
	113	1001	1039	39X	Blank fill
	114	1040	1040	A1	Carriage return
14	115	1041	1061	21A	“SUNbELEVATIONbANGLEb=”
	116	1062	1065	F4.1	Sun elevation angle in degrees at product center
	117	1066	1085	A20	“bSUNbAZIMUTHbANGLEb=”
	118	1086	1090	F5.1	Sun azimuth in degrees at product center
	119	1091	1119	29X	Blank fill
	120	1120	1120	A1	Carriage return
15	121	1121	1199	79X	Blank fill
	122	1200	1200	A1	Carriage return
16	123	1201	1279	79X	Blank fill
	124	1280	1280	A1	Carriage return
17	125	1281	1359	79X	Blank fill
	126	1360	1360	A1	Carriage return
18	127	1361	1439	79X	Blank fill
	128	1440	1440	A1	Carriage return
19	129	1441	1519	79X	Blank fill
	130	1520	1520	A1	Carriage return
20	131	1521	1535	79X	Blank fill
	132	1536	1536	A1	Carriage return

4.2 GeoTIFF File Formats

The description of an image in Geo-TIFF requires tags and keys as described in Reference 7. These tags and keys will be included in the image files and are automatically detected and read by TIFF readers. They are described in the following subsections.

4.2.1 GeoTIFF Tags

TIFF tags convey information about the image and are TIFF's version of metadata. The tags describe the image with information the TIFF reader needs to control the appearance of the image on the user's screen. The TIFF tags are in the same file as the TIFF image.

A complete description of the raster data requires georeferencing of the data, which is accomplished through the use of tags. LPGS will use transformation raster and model space tiepoints and scaling parameters. ModelTiepointTag and ModelPixelScaleTag will be used for this purpose:.

ModelTiepointTag

Tag = 33922

Type = DOUBLE

N = 6*K, K = number of tiepoints

Alias: GeoreferenceTag

Owner: Intergraph

This tag stores the raster-to-model tiepoint pairs in the order

ModelTiepointTag = (..., I, J, K, X, Y, Z...),

where (I, J, K) is the point at location (I, J) in raster space with pixel-value K, and (X, Y, Z) is a vector in model space.

The raster image is georeferenced by specifying its location, size, and orientation in the model coordinate space. Because the relationship between the raster space and the model space often will be an exact, affine transformation, the relationship can be defined using one set of tiepoints and the ModelPixelScaleTag, which gives the vertical and horizontal raster grid cell size.

ModelPixelScaleTag:

Tag = 33550

Type = DOUBLE

N = 3

Owner: SoftDesk

This tag is used to specify the size of raster pixel spacing in the model space units, when the raster space can be embedded in the model space coordinate system without rotation, and consists of the following three values:

ModelPixelScaleTag = (ScaleX, ScaleY, ScaleZ)

where ScaleX and ScaleY give the horizontal and vertical spacing of raster pixels and ScaleZ is used to map the pixel value of a digital elevation model into the correct Z-scale. Scale Z will not be used for LPGS data since it is only systematically corrected and not corrected for elevation.

A single tiepoint in the ModelTiepointTag, together with the ModelPixelScaleTag, completely determines the relationship between raster and model space.

4.2.2 GeoTIFF Keys

In addition to tags, the description of a projection in GeoTIFF requires the use of keys. The keys necessary to define the projections supported by LPGS, and their possible values are listed below. LPGS supports the following projections in GeoTIFF:**Transverse Mercator (TM)**

Valid Keys:

ProjCoordTransGeoKey = 1, CT_Transverse Mercator GTModelTypeGeoKey = 1, ModelTypeProjected(Projection Coordinate System)

GTRasterTypeGeoKey = 1, RasterPixelIsArea or,

2, RasterPixelIsPoint

GTCitationGeoKey = =(ASCII, 17), ASCII reference to public documentation

GeographicTypeGeoKey =GCS_WGS_84 = 4326

GeogLinearUnitsGeoKey

= 9001, Linear_Meter , or

= 9002, Linear_Foot

GeogAngularUnitsGeoKey = 9102, Angular Degree

ProjectedCSTypeGeoKey = Range= 20000-32760, EPSG Projection System Codes. (See Reference Document 7 for values)

UTM zones = Range = 32601-32760, (See Applicable Document 7 for values)

User Defined = 32767

ProjectionGeoKey

Range = 10000-19999, EPSG/POSC Projection Codes (See Appl. Doc. 7 for values).

32767= User Defined

ProjNatOriginLatGeoKey

Value in units of GeogAngularUnits

ProjScaleAtNatOriginGeoKey

Value entered as a ratio

ProjCenterLongGeoKey

Value entered in units of GeogAngularUnits

ProjFalseNorthingGeoKey

Value entered in units of ProjLinearUnits

ProjFalseEastingGeoKey

Value entered in units of ProjLinearUnits

Universal Transverse Mercator (UTM)

Valid Keys:

GTModelTypeGeoKey = 1, ModelTypeProjected(Projection Coordinate System)

GTRasterTypeGeoKey =1, RasterPixelIsArea or,

2, RasterPixelIsPoint

GTCitationGeoKey =(ASCII, 17), ASCII reference to public documentation

GeogLinearUnitsGeoKey

= 9001, Linear_Meter or

= 9002, Linear_Foot

GeogAngularUnitsGeoKey

= 9102, Angular_Degree

ProjectedCSTypeGeoKey

Range= 20000-32760, EPSG Projection System Codes. (See Reference Document 7 for values)

UTM zones = Range = 32601-32760, (See Applicable Document 7 for values)

User Defined = 32767

Oblique Mercator, Type B (OMB)

Valid Keys:

ProjCoordTransGeoKey = 3, CT_ObliqueMercator

GTModelTypeGeoKey = 1, ModelTypeProjected(Projection Coordinate System)

GTRasterTypeGeoKey = 1, RasterPixelIsArea or,

2, RasterPixelIsPoint

GTCitationGeoKey ==(ASCII, 17), ASCII reference to public documentation

GeographicTypeGeoKey = 4326, GCS_WGS_84

GeogLinearUnitsGeoKey

= Linear_Meter = 9001, or

=Linear_Foot = 9002

GeogAngularUnitsGeoKey = 9102, Angular_Degree

GeogAzimuthUnitsGeoKey = 9102, Angular_Degree

ProjectedCSTypeGeoKey

Range= 20000-32760, EPSG Projection System Codes. (See Reference Document 7 for values)

UTM zones = Range = 32601-32760, (See Applicable Document 7 for values)

User Defined = 32767

ProjectionGeoKey

Range = 10000-19999, EPSG/POSC Projection Codes (See Appl. Doc. 7 for values).

32767= User Defined

ProjAzimuthAngleGeoKey

Value entered in units of GeogAzimuthUnits

ProjScaleAtNatOriginGeoKey

Value entered as a ratio

ProjCenterLatGeoKey

Value entered in units of GeogAngularUnits

ProjCenterLongGeoKey

Value entered in units of GeogAngularUnits

ProjFalseNorthingGeoKey

Value entered in units of ProjLinearUnits

ProjFalseEastingGeoKey

Value entered in units of ProjLinearUnits

Lambert Conformal Conic (LCC)

Valid Keys:

ProjCoordTransGeoKey = 8, CT_LambertConfConic_2SP

GTModelTypeGeoKey = ModelTypeProjected(Projection Coordinate System) =1

GTRasterTypeGeoKey = RasterPixelIsArea =1 or,

= RasterPixelIsPoint =2

GTCitationGeoKey = ASCII reference to public documentation =(ASCII, 17)

GeographicTypeGeoKey =GCS_WGS_84 = 4326

GeogLinearUnitsGeoKey

= Linear_Meter = 9001, or

=Linear_Foot = 9002

GeogAngularUnitsGeoKey

=Angular_Degree = 9102

ProjectedCSTypeGeoKey = Range= 20000-32760, EPSG Projection System Codes. (See Reference Document 7 for values)

UTM zones = Range = 32601-32760, (See Applicable Document 7 for values)

User Defined = 32767

ProjectionGeoKey

Range = 10000-19999, EPSG/POSC Projection Codes (See Appl. Doc. 7 for values).

32767= User Defined

ProjStdParallel1GeoKey (LCC):

Value entered in units of GeogAngularUnits

ProjStdParallel2GeoKey (LCC):

Value entered in units of GeogAngularUnits

ProjFalseOriginLongGeoKey (LCC):

Value entered in units of GeogAngularUnits(Default to 0))

ProjFalseOriginLatGeoKey (LCC):

Value entered in units of GeogAngularUnits(Default to 0))

ProjNatOriginLatGeoKey:

Value in units of GeogAngularUnits

ProjFalseNorthingGeoKey

Value entered in units of ProjLinearUnits

ProjFalseEastingGeoKey

Value entered in units of ProjLinearUnits

Polar Stereographic (PS)

Valid Keys:

ProjCoordTransGeoKey

=15, CT_PolarStereographic

GTModelTypeGeoKey = ModelTypeProjected(Projection Coordinate System) =1

GTRasterTypeGeoKey = RasterPixelIsArea =1 or,

= RasterPixelIsPoint =2

GTCitationGeoKey = ASCII reference to public documentation =(ASCII, 17)

GeographicTypeGeoKey =GCS_WGS_84 = 4326

GeogLinearUnitsGeoKey

= Linear_Meter = 9001, or

=Linear_Foot = 9002

GeogAngularUnitsGeoKey

=Angular_Degree = 9102

ProjectedCSTypeGeoKey

Range= 20000-32760, EPSG Projection System Codes. (See Reference Document 7 for values)

UTM zones = Range = 32601-32760, (See Applicable Document 7 for values)

User Defined = 32767

ProjectionGeoKey

Range = 10000-19999, EPSG/POSC Projection Codes (See Appl. Doc. 7 for values).

32767= User Defined

ProjStraightVertPoleLongGeoKey

Value entered in units of GeogAngularUnits

ProjNatOriginLatGeoKey

Value in units of GeogAngularUnits

ProjFalseNorthingGeoKey

Value entered in units of ProjLinearUnits

ProjFalseEastingGeoKey

Value entered in units of ProjLinearUnits

Polyconic (PC)

Valid Keys:

ProjCoordTransGeoKey

=22, CT_Polyconic

GTModelTypeGeoKey = ModelTypeProjected(Projection Coordinate System) =1

GTRasterTypeGeoKey = RasterPixelIsArea =1 or,

= RasterPixelIsPoint =2

GTCitationGeoKey = ASCII reference to public documentation =(ASCII, 17)

GeographicTypeGeoKey =GCS_WGS_84 = 4326

GeogLinearUnitsGeoKey

= Linear_Meter = 9001, or

=Linear_Foot = 9002

GeogAngularUnitsGeoKey

=Angular_Degree = 9102

ProjectedCSTypeGeoKey

Range= 20000-32760, EPSG Projection System Codes. (See Reference Document 7 for values)

UTM zones = Range = 32601-32760, (See Applicable Document 7 for values)

User Defined = 32767 ProjectionGeoKey

Range = 10000-19999, EPSG/POSC Projection Codes (See Appl. Doc. 7 for values).

32767= User Defined

ProjCenterLatGeoKey

Value entered in units of GeogAngularUnits

ProjCenterLongGeoKey

Value entered in units of GeogAngularUnits

ProjFalseNorthingGeoKey

Value entered in units of ProjLinearUnits

ProjFalseEastingGeoKey

Value entered in units of ProjLinearUnits

4.3 HDF File Formats

4.3.1 Image Files

Each Earth image band in the requested product is contained in a separate file. The data are laid out in a scan line sequential format in descending detector order (i.e., detector 16 followed by detector 15 and so forth for the 30-m bands). The L1R image is radiometrically corrected but not geometrically resampled. The L1G image is radiometrically corrected and resampled for geometric correction and registration to geographic map projections.

4.3.2 Internal Calibrator Data Files

The IC data files are included only with the L1R output product. The IC data for format 1 consist of scan-line-ordered internal lamp and shutter data for bands 1 through 5 and blackbody radiance and shutter data for band 6L. IC data for format 2 consists of scan line ordered internal lamp and shutter data for bands 7 and 8 and black body radiance and shutter data for band 6H. The data are collected once per scan and structured in a band sequential format in detector descending order. The IC data format 1 file is provided with products that include bands 1 through 6 low image data; the format 2 file is provided with products that include bands 6 high through 8. These data are subsetted to correspond to the user-requested product (i.e., by band and product size).

4.3.3 Mirror Scan Correction Data File

The MSCD data file is included only with the L1R output product. Each logical record consists of three data values—the first half scan error, the second half scan error, and the scan line direction, along with scan quality information. This information, which usually applies to the previous scan, is used to compute deviations from nominal scan mirror profiles as measured on the ground and reported in the CPF. One consensus MSCD file is provided. A consensus MSCD file is a single MSCD file, created from the two original files included with the L0R product, with errors corrected according to LPGS processing algorithms. These data are subsetted to correspond to the user-requested product size. See Table 4.3-1 for file structure.

4.3.4 Payload Correction Data File

The PCD data file is included only with the L1R output product. This file consists of attitude and ephemeris profiles as well as high-frequency jitter measurements. One consensus PCD file is provided. A consensus PCD file is a single PCD file created from the two original files included with the L0R product and with errors corrected according to LPGS processing algorithms. This consensus PCD file will not be subsetted. See Table 4.3-2 for file structure.

4.3.5 Scan Line Offsets

The scan line offsets are included only with the L1R output product. The scan line offsets represent the actual starting and ending pixel positions for valid (nonzero fill) Earth image data on a data-line-by-data-line basis. The scan line offsets format 1 file is provided with products that include bands 1 through 6 low image data; the format 2 file is provided with products that include bands 6 high through 8. These data are subsetted to correspond to the user-requested product (i.e., by band and product size). See Table 4.3-3 for file structure.

4.3.6 Calibration Parameter File

The CPF is a formatted file containing radiometric and geometric processing parameters required for L1 processing. It is provided only with the L1R product, without modification from what was provided with the L0R product. A complete description of this file currently exists in the *Landsat 7 Calibration Parameter File Definition* (Applicable Document 5).

4.3.7 Geolocation Table File

The geolocation table file contains scene corner coordinates and their product-specific scan line numbers and is included only with the L1R product. See Table 4.3-4 for file structure.

4.3.8 LPS Metadata File

The Landsat Processing System (LPS) metadata files are included with the L1R output product without modification from what was provided with the L0R product. The metadata format 1 and format 2 files are provided with all L1R products.

Some information in the LPS metadata file pertains to parent subintervals of the LPGS product and may not be applicable to L1 products produced by the LPGS. See Table 4.3-5 for file structure.

4.3.9 LPGS Metadata File

The LPGS metadata file is created during product generation and contains information specific to the product ordered. Table 4.3-6 lists the full contents of the LPGS metadata file. This file contains all applicable image description information from the ECS metadata provided with the L0R product.

4.3.10 HDF Directory File

The directory file contains all the pointers, file size information, and data objects required to open and process the L1 product using the HDF library and interface routines.

4.3.11 Vgroup Definitions

The Vgroup structure was designed to associate related HDF data objects. Any HDF data object [e.g., Vdata, scientific data sets (SDSs), and attributes] can be included in an HDF Vgroup definition. Vgroups employ Vgroup names and Vgroup classes for characterizing a collection of data objects and for searching activities. Three classes are recognized for the L1 HDF product: image data, correction data, and metadata.

The HDF Vgroup interface consists of routines for accessing and getting information about the L1 product Vgroups. This information is stored in the HDF data directory.

The Vgroups used to relate the different data objects that make up a complete L1 product are presented in Tables 4.3-7 and 4.3-8.

Table 4.3-1. MSCD Vdata—Format 1 or 2 (1 of 4)

Vdata Name: "L71ppprrr_rrrYYYYMMDD.MSD"
Vdata Class: LPGS_MSCD
Interlace Type: FULL_INTERLACE
Bytes per Logical Record: 85
Number of Records: One record per product scan line (major frame)

Field Name	Number Type	Order	Description	Remarks
scan_no	uint16	1	Subinterval scan line counter; values = 1–11725	Provides a sequence counter for the ETM+ scans (major frames) contained in a 0R product. This counter is referenced relative to the subinterval, not the product.
Time	float64	1	ETM+ scan time in seconds since midnight January 1, 1993, rounded to 7 decimal places	Time code conversion from scan_timecode (next entry). ECS required time format.
scan_timecode	char8	25	Scan line time of the format 'YYYY:ddd:hh:mm:ss:tttttt' where YYYY = 4-digit Julian year ddd = Day (01–366) hh = Hour (00–23) mm = Minute (00–59) ss = Second (00–59) tttttt = Fractional second [0–9999375, where the clock cycle is 1/16 ms]	The ETM+ scan start time extracted from the timecode minor frames of the ETM+ major frame data reported in this data record. A computed scan start time is provided if a valid time is not available from the time code minor frames. Time is expressed using the Greenwich Mean Time (GMT) standard.
timecode_flag	uint8	1	Valid timecode flag, where 0 = Valid timecode 1 = Computed timecode	

eol_flag	uint8	1	Flag for valid end-of-line (EOL) pattern code: 0 = Valid pattern in expected minor frame location. 1 = Missing EOL code. The EOL pattern is not found at all. 2 = Valid pattern is found inside the user-specified range but outside the nominal range.	An EOL code is needed by LPS to start calibration data extraction. If an EOL code is missing, the nominal scan line length will be assumed. In this way, the pixel data may be salvaged, but the flag is needed to warn users that it may be suspect. However, calibration data would need to be filled because there is no way of knowing where that data started. A user-specified parameter gives the bilateral search zone around the nominal location for the EOL marker. The nominal range for the EOL marker is given in the eol_location field description (next entry).
eol_location	uint16	1	Minor frame location (number in the range 6318–6323) The minor frame location (number) within a major frame that contains the first word of the ETM+ EOL code. The eol_flag reports eol_location errors.	The EOL code is expected to occur within the vicinity of minor frame number 6,320 in each ETM+ major frame. The EOL code consists of two adjacent minor frames and indicates an end of the active scan period and start of a calibration data period past the scan line data (SLD) words. If ed_flag = 1, LPS supplies the nominal location for eol_location. This number is one based

Table 4.3-1. MSCD Vdata—Format 1 or 2 (2 of 4)

Field Name	Number Type	Order	Description	Remarks
scan_dir_vote	uint8	1	Scan direction majority vote quality 0 = All bits in all scan direction word groups are equal. 1 = At least 1 bit in the scan direction word groups is not equal to the other bits. 2 = Scan direction is not found for a missing and/or an entirely filled scan and is, therefore, interpolated from the previous scan if possible or is classified as unknown.	A majority vote quality of 1 may indicate an error with the received and/or decoded scan direction value (back to back forward or reverse scans).
scan_dir	char8	1	Scan direction character 'F' = Forward scan 'R' = Reverse scan U = Unknown	The ETM+ scan direction is interpolated from SLD minor frames of the first valid ETM+ major frame. This scan direction is for the previous scan (major frame). If the scan direction is unknown, the default Forward direction will be used for placing the data.
fhs_vote	uint8	1	First half scan (FHS) error majority vote quality 0 = All bits in each FHS error word group are equal. 1 = At least 1 bit in at least 1 FHS error word group is not equal to other bits in the group.	A value of 1 indicates that the received/decoded fhs_err value is probably erroneous.
fhs_err	int16	1	FHS error count: –2048 to 2047 This is a 12-bit number provided in an int16 field using two's complement notation.	The FHS error is interpolated from the SLD minor frames of the ETM+ major frame. This value is for the previous scan.
shs_vote	uint8	1	Second half scan (SHS) error majority vote quality 0 = All bits in each SHS error word group are equal. 1 = At least 1 bit in at least 1 SHS error word group is not equal to other bits in the group.	A value of 1 indicates that the received/decoded shs_err value is probably in error.
shs_err	int16	1	SHS error count: -2048 to 2047 This is a 12-bit number provided in an int16 field using two's complement notation.	The SHS error is interpolated from the SLD minor frames of the ETM+ major frame. This value is for the previous scan.
gain_status	char8	9	"ggggggggg" where g's identify bands 123456678 for both formats = 123456$$$ for format 1 = $$$$$$678 for format 2 where g = $ indicates unused field g = L indicates a low-gain state g = H indicates a high-gain state g = N's in all band positions indicates that gain values could not be found due to an entirely filled major frame.	For each band, the gain status is defined by the gain state value in the "PCD/Status Data" field of the first error-free virtual channel data unit (VCDU) containing data for the scan.

Table 4.3-1. MSCD Vdata—Format 1 or 2 (3 of 4)

Field Name	Number Type	Order	Description	Remarks
gain_change	char8	9	"ggggggggg" where g's identify bands 123456678 for both formats = 123456$$$ for format 1 = $$$$$$678 for format 2 where g = 0 indicates no gain change in a band position since last scan g = + indicates a gain change from low to high in a band position g = –indicates a gain change from high to low in a band position	This value is 0 if it is the first scan of a subinterval.
mux_assembly_id	uint8	1	0–7 = Landsat 7 multiplexer assemblies 0–7 9 = mux_assembly_id value could not be extracted from an entirely filled major frame.	Identifies the Landsat 7 spacecraft onboard multiplexer used in the ETM+ dataflow for this major frame. The multiplexer status is obtained from the first error-free channel access data unit (CADU)/VCDU used in the construction of this major frame.
cal_shutter_status	uint8	1	0 = Primary shutter 1 = Backup shutter 9 = cal_shutter_status value could not be extracted from an entirely filled major frame.	Identifies the Landsat 7 spacecraft internal calibration shutter status during the ETM+ data flow for this major frame. The CAL shutter status is obtained from the first error-free CADU/VCDU used in the construction of this major frame.
cadu_sync	uint8	1	Flag to indicate loss of CADU sync anywhere within the scan 0 = No loss 1 = Sync loss	A sync loss condition indicates potential loss of minor frame data requiring LPS to use fill data in completing a major frame.
scan_sync	uint8	1	Flag for valid sync for current major frame 0 = Valid sync 1 = Flywheeled sync	Valid sync: Line sync code was correctly found and decoded as specified in the Landsat 7 DFCB. Flywheeled sync: The sync in the current scan is forced "True" because the line sync code minor frame could not be correctly found and/or decoded as specified in the Landsat 7 DFCB. The presence of the line sync code was "deduced" from correctly finding/decoding the time code minor frames of an ETM+ major frame.

Table 4.3-1. MSCD Vdata—Format 1 or 2 (4 of 4)

Field Name	Number Type	Order	Description	Remarks
minf_faults	char8	1	Index (hexadecimal 0 through D) representing the number of minor frame faults (m) in the range: N = 0 for no faulty minor frames N = 1 for 1 <= m <=2 N = 2 for 3<= m <= 4 N = 3 for 5<= m <= 8 N = 4 for 9 <= m <= 16 N = 5 for 17 <= m <= 32 N = 6 for 33 <= m <= 64 N = 7 for 65 <= m <= 128 N = 8 for 129 <= m <= 256 N = 9 for 257 <= m <= 512 N = A for 513 <= m<= 1024 N = B for 1025 <= m <= 2048 N = C for 2049 <= m <= 4096 N = D for 4097 <= m <= NNNN where NNNN is an LPS operator-selectable parameter for the maximum number of minor frames possible in an ETM+ major frame.	LPS compute this quality index on a major frame basis. This index provides a quicklook assessment on the number of faulty minor frames contained in a major frame. Faulty minor frames contain fill data or are extracted from VCDUs containing uncorrected BCH errors. Lower quality indices indicate better quality major frames. Without bumper wear, there is a nominal of 7,423 minor frames in an ETM+ major frame. Accounting for 17 (TBR) minor frames of bumper wear on each end of the scanner, there could be a maximum of 7,457 minor frames in an ETM+ major frame.
cadus/vcdus_ received	uint16	1	= 0–650 Approximately 643 VCDUs are required to build one ETM+ major frame (~7,423 minor frames).	The number of VCDUs used to construct this ETM+ major frame.
fly_wheel_cadus	uint6	1	= 0–650	The total number of flywheel CADUs/VCDUs in this ETM+ major frame.
bit_slip_cadus	uint6	1	= 0–650	The total number of CADUs/ VCDUs detected with bit slip errors in this ETM+ major frame.
r-s_err_vcdus	uint6	1	= 0–650	The number of VCDUs with Reed-Solomon error used in building this ETM+ major frame.
bch_corrected_vcdus	uint6	1	= 0–650	The total number of VCDUs, containing corrected BCH errors in this major frame.
bch_uncorrected_ vcdus	uint6	1	= 0–650	The total number of VCDUs containing uncorrected BCH errors in this major frame.
filled_scan_flag	uint8	1	0 = No fill data used in this of four consecutive PCD major frames: (0), (1), (2), and (3). This number is incremented by one for each PCD major frame scan 1 = Entirely filled scan 2 = Partially filled scan	This flag indicates whether any predetermined fill data were used to build this ETM+ scan.
minf_filled	uint6	1	= 0–7500	The total number of filled minor frames in this ETM+ major frame. There are nominal 7,423 minor frames in a scan.

Table 4.3-2. PCD Vdata—Format 1 or 2 (1 of 10)

Vdata Name: "L71ppprrr_rrrYYYYMMDD.PCD
Vdata Class: LPGS_PCD
Interlace Type: FULL_INTERLACE
Bytes per Logical Record: 26,512
Number of Records: One record per PCD major frame (4.096 spacecraft second)

Field Name	Number Type	Order	Description	Remarks
cycle_count	uint8	1	PCD cycle number (00–99) There are approximately 52 PCD cycles in a 14-minute subinterval.	The PCD cycle number associated with PCD major frame reported in this record of the PCD file. A PCD cycle consists of a set of four consecutive PCD major frames: (0), (1), (2), and (3). This number is incremented by one for each PCD major frame.
majf_count	uint8	1	Major frame counter (001–255) The maximum number of PCD major frames in a 14-minute subinterval is 206.	The major frame counter value of the PCD major frame reported in this record of the subinterval PCD file. The PCD major frame number is incremented by one for each new PCD major frame added to this file.
majf_id	uint8	1	PCD major frame ID (0–3) Fill value = 255	PCD major frame (0) is identified by the presence of spacecraft ID and timecode information. Other PCD major frames are identified by their ID numbers (1–3).
majf_time	float64	1	PCD major frame time in GMT integer and fractional seconds since January 1, 1993, rounded to 7 decimal places. Fill value = -10	This time is the PCD major frame time (majf_timecode; see next entry) converted by LPS to seconds since January 1, 1993.
scan_timecode	char8	25	Scan line time of the form 'YYYY:ddd:hh:mm:ss.tttttt' where YYYY = 4-digit Julian year ddd = Julian day (001–366) hh = hours (00–23) ss = seconds (00–59) tttttt = fraction seconds (0–9999375, where the clock cycle is 1/16 ms) Fill value = $$$$....	For PCD major frame (0), the spacecraft time is extracted from PCD major frame (0) of a PCD cycle. For PCD major frames 1–3, the spacecraft timecode is interpolated using the time received for PCD major frame (0) of the associated PCD cycle. Time is expressed using the GMT standard. Fill value occurs at the beginning of the PCD file when there has not yet been a valid major frame (0) or there is a missing cycle.
bands_states	char8	8	Indicates ETM+ bands on/off states for format 1 and format 2 data. = 12345678 for all bands "ON" state in format 1 and format 2 data. A "–" indicates an off state or a missing band (e.g., "123–5678" means band 4 is off or missing). Fill value = $$$$$$$$	This information is extracted from the third PCD major frame, minor frame 32, word 72, bits 0–6 and major frame 2, minor frame 35, word 72, bit 0.
fac_flag	uint8	1	Full aperture calibration door flag: = 0 indicates no activity = 1 indicates calibration door activity (open and/or imaging) Fill value = 255	ETM+ calibration activity status. This status is interpolated from "serial word P" of the third PCD major frame, minor frame 84, word 72, bits 2 and 3.

Table 4.3-2. PCD Vdata—Format 1 or 2 (2 of 10)

Field Name	Number Type	Order	Description	Remarks
PCD Major Frame Quality and Accounting Data Except for majf_flag and timecode_flag, which have fill or missing indicators, the value 0 is used for an entirely filled major frame.				
unpacked_pcd_words	uint32	1	= 0-147,497 unpacked PCD words received for this major frame	Count of unpacked PCD words received for this PCD major frame.
unpacked_words_ missing	uint32	1	= 0-147,497 unpacked PCD words missing for this major frame	Count of unpacked PCD words identified as missing due to missing VCDUs. Some received PCD major frames may contain LPS filled data.
vote_errors	uint16	1	= 0-16384 packed words in a PCD major frame	Count of (packed) PCD major frame words found to contain voting errors during packing a PCD word/minor frame. Some PCD major frame words may contain erroneous or LPS filled data.
minf_sync_errors	uint8	1	= 0-128 (minor frames per major frame)	Count of PCD minor frames received with sync errors in this major frame. Some PCD words may be lost and filled due to minor frame sync errors.
minf_id_errors	uint8	1	= 0-128 (minor frames per major frame)	Count of PCD minor frames received with incorrect minor frame IDs (counter values). Corrected IDs are filled in.
minf_filled	uint8	1	= 0-128 (minor frames per major frame)	Count of PCD minor frames found with erroneous data in PCD words and filled by LPS with a known value.
majf_flag	uint8	1	PCD major frame flag where 0 = Valid major frame ID 1= Incorrect major frame ID; used for major frames (1), (2), and (3) only. If in error, the PCD major frame ID is corrected by LPS. 2 = Missing major frame ID	Indicates the quality of the PCD major frame ID found in word 72, minor frames 96-103 of PCD major frames (1), (2), and (3). PCD major frame (0) contains the timecode flag (next entry).
timecode_flag	uint8	1	Valid PCD timecode flag, where 0 = Valid timecode and spacecraft ID 1 = Computed timecode 2 = Corrected spacecraft ID 3 = Flags 1 and 2 combined. 4 = Fill value for timecode 5 = Fill value for timecode and spacecraft ID	Indicates the quality of the spacecraft ID and timecode data contained in word 72, minor frames 9-103, of PCD major frames(0). For PCD major frames (1)-(3), the timecode flag is also interpolated/ derived from the timecode flag used for major frame (0). Note that not all combinations of computed timecode, corrected spacecraft ID, and fill values for either are uniquely represented.

Table 4.3-2. PCD Vdata—Format 1 or 2 (3 of 10)

Field Name	Number Type	Order	Description	Remarks
PCD Major Frame Clock, Temperature, Ephemeris, and Attitude Data				
spacecraft_id	char8	1	spacecraft_id = “7 Fill value = $”	The Landsat 7 spacecraft ID is determined from bytes 0-3 of PCD timecode word 96 located in major frame (0) of each PCD cycle. For the remaining three major frames in a PCD cycle, this spacecraft ID is copied for each major frame. The spacecraft ID is also forced to “7” when an erroneous ID is read. The spacecraft ID error is noted in the s/c_id_pcd field.
The following four parameters are used to correct the spacecraft time, reported in the PCD and video, for clock drift to within 15 ms of universal time coordinated (UTC) using the following formulas. $\Delta t = Tsc - sv\_clk\_last\_u/d\_time$ $Tc = Tsc + C0 + C1\ \Delta t + .5\ C2\ (\Delta t\ \Delta t)$ where Tc is correct time, Tsc is uncorrected time, Δt is spacecraft clock time relative to last update.				
sv_clk_last_u/d_time	float64	1	sv_clk_last_u/d_time = 0-31,622,400 seconds from midnight of the first day of the current year. Fill value = 1.0	The time the last space vehicle clock update is inserted in the PCD stream by the Mission Operations Center (MOC) once per day during ETM+ nonimage periods.
time_drift_bias_c0	int16	1	Spacecraft time drift bias (C0) = –15 to +15 ms Fill value = 7FFF	Clock correction bias term—can be used to minimize the clock error over some span of time; may be set to zero if not needed.
time_drift_rate_c1	int16	1	Spacecraft clock drift rate (C1) = +/– ms/day Fill value = 7FFF	Clock correction first order coefficient (drift rate).
time_drift_acceln_c2	int16	1	Spacecraft clock drift acceleration (C2) = +/– ms/day^2 Fill value = 7FFF	Clock correction second order coefficient (drift acceleration); may be set to zero if not needed.
ETM+ Telemetry Sampled @4.096 Seconds Rate The following ETM+ telemetry is sampled every 4.096 seconds and inserted into the next PCD major frame. Major frames with missing or erroneous values are filled with ones (FF in hexadecimal for uint8 and FFFF for uint16).				
black_body_temp_iso	uint8	1	Black body temperature (isolated)	
cfpa_heater_current	uint8	1	Cold focal plane assembly (CFPA) heater current	
cal__shutr_flag_temp	uint8	1	Calibration shutter flag temperature	
b/u_shutr_flag_temp	uint8	1	Backup shutter flag temperature	
black_body_temp_con	uint8	1	Black body temperature (control)	
baffle_temp_heater	uint8	1	Baffle temperature (heater)	
cfpa_control_temp	uint8	1	CFPA control temperature	
pdf_a/d_ground_ref	uint16	1	PDF A/D ground reference	
ETM+ Telemetry Sampled @16.384 Seconds Rate The following PCD values are repeated for each PCD major frame. Major frames with missing or erroneous values are filled with ones (FF in hexadecimal).The following PCD values should be copied in the same format as found in their respective PCD words/minor frames in a PCD major frame.				

Table 4.3-2. PCD Vdata—Format 1 or 2 (4 of 10)

Field Name	Number Type	Order	Description	Remarks
serial_words_a_s	uint8	18	a,b,c,d,e,f,g,h,i,j,k,l,m,n,p,q,r,s	Serial Word "A" — Bits PS 2 Therm Shutdown Enabled 0 PS 1 Therm Shutdown Enabled 1 SMA +Z Heater Controller ON 2 SMA –Z Heater Controller ON 3 Spare 4 Shutter Link Switch A Closed 5 Shutter Link Switch A Closed 6 Shutter Link Switch A Closed 7 Serial Word "B" — Bits Band 1 ON 0 Band 2 ON 1 Band 3 ON 2 Band 4 ON 3 Band 5 ON 4 Band 6/mir ON 5 Band 7 ON 6 Cold Stage Telemetry ON 7 Serial Word "C" — Bits Cooler Door (CD) Closed 0 CD Outgas Position 1 CD Full Open 2 CD Magnet ON 3 CD Motor Drive ON 4 CD Link Switch A Closed 5 CD Link Switch A Closed 6 CD Link Switch A Closed 7 Serial Word "D" — Bits IC Lamp 1 ON 0 IC Lamp 2 ON 1 Spares 2, 5, 6, 7 IC Lamp 1 Backup ON 3 IC Lamp 2 Backup ON 4 Serial Word "E" — Bits Band P ON 0 Spare 1 Blackbody Heater Controller ON 2 Blackbody T2 ON 3 Blackbody T3 ON 4 Blackbody Backup ON 5 SME 1 ON 6 SME 2 ON 7 Serial Word "F" — Bits Baffle Heater Controller ON 0 Baffle Heater Backup ON 1 Spare 2 Spare 3 Spare 4 Spare 5 Spare 6 Spare 7

Table 4.3-2. PCD Vdata—Format 1 or 2 (5 of 10)

Field Name	Number Type	Order	Description	Remarks
				Serial Word "G" — Bits Scan Line Corrector 1 ON — 0 Scan Line Corrector 2 ON — 1 Calibration Shutter ON — 2 Calibration Shutter Phase Error — 3 Calibration Shutter Amp. Error — 4 Backup Shutter ON — 5 Backup Shutter Phase Error — 6 Backup Shutter Amp. Error — 7 Serial Word "H" — Bits Cold Stage Heater Cont. ON — 0 Cold Stage Outgas Heater Controller ON — 1 Int. Stage Heater Controller ON — 2 Int. Stage Heater Enabled — 3 CFPA Heater Controller ON — 4 CFPA T2 Relay ON — 5 CFPA T3 Relay ON — 6 CFPA Telemetry ON — 7 Serial Word "I" — Bits DC Restore Normal — 0 Frame DC Restore Selected — 1 Telemetry Scaling ON — 2 SMA +Z Heater Enabled — 3 SMA –Z Heater Enabled — 4 Spare — 5 SME 1 Select SAM — 6 Spare Opto — 7 Serial Word "J" — Bits AEM Mtpx 1 Bnd 1 Gain State — 0 AEM Mtpx 1 Bnd 2 Gain State — 1 AEM Mtpx 1 Bnd 3 Gain State — 2 AEM Mtpx 1 Bnd 4 Gain State — 3 AEM Mtpx 1 Bnd 5 Gain State — 4 AEM Mtpx 1 Bnd 6 PRI G State — 5 AEM Mtpx 1 Band 7 Gain State — 6 AEM Mtpx 1 Band P Gain State — 7

Table 4.3-2. PCD Vdata—Format 1 or 2 (6 of 10)

Field Name	Number Type	Order	Description	Remarks
				Serial Word "K" Bits AEM Mtpx 2 Bnd 1 Gain State 0 AEM Mtpx 2 Bnd 2 Gain State 1 AEM Mtpx 2 Bnd 3 Gain State 2 AEM Mtpx 2 Bnd 4 Gain State 3 AEM Mtpx 2 Bnd 5 Gain State 4 AEM Mtpx 2 Bnd 6 PRI G State 5 AEM Mtpx 2 Band 7 Gain State 6 AEM Mtpx 2 Band P Gain State 7 Serial Word "L" Bits Cooler Door Dir. (1 = Open) 0 Cooler Door Move Enable 1 FAC Failsafe Stat Motor Power ON 2 FAC Primary Stat Motor Power ON 3 FAC Primary Motor Power ON 4 FAC Failsafe Motor Power ON 5 FAC Primary Contr. Direction 6 FAC Failsafe Contr. Direction 7 Serial Word "M" Bits Mux 1/2 Anlg Power Selected 0 Mux 1/2 Digtl Power Selected 1 Spare 2 Spare 3 FAC Prim Contr Sngl Stp Sizes 4 FAC Flsfe Contr Sngl Stp Sizes 5 FAC Primary Contr Power ON 6 FAC Failsafe Contr Power ON 7 Serial Word "N" Bits AEM Multiplexer 1 ON 0 AEM Multiplexer 2 ON 1 AEM Mtpx 1 MDE ON Status 2 AEM Mtpx 2 MDE ON Status 3 AEM Mtpx 1 B6 RDT Gain St 4 AEM Mtpx 2 B6 RDT Gain St 5 AEM Mtpx 1 Data Priority Sel 6 AEM Mtpx 2 Data Priority Sel 7

Table 4.3-2. PCD Vdata—Format 1 or 2 (7 of 10)

Field Name	Number Type	Order	Description	Remarks
				Serial Word "P" — Bits FAC Stow Position Switch PRI — 0 FAC Stow Position Switch RDT — 1 AEM Cal Position Switch PRI — 2 AEM Cal Position Switch RDT — 3 AEM Cal/Stw Mv ON Stat PRI — 4 AEM Cal/Stw Mv ON Stat RDT — 5 AEM Mtpx 1 Data Priority Sel — 6 AEM Mtpx 2 Data Priority Sel — 7 Serial Word "Q" — Bits FAC Pull-Pin (PP) Heater 1 ON — 0 FAC PP Heater 2 ON — 1 FAC PP Heat Pwr, En PRI — 2 FAC PP Heater Power — 3 FAC PP Retrct Pos Swtch PRI — 4 FAC PP Retrct Pos Swtch RDT — 5 FAC PP Fully Ret Pos Swt PRI — 6 FAC PP Fully Ret Pos Swt RDT — 7 Serial Word "R" — Bits FAC Prim CW Rot Swtch Stat — 0 FAC Prim CCW Rot Swtch Stat — 1 FAC Red CW Rot Swtch Stat — 2 FAC Red CCW Rot Swtch Stat — 3 Spare — 4 Spare — 5 Spare — 6 Spare — 7 Serial Word "S" — Bits Command Reject, Enable 1 P — 0 Command Reject, Enable 2 P — 1 Command Reject, Enable 3 P — 2 Command Reject, Enable 4 P — 3 Command Reject, Enable 1 R — 4

Table 4.3-2. PCD Vdata—Format 1 or 2 (8 of 10)

Field Name	Number Type	Order	Description	Remarks
				Serial Word "S" Bits Command Reject, Enable 2 R 5 Command Reject, Enable 3 R 6 Command Reject, Enable 4 R 7
mux1_elec_temp	uint8	1	Mux 1 electronics temperature	See group comment above.
mux1_ps_ temp	uint8	1	Mux 1 power supply temperature	See group comment above.
mux2_elec_temp	uint8	1	Mux 2 electronics temperature	See group comment above.
mux2_ps_temp	uint8	1	Mux 2 power supply temperature	See group comment above.
acs_cpu_mode	uint8	1	Attitude Control System (ACS) CPU mode	See group comment above.
etm_tlm_mnf_16_30	uint8	15	ETM telemetry MF(2), mfs (16-30)	See group comment above.
etm_tlm_mnf_40_49	uint8	10	ETM telemetry MF(2) mfs (40-49)	See group comment above.
etm+_on_time	float64	1	Time ETM+ was last on: etm_on_time = 0-31,622,400 seconds from midnight of the first day of the current year. Reported for each PCD major frame (0) record. If a PCD major frame (1, 2, or 3) does not contain the required PCD value, use -1.0 as the fill value.	Reported as an HDF double-precision floating point number to accommodate the 48-bit extended precision floating point value/ sample received in major frame (0) of a PCD cycle.
etm+_off_time	float64	1	Time ETM+ was last off: See above for related description.	See above.
Ephemeris Data The ephemeris data, consisting of the position and velocity components, are available on a PCD major frame basis.				
ephem_position_xyz	float64	3	x,y,z position range: +/– 8.3886 x 10^6 meters Fill value = 10^7	The coordinate system is the J2000 and is defined in the Program Coordinates System Standard.
ephem_velocity_xyz	float64	3	x,y,z velocity range: +/– 8.0 meters/ms Fill value = 10	
Attitude Estimate The spacecraft calculates an estimate of the attitude represented as Euler parameters. Components 1–3 define the eigen-axis of rotation in Earth Center Inertial (ECI) coordinates, and component 4 defines the rotation about that axis				
attitude_est_epa1234	float64	4	epa1, epa2, epa3, epa4 Fill value = 2	epa1, epa2, epa3 are components 1–3. epa4 is component 4.
Gyro (Inertial Measurement Unit (IMU) Axes) Data The following IMU axes (x, y, z) readings are repeated 64 times in each major frame. The IMU axes values are in arc-seconds of angular motion. A total of 256 readings (samples) are collected for each PCD cycle. The Gyro data order is as follows: · All 64 roll values (Roll-1, Roll-21...) · All 64 pitch values (Pitch-1, Pitch-2...) · All 64 yaw values (Yaw-1, Yaw-2...) Each IMU axes counter value is first constructed by concatenating the 3 bytes for each axis (e.g., x1, x2, and x3) and then converting to arc-seconds. For converting the IMU counter values to engineering units, each increment or decrement in the 24-bit counter value of an IMU axis represent a 0.061 arc-second change. Fill values are MAXFLOAT.				

Table 4.3-2. PCD Vdata—Format 1 or 2 (9 of 10)

Field Name	Number Type	Order	Description	Remarks
gyro-select_data	char8	1	A = gyro A selected B = gyro B selected – = gyro select error (decoding error) A gyro selection is error free when all three X, Y, and Z axes associated with a selected gyro A or B, are true (1's for gyro A and 0's for gyro B). Fill value = $	Bits 0–2 of minor frame 34 in subcom word 72 of PCD major frame 0 identifies the Landsat 7 selected gyro, A or B. Bits 3–7 are ignored.
imu_roll_x00_x63	float64	64	= – 511705.088 to + 511705.027 arc-seconds, and nn = 0-63 represents the sample number within the major frame.	See above.
imu_pitch_y00_y63	float64	64	See above.	See above.
imu_yaw_z00_z63	float64	64	See above.	See above.
Gyro Drift Data The gyro drift data are reported once per PCD cycle in major frame (0) only. The calculation is made at the PCD cycle time code minus 8.192 seconds in the ACS reference axis coordinate system.				
gyro_drift_theta-xyz	float64	3	x, y, z gyro drift The units of gyro drift (rate) data for each axis are in radians/512 ms. Fill value = -1.0	The least significant bit weight of the theta value is adjusted to 2^{-47} before converting to engineering units.
Angular Displacement Sensor Data (ADS) The minor frame IDs are reported serially for each major frame. The 16 sets of ADS x, y, z values are reported as a distinct entry for each of the 128 minor frames in a PCD major frame. All ADS x, y, z measurements are converted to microradians and reported in ascending order of their source words and minor frames in a PCD major frame. All data are reported with single floating point precision. A total of 16 ADS measurements, each consisting of the x, y and z components, are received in a PCD minor frame. Fill value for all, including mnfm_ids_000_127, is 255.				
mnfm_ids_000_127	uint8	128	Minor frame counter or ID: 000–127	The PCD minor frame counter value/ID from word location 65 of each minor frame. There are 128 (IDs: 000-127) minor frames in a PCD major frame.
ads_xyz16_mnfm_000	float32	48	ADS measurement x01, y01, z01 through x16,y16,z16 received in minor frame 0	
ads_xyz16_mnfm_001	float32	48	ADS measurement x01, y01, z01 through x16,y16,z16 received in minor frame 1	
⋮	⋮	⋮	ADS measurements as above for minor frames 2 through 126	
ads_xyz16_mnfm_127	float32	48	ADS measurement x01, y01, z01 through x16,y16,z16 received in minor frame 127	
ADS Temperatures The ADS x, y, z, and A/D electronic temperature values are reported on a major frame basis (i.e., every 4.096 seconds). All temperatures are reported in degrees Centigrade.				
ads_temp_xyz+a/d	float32	4	See above. Includes temperature values for components: x, y, z and elec_a/d. Fill value = 255	See above.
PCD Quality and Accounting Data The following PCD quality data are LPS-produced and appended to each major frame record of the PCD file.				

Table 4.3-2. PCD Vdata—Format 1 or 2 (10 of 10)

Field Name	Number Type	Order	Description	Remarks
s/c_id_err_pcd	char8	1	Spacecraft ID error in PCD n = no errors y = errors detected in the spacecraft ID field	The error flag is true whenever the spacecraft ID is not equal to “7” and is corrected to “7”.
att_data_quality	char8	1	Attitude data point quality g = good data r = rejected data m = missing data	Determined and produced by LPS for each PCD major frame. “r” indicates that the attitude data failed range check. “m” indicates missing attitude data replaced with fill data.
ephem_data_quality	char8	1	Ephemeris data point quality g = good data r = rejected data m = missing data	Determined and produced by LPS for each PCD major frame. “r” indicates ephemeris data failed range check. “m” indicates missing ephemeris data replaced with fill data.

Table 4.3-3. Scan Line Offsets Vdata

Vdata Name: "L7fppprrr_rrrYYYYMMDD.ONN"
Vdata Class: LPGS_SLO
Interlace Type: FULL_INTERLACE
Bytes per Logical Record: 44
Number of Records: One record per data line for the corresponding band file.

Field Name	Number Type	Order	Description	Remarks
scan_timecode	char8	25	Scan line time of the form 'YYYY:ddd:hh:mm:ss.tttttt' where YYYY = 4-digit Julian year ddd = Day (01 through 366) hh = Hour (00 through 23) mm = Minute (00 through 59) ss = Second (00 through 59) tttttt = Fractional second (0-9999375 or 0-15/16 ms)	The ETM+ scan start time extracted from the timecode minor frames of the ETM+ major frame data reported in this record. A computed scan start time is provided if a valid time is not available from the ETM+ time code minor frames. The scan time code is referenced to GMT.
scan_time	float64	1	The ETM+ scan time in decimal notation seconds since midnight on January 1, 1993, rounded to 7 decimal places.	The scan_time is obtained by converting the scan_timecode (previous entry) to seconds. This is also referenced to GMT.
scan_no	uint16	1	1-11,725 The maximum scan count is based on a subinterval duration of 14 minutes for 35 scenes, each consisting of 335 nonoverlapping scans.	A sequence counter for ETM+ scans (major frames) contained in a subinterval. The ETM+ scan counter is incremented by one for each new scan, real or flywheeled, added to the subinterval file.
scan_data_line_no	uint32	1	SSSSSS where SSSSSS = 1-187,600 for bands 1-5 and 7 = 1-93,800 for band 6 = 1-375,200 for band 8 **NOTE**: The band 8 scan data line count is not reset between segments (1 -3).	The scan line counter is incremented for each detector data line added to the product band file. There are 16 scan data lines each for bands 1-5 and 7, 8 for band 6, and 32 for band 8 in each ETM+ scan. The maximum line counts are shown for a 14-minute subinterval (35 scenes).
detector_id	int8	1	= 1-16 for bands 1-5 and 7 = 1-8 detectors for band 6 = 1-32 for band 8	Each scan line in an image file consists of samples from a single detector of a single band. Each detector, chosen in a descending ID order, is used once during each scan for generating a scan line.
scan_data_line_ offset_rhs	int16	1	= 0-240 bytes for bands 1-5 and 7 = 0-120 bytes for bands 6L (format 1) and 6H (format 2) = 0-480 bytes for band 8 The scan line data may be shifted to right in the band data buffer after an integer-pixel alignment.	The scan line data are shifted to the right in a larger buffer to accommodate integer pixel alignment without data loss. After integer-pixel alignment, this field indicates the trailing zero fill buffer for each data line. This offset can accommodate an enlarged active scan line length from attitudinal gyrations and ETM+ bumper wear.
scan_data_line_ offset_lhs	int16	1	= 0-44 bytes for bands 1-5 and 7 = 0-22 for band 6 = 0-88 for band 8	The left-hand-side offset is not as significant as the right-hand-side margin. It can accommodate scan line length growths due to ETM+ scanner bumper wear.

Table 4.3-4. Geolocation Table Vdata

Vdata Name: "L71ppprrr_rrrYYYYMMDD.GEO"
Vdata Class: Index
Interlace Type: FULL_INTERLACE
Bytes Per Logical Record: 57
Number of Records: One record per WRS scene in the product

Field Name	Number Type	Order	Description
UlLon	float32	1	Scene longitude—upper left corner
UlLat	float32	1	Scene latitude—upper left corner
UrLon	float32	1	Scene longitude—upper right corner
UrLat	float32	1	Scene latitude—upper right corner
LlLon	float32	1	Scene longitude—lower left corner
LlLat	float32	1	Scene latitude—lower left corner
LrLon	float32	1	Scene longitude—lower right corner
LrLat	float32	1	Scene latitude—lower right corner
FirstLine_15m	int32	1	Beginning scene line number—15m
LastLIne_15m	int32	1	Ending scene data line number—15m
FirstLine_30m	int32	1	Beginning scene line number—30m
LastLine_30m	int32	1	Ending scene line number—30m
FirstLine_60m	int32	1	Beginning scene line number 60m
LastLIne_60m	int32	1	Ending scene line number—60m
FullScene	char8	1	Full scene indicator flag (Y or N)

Table 4.3-5. LPS Metadata File—ODL Parameter Values (1 of 16)

Vdata Name: "L7fppprrr_rrrYYYYMMDD.MTA"
Vdata Class: LPS_Metadata
Interlace Type: FULL_INTERLACE
Bytes Per Logical Record: 65536
Number of Records: One record.
Field Name: Metadata_Format_1 or Metadata_Format_2
Data Type: Char8 – Count: 65536

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
GROUP	13	= METADATA_FILE	Beginning of first level ODL group. It indicates the start of the LPS metadata file level group records for an ETM+ format 1 or format 2 subinterval.
GROUP	18	= METADATA_FILE_INFO	Beginning of second level ODL group. It indicates the start of the LPS metadata file information group records.
FILE_NAME	22	= "L7XsssfnYYDOYHHuuv.XXX" where XXX = "MTA" for the metadata file.	Complete details on the LPS file naming convention are specified in Applicable Document 4
FILE_CREATION_ DATE_TIME	20	= YYYY-MM-DDThh:mm:ssZ where YYYY = 4-digit Julian year (e.g.,1998 and 2001) MM = Month number of a Julian year (01-12 for January to December) DD = Day of a Julian month (01-31) T indicates the start of time information in the ODL time code format hh = Hours (00-23) mm = Minutes (00-59) ss = Seconds (00-59) Z indicates "Zulu" time (same as GMT)	The LPS system date and time when the metadata file for an L0R file set was created. For ease of human readability, this date and time information is presented in the ODL ASCII format. The time is expressed as Universal Coordinated Time (also known as Greenwich Mean Time (GMT)). Insertion of additional characters "T" and "Z" is required to meet the ODL ASCII time format.
FILE_VERSION_NO	1	= 0-9, where = 0 indicates "not a reprocessed file" = 1-9 indicates the file reprocess count. The 1-digit LPS file version no. is also used in the FILE_NAME.	Reprocessing indicator to distinguish this file from the metadata file generated earlier for the same subinterval and provided to the EDC DAAC. The reprocessing information is entered/ supplied by an operator during setup of the L0R processing operations.
STATION_ID	3	= SSS, where SSS indicates a 3-character ground station code. For LPS, SSS = "EDC" for station contacts received directly at EDC. For data received from other stations, SSS = 'AGS' for Fairbanks, Alaska, and 'SGS' for Svalbard, Norway. If data are received on tape from an IGS station, then the IGS station ID is used. See the Landsat 7 to IGS ICD for the full set of IGS stations.	This parameter identifies the Landsat 7 ground station that received the raw data from Landsat 7. This parameter distinguishes metadata processed from files received directly at EDC from data originating at other ground stations.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (2 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
SOFTWARE_ VERSION_NO	5	= X.Y.Z where X is the major release number. Y is the minor release number. Z is the patch (or engineering) release number. X, Y, and Z are numeric numbers.	Version number of the software installed on the LPS string when metadata and associated L0R files were generated.
L7_CPF_NAME	25	= L7CPFyyyymmdd-yyyymmdd.nn, where yyyymmdd = effective_date_ begin and effective_date_end, respectively nn = incrementing version number for within a quarter (00-99)	The name number of the Landsat 7 CPF received from IAS and used in generating the L0R files identified in this metadata file.
END_GROUP	18	= METADATA_FILE_INFO	End of the second level ODL group. It indicates the end of the LPS metadata file information group records.
GROUP	26	= SUBINTERVAL_ METADATA_ FMT_m where m = 1 for format 1 or 2 for format 2	Beginning of the second level ODL group. It indicates the start of the ETM+ format 1 or format 2 subinterval level metadata group records.
SPACECRAFT_ID	8	= “Landsat7”	
SENSOR_ID	4	= “ETM+”	
CONTACT_ PERIOD_START_ TIME	187	YYYY-DOYTHH:MM:SSZ where YYYY = 4-digit Julian year DOY = Julian day of year (001-366) T indicates start of time information in the ODL ASCII time code format HH = Hour of day (00-23) MM = Minutes (00-59) SS = Seconds (00-59) Z indicates ‘Zulu’ time (same as GMT)	The Julian date and GMT when capture of a Landsat 7 contact period, associated with this subinterval, was started by the LPS. An uppercase time format indicates time obtained from LPS or a Landsat 7 system. A lowercase time format indicates time obtained from the Landsat 7 spacecraft wideband data (image and/or PCD).
CONTACT_ PERIOD_STOP_ TIME	18	YYYY-DOYTHH:MM:SSZ (See CONTACT_PERIOD_ START_TIME, above)	The Julian date and GMT when capture of a contact period, associated with this subinterval, was completed by the LPS.
STARTING_PATH	3	= 001-233 (leading 0s are required)	The WRS path number for the scenes included in this subinterval.
STARTING_ROW	3	= 001-248 (leading 0s are required)	The starting WRS row number for the scene data included in this subinterval.
ENDING_ROW	3	= 001-248 (leading 0s are required)	The ending WRS row number for the scene data included in this subinterval.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (3 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
SUBINTERVAL_ START_TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where YYYY = 4-digit Julian year ddd = Day (001-366*) T indicates the start of time information in the ODL ASCII time code format hh = Hour (00-23) mm = Minute (00-59) ss = Second (00-59) tttttt = Fractional second (0-9999375 or 0-15/16 ms) Z indicates 'Zulu' time (same as GMT) * For cases when active imaging occurs past the end of a leap year during a single contact period.	The spacecraft time extracted from the timecode minor frames of the first ETM+ major frame of the subinterval reported in this file. A computed start time is provided if the timecode in the first ETM+ major frame is in error. **NOTE**: The year information (Capitalized) is appended by LPS to the spacecraft timecode.
SUBINTERVAL_ STOP_TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where the time format is the same as for SUBINTERVAL_START_ TIME, above	The spacecraft time extracted from the timecode minor frames of the last ETM+ major frame of the subinterval reported in this file. **NOTE**: The year information (Capitalized) is appended by LPS to the spacecraft timecode.
TOTAL_ETM_ SCANS	1-5	= N-11725 where N is an LPS operator-selectable parameter value for the smallest scene size to be included in a subinterval. The default value of N is 335.	The total number of ETM+ scans reported in this subinterval file. A maximum of 11,725 scans can be received in a 14-minute subinterval (based on a maximum of 35 full scenes, each consisting of at most 335 nonoverlapping scans).
PCD_START_TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where the time format is the same as for SUBINTERVAL_START_ TIME, above.	Spacecraft time of the first PCD major frame in the PCD file associated with this subinterval.
PCD_STOP_TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where the time format is the same as for SUBINTERVAL_START_ TIME, above.	Spacecraft time of the last PCD major frame in the PCD file associated with this subinterval.
TOTAL_PCD_ MAJOR_FRAMES	1-3	= 0-255	The total number of PCD major frames received in the PCD file associated with this subinterval. Approximately 212 major frames can be received by the LPS during a 14-minute subinterval.
SUBINTERVAL_UL_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	LPS calculated "actual" latitude value for the upper left corner of the subinterval. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_UL_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	LPS calculated "actual" longitude value for the upper left corner of the subinterval. A subinterval may start at the first actual scan (not filled) in a partial scene.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (4 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
SUBINTERVAL_UR_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	LPS calculated “actual” latitude value for the upper right corner of the subinterval. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_UR_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	LPS calculated “actual” longitude value for the upper right corner of the subinterval. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_LL_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	LPS calculated “actual” latitude value for the lower left corner of the subinterval. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LL_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	LPS calculated “actual” longitude value for the lower left corner of the subinterval. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LR_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	LPS calculated “actual” latitude value for the lower right corner of the subinterval. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LR_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	LPS calculated “actual” longitude value for the lower right corner of the subinterval. A subinterval may end at the last actual scan (not filled) in a partial scene.
ETM_LAST_ON_TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where the time format is the same as for SUBINTERVAL_START_ TIME above.	See the Landsat 7 DFCB for details on this time.
ETM_LAST_OFF_ TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where the time format is the same as for SUBINTERVAL_START_ TIME above.	See the Landsat 7 DFCB for details on this time.
UT1_CORRECTION	8	= –0.90000-0.90000 seconds This time could be as large as 0.9 seconds in increments of fractions of seconds.	The UTC-UT1 time difference in seconds obtained from the Landsat 7 CPF received from IAS.
BAND1_PRESENT	1	= “Y” indicates that band 1 is present in this subinterval or = “N” indicates that band 1 is not present in this subinterval This field is included in the ETM+ format 1 metadata only.	This is the “Band 1 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 0, where a bit set condition. (=1) indicates “Band 1 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (5 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
BAND2_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	This is the “Band 2 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 1, where a bit set condition (=1) indicates “Band 2 ON state.” The first error-free PCD major frame (2) is used to derive this value.
BAND3_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	This is the “Band 3 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 2, where a bit set condition (=1) indicates “Band 3 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.
BAND4_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	This is the “Band 4 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 3, where a bit set condition (=1) indicates “Band 4 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.
BAND5_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	This is the “Band 5 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 4, where a bit set condition (=1) indicates “Band 5 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.
BAND6_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 1 or format 2 metadata.	This is the “Band 6/MIR ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 5, where a bit set condition (=1) indicates “Band 6 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.
BAND7_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 2 metadata only.	This is the “Band 7 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 6, where a bit set condition (=1) indicates “Band 7 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.
BAND8_PRESENT	1	Same as BAND1_PRESENT values and format. This field is included in the ETM+ format 2 metadata only.	This is the “Band 8 ON” status information obtained from PCD Serial Word “E” (major frame (2), minor frame 35, word 72), bit 0, where a bit set condition (=1) indicates “Band 8 ON state.” The first error-free PCD major frame (2), found in the subinterval, is used to derive this value.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (6 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
TOTAL_WRS_ SCENES	1-2	= 0-9 This field is included in ETM+ format 1 and 2 metadata. **NOTE**: The LPS produces this count from the total number of WRS scenes identified in a subinterval. The LPS does not use the absolute difference between STARTING_ROW and ENDING_ROW to compute this +1 count.	This count indicates the total number of WRS scenes identified by LPS in a subinterval. A maximum of 35 full WRS scenes, including partial scenes at the start and/or the end of a subinterval, may be received by LPS in a 14-minute subinterval. This count also indicates the total number of multiband-scene browse files, for full and partial scenes, that may be produced by LPS and reported in the scene metadata.
PARTIAL_WRS_ SCENES	1	= 0-2	Indicates the count of partial scenes, if any, at the start and/or at the end of a subinterval.
TOTAL_FILES	1-2	= 10-45 (format 1 with up to 35 multiband browse scene files) or = 6– 9 (format 2 with up to 3 band 8 file segments)	The total number of LPS files included in this subinterval for ETM+ format 1 or format 2. Assuming that a subinterval contains at least one scene, the metadata file will contain the names of a minimum of 10 files (6 band, 1 MSCD, 1 PCD, 1 calibration, and 1 multiband scene browse) for format 1, and 6 files (3 band, 1 MSCD, 1 PCD, and 1 calibration) for format 2, respectively. A maximum of 35 full multiband scene browse files are provided for format 1 subinterval only.
BAND1_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B10” (see Applicable Document 4 for details on the file naming convention. Also note that actual product filenames are born from this convention.)	This file name is included in a format 1 metadata file only.
BAND2_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B20” (see Applicable Document 4 for details)	This file name is included in a format 1 metadata file only.
BAND3_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B30” (see Applicable Document 4 for details)	This file name is included in a format 1 metadata file only.
BAND4_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B40” (see Applicable Document 4 for details.	This file name is included in a format 1 metadata file only.
BAND5_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B50” (see Applicable Document 4 for details)	This file name is included in a format 1 metadata file only.
BAND6_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B60” (see Applicable Document 4 for details)	This file name is included in a format 1 or format 2 metadata file.
BAND7_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.B70” (see Applicable Document 4 for details)	This file name is included in a format 2 metadata file only.
BAND8_FILE1_NAME	22	= “L7XsssfnYYDOYHHuuv.B81” (see Applicable Document 4 for details)	This band 8 file segment name is included in a format 2 metadata file only. Up to three band 8 file segments, each up to 2 GB long, are expected in a format 2 subinterval.
BAND8_FILE2_NAME	22	= “L7XsssfnYYDOYHHuuv.B82” (see Applicable Document 4 for details)	The name of this band 8 file segment, if it exists in a subinterval, is included in a format 2 metadata file only.
BAND8_FILE3_NAME	22	= “L7XsssfnYYDOYHHuuv.B83” (see Applicable Document 4 for details)	The name of this band 8 file segment, if it exists in a subinterval, is included in a format 2 metadata file only.
MSCD_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.MSD” (see Applicable Document 4 for details)	Name of the MSCD file associated with this subinterval.
PCD_FILE_NAME	22	= “L7XsssfnYYDOYHHuuv.PCD” (see Applicable Document 4 for details)	Name of the PCD file associated with this subinterval.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (7 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
CAL_FILE_NAME	22	= "L7XsssfnYYDOYHHuuv.CAL" (see Applicable Document 4 for details)	Name of the calibration file associated with this subinterval.
Scene-Level Metadata The following parameter values are repeated for each ETM+ format 1 or format 2 scenes included in a subinterval.			
GROUP	17	= METADATA_SCENE_NN where NN = 01-99 (up to 35 full scenes are expected in a 14-minute subinterval)	Beginning of the second level ODL group. It indicates the beginning of the ETM+ format 1 or format 2 Scene NN level metadata group records.
GROUP	12	= WRS_SCENE_NN_ where NN = 01-99	Beginning of the third level ODL group. It indicates the beginning of the ETM+ format 1 or format 2 WRS Scene 1 metadata group records.
Scene-Level Metadata The following parameter values are repeated for each WRS scene included in the subinterval.			
WRS_SCENE_NO	1-2	= 1-99	This is the LPS-assigned WRS scene number within a subinterval.
FULL_OR_ PARTIAL_SCENE	1	= F or P where F indicates a full WRS scene P indicates a partial WRS scene at start or end of a subinterval.	The LPS may receive partial WRS scenes at the start and/or the end of a subinterval.
BROWSE_FILE_NAME	22	= "L7XsssfnYYDOYHHuuv.XXX" for a format 1 subinterval (see Applicable Document 4) No browse file names are provided if its a format 2 subinterval. XXX = Rnn where R indicates a multiband scene browse file, and nn = 00-99 indicates the multiband scene browse file number within a subinterval.	The LPS generates multiband scene browse files for ETM+ format 1 (bands 1-6) only. The names of all multiband scene browse files, generated for a format 1 subinterval, are provided with and reported in the format 1 metadata. A maximum of 35 full WRS scenes are possible in a subinterval.
WRS_PATH	3	= 001-233 (leading zeros are required)	The WRS path number associated with the scene from PCD scene accounting.
WRS_ROW	3	= 001-248 (leading zeros are required)	The WRS row number associated with the scene.
SCENE_CENTER_ SCAN_NO	2-5	= 1-11725 for "actual" scene centers in the subinterval. For a partial scene with less than a half scene length data, the scene center scan number may be outside the actual subinterval band data range. It will point to the nonexistent scan 0 in the band file.	The ETM+ scan number nearest the calculated (actual) center of a WRS scene. A WRS scene scan number within a 14-minute subinterval can be as high as 11,725.
SCENE_CENTER_ SCAN_TIME	26	= YYYY-dddThh:mm:ss.ttttttZ where the time format is the same as for SUBINTERVAL_START_ TIME, above.	The spacecraft time associated with a WRS scene center scan (number).

Table 4.3-5. LPS Metadata File—ODL Parameter Values (8 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
SCENE_CENTER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	WRS scene center latitude – LPS calculated coordinate value. The computed "actual" scene centers for full and greater than half a scene length partial scenes are expected to be in proximity of the nominal WRS scene centers. They are always indexed to actual data in the band file. The computed "actual" scene centers for smaller than half a scene length partial scenes are also expected to be in proximity of the nominal WRS scene centers, but outside the actual subinterval band data range. They are indexed to a non-existent scan 0 in the band file.
SCENE_CENTER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	WRS Scene Center Longitude is an LPS-calculated coordinate value. The computed "actual" scene centers for full and greater than half a scene length partial scenes are expected to be in the proximity of the nominal WRS scene centers. They are always indexed to actual data in the band file. The computed "actual" scene centers for less than half a scene length partial scenes are also expected to be in the proximity of nominal WRS scene centers, but outside the actual subinterval band data range. They are indexed to a nonexistent scan 0 in the band file.
HORIZONTAL_ DISPLAY_SHIFT	2-5	= – 9999 through 9999 meters A negative (–) value defines a shift of the calculated "true" WRS scene center to the west of the nominal WRS scene center. A positive value defines a shift of the calculated "true" WRS scene center to the east of the nominal WRS scene center.	The horizontal distance between the perpendiculars through the LPS calculated "true" WRS scene center and the nominal (known) WRS scene center on ground. The LPS will maintain a lookup table of nominal WRS scene centers for computing the HORIZONTAL_DISPLAY_ SHIFT (HDS) values for WRS scenes.
SCENE_UL_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	WRS scene upper left corner "actual" latitude for a full or a partial scene.
SCENE_UL_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	WRS scene upper left corner "actual" longitude for a full or a partial scene.
SCENE_UR_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	WRS scene upper right corner "actual" latitude for a full or a partial scene.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (9 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
SCENE_UR_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	WRS scene upper right corner “actual” longitude for a full or a partial scene.
SCENE_LL_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	WRS scene lower left corner “actual” latitude at for a full or a partial scene.
SCENE_LL_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	WRS scene lower left corner “actual” longitude at for a full or a partial scene.
SCENE_LR_ CORNER_LAT	8	= –90.0000 through 90.0000 degrees (with a 4-digit precision) A positive value indicates north latitude. A negative (–) value indicates south latitude.	WRS scene lower right corner “actual” latitude at for a full or a partial scene.
SCENE_LR_ CORNER_LON	9	= –180.0000 through 180.0000 degrees (with a 4-digit precision) A positive value indicates east longitude. A negative (–) value indicates west longitude.	WRS scene lower right corner “actual” longitude at for a full or a partial scene.
SCENE_CCA	1-3	= 0-100 This field is included in the ETM+ format 1 metadata only.	WRS scene cloud cover assessment (CCA) indicates the percent of a WRS scene area covered with clouds. This CCA is an average of the quadrant's CCA scores.
UL_QUAD_CCA	1-3	= 0-100 This field is included in the ETM+ format 1 metadata only.	Indicates the percent of the upper left quadrant of the WRS scene area covered with clouds. For partial scenes, the quadrant score is for the quadrant of the actual data and not for what would be for a full WRS scene.
UR_QUAD_CCA	1-3	= 0-100 This field is included in the ETM+ format 1 metadata only.	Indicates the percent of the upper right quadrant of the WRS scene area covered with clouds. For partial scenes, the quadrant score is for the quadrant of the actual data and not for what would be for a full WRS scene.
LL_QUAD_CCA	1-3	= 0-100 This field is included in the ETM+ format 1 metadata only.	Indicates the percent of the lower left quadrant of the WRS scene area covered with clouds. For partial scenes, the quadrant score is for the quadrant of the actual data and not for what would be for a full WRS scene
LR_QUAD_CCA	1-3	= 0-100 This field is included in the ETM+ format 1 metadata only.	Indicates the percent of lower right quadrant of the WRS scene area covered with clouds. For partial scenes, the quadrant score is for the quadrant of the actual data and not for what would be for a full WRS scene

Table 4.3-5. LPS Metadata File—ODL Parameter Values (10 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
ACCA_ALGORITHM_ ID_VER	22	= 22 ASCII characters The algorithm name and version numbers are determined by the Landsat 7 Project.	Identifies the automated cloud cover assessment (ACCA) algorithm (name and version number), used by LPS to compute the cloud cover score for this scene.
SUN_AZIMUTH_ ANGLE	12	= –180.0000000 through 180.0000000 degrees (with 7-digit precision) A positive value indicates angles to the east or clockwise from north. A negative value (–) indicates angles to the west or counterclockwise from north. Leading zeros are not required.	The Sun azimuth angle at the “true” WRS scene center (LPS calculated from PCD processing).
SUN_ELEVATION_ ANGLE	12	= –90.0000000 through 90.0000000 degrees (with 7-digit precision) A positive value indicates a daytime scene. A negative value (–) indicates a nighttime scene. Leading zeros are not required.	The Sun elevation angle at the “true” WRS scene center (LPS calculated from PCD processing).
SCENE_BAND1_ PRESENT	1	= “Y” indicates that band 1 is present or = “N” indicates that band 1 is not present = “U” indicates that band 1 presence is unknown This field is included in the ETM+ format 1 metadata only.	This is the “Band 1 ON” state information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 0, where a bit set condition. (=1) indicates “Band 1 ON state” The first error-free PCD major frame (2) associated with the scene is used to derive this value. If no valid PCD major frame falls within the scene’s time boundary, then the value for the previous scene will be used. If the previous scene has no valid major frame (e.g., the first partial scene in a subinterval), then the value “U” for unknown is used.
SCENE_BAND2_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	Same as above with exception as noted. This is the “Band 2 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 1, where a bit set condition (=1) indicates “Band 2 ON state.”
SCENE_BAND3_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	Same as above with exception as noted. This is the “Band 3 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 2, where a bit set condition (=1) indicates “Band 3 ON state.”
SCENE_BAND4_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	Same as above with exception as noted. This is the “Band 4 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 3, where a bit set condition (=1) indicates “Band 4 ON state.”
SCENE_BAND5_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 1 metadata only.	Same as above with exception as noted. This is the “Band 5 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 4, where a bit set condition (=1) indicates “Band 5 ON state.”

Table 4.3-5. LPS Metadata File—ODL Parameter Values (11 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
SCENE_BAND6_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 1 or format 2 metadata.	Same as above with exception as noted. This is the “Band 6/MIR ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 5, where a bit set condition (=1) indicates “Band 6 ON state.”
SCENE_BAND7_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 2 metadata only.	Same as above with exception as noted. This is the “Band 7 ON” status information obtained from PCD Serial Word “B” (major frame (2), minor frame 32, word 72), bit 6, where a bit set condition (=1) indicates “Band 7 ON state.”
SCENE_BAND8_ PRESENT	1	Same as SCENE_BAND1_PRESENT values and format. This field is included in the ETM+ format 2 metadata only.	Same as above with exception as noted. This is the “Band 8 ON” status information obtained from PCD Serial Word “E” (major frame (2), minor frame 35, word 72), bit 0, where a bit set condition (=1) indicates “Band 8 ON state.”
BAND1_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 1 metadata only.	The band gain condition detected at the start of a WRS scene. This information is obtained from Words 7 and 8 of the PCD/Status Data field of the first error-free VCDU in a WRS scene.
BAND2_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN.
BAND3_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN.
BAND4_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN.
BAND5_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN.
BAND6_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 1 or format 2 metadata.	See parameter description for BAND1_GAIN.
BAND8_GAIN	1	= “L” for a low-gain condition = “H” for a high-gain condition This field is included in the ETM+ format 2 metadata only.	See parameter description for BAND1_GAIN.
BAND1_GAIN_ CHANGE	1	= “0” indicates no band gain change within scene or = “+” indicates a low to high band gain change within scene or = “–” indicates a high to low band gain change within scene This field is included in the ETM+ format 1 metadata only.	Band gain change flags are generated by LPS by evaluating corresponding band gain states in adjacent ETM+ scans (major frames).

Table 4.3-5. LPS Metadata File—ODL Parameter Values (12 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
BAND2_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN_CHANGE.
BAND3_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN_CHANGE.
BAND4_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN_CHANGE.
BAND5_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_GAIN_CHANGE.
BAND6_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 1 or format 2 metadata.	See parameter description for BAND1_GAIN_CHANGE.
BAND7_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 2 metadata only.	See parameter description for BAND1_GAIN_CHANGE.
BAND8_GAIN_ CHANGE	1	Same as for BAND1_GAIN_CHANGE This field is included in the ETM+ format 2 metadata only.	See parameter description for BAND1_GAIN_CHANGE.
BAND1_SL_GAIN_ CHANGE	1-5	= NNNNN where 0 = no gain change 1-12000 = scan line number where the first change in band gain was detected. This field is included in the ETM+ format 1 metadata only.	This field indicates the scan line number in the scene for the first change detected in the band gain condition.
BAND2_SL_GAIN_ CHANGE	1-5	Same as for BAND1_SL_GAIN_ CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_SL_GAIN_CHANGE.
BAND3_SL_GAIN_ CHANGE	1-5	Same as for BAND1_SL_GAIN_ CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_SL_GAIN_CHANGE.
BAND4_SL_GAIN_ CHANGE	1-5	Same as for BAND1_SL_GAIN_ CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_SL_GAIN_CHANGE.
BAND5_SL_GAIN_ CHANGE	1-5	Same as for BAND1_SL_GAIN_ CHANGE This field is included in the ETM+ format 1 metadata only.	See parameter description for BAND1_SL_GAIN_CHANGE.
BAND6_SL_GAIN_ CHANGE	1-5	Same as for BAND1_SL_GAIN_ CHANGE This field is included in the ETM+ format 1 or format 2 metadata.	See parameter description for BAND1_SL_GAIN_CHANGE.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (13 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
DAY_NIGHT_FLAG	1	= “D” for day flag ‘True’ = “N” for night flag ‘True’	This field indicates the day or night condition for the scene. The LPS determines the day/night condition of a scene by comparing the Sun elevation values against an angle value of 0 degrees. A scene is declared a day scene if the Sun elevation angle is greater than 0 degrees; otherwise it is declared a night scene.
END_GROUP	12	= WRS_SCENE_NN_ where NN = 01-99 Up to 35 full scenes are expected to be received by LPS in a 14-minute subinterval	End of the third level ODL group. It indicates the end of the ETM+ format 1 or format 2 WRS Scene metadata group records.
Image Q&A Data The following parameter values are repeated for each WRS scene included in this subinterval			
GROUP	9	= ETM_QA_NN where NN = 01-99	Beginning of the third level ODL group. It indicates the beginning of the ETM+ format 1 or format 2 Scene NN Q&A data group records.
SCENE_QUALITY	3	= 00-99, -99	The first digit represents image quality; the second PC quality. A 99 represents the highest quality and a 00 the lowest quality. A -99 occurs if no scene quality score was obtained.
CADUS_VCDUS_ RECEIVED	1-6	= 1-999999	The total number of CADUs/VCDUs received for this scene. Approximately 362,380 VCDUs are expected to be received for a 26.8-second long WRS scene. A WRS scene consists of a maximum of 374, including 40 overlap scans.
FLY_WHEEL_ CADUS	1-6	= 0-999999	The total number of CADUs flywheeled due to sync errors.
CADUS_SYNC_ERR	1-6	1-999999	The total number of CADUs with synchronization errors.
CADUS_MISSING	1-6	1-999999	The total number of missing CADUs.
BCH_CORRECTED_ BITS	1-6	1-999999	The total number of BCH corrected bits between the mission data zone and the data pointer zone.
RS_ERR_VCDUS	1-6	= 0-999999	The total number of VCDUs with Reed-Solomon error corrected in the header field.
BCH_CORRECTED_ VCDUS	1-6	= 0-999999	The total number of VCDUs with BCH errors corrected for up to 3 bits in their mission data fields.
BCH_ UNCORRECTED_ VCDUS	1-6	= 0-999999	The total number of VCDUs containing uncorrected BCH errors (bits) in their mission data fields.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (14 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
BIT_ERROR_RATE	1-4	= 0-9999	The number of bit errors detected over the whole length of the scene and normalized to average number of errors in 100,000 bits. BIT_ERROR_RATE = (Total Detected Bit Errors/Total Number of Bits in Subinterval) x 100,000. This BER is calculated using bit errors detected (corrected or not) during CRC and BCH checks of the input VCDUs. An input data bit error rate of 1 in 100,000 or less is considered acceptable.
ETM_TIMECODE_ ERRORS	1-3	0-375999	The total number of ETM+ scans (major frames) detected with errors in their time code fields during processing of this subinterval scene. A maximum of 375 ETM+ scans are possible in a WRS scene.
ENTIRELY_FILLED_ SCANS	1-3	0-375999	The total number of ETM+ major frames (maximum of 374) in this WRS scene (~26.8 seconds for 374 scans) that were entirely filled using a predetermined fill data pattern.
PARTIALLY_ FILLED_SCANS	1-3	0-375999	The total number of ETM+ major frames (maximum of 374) in this WRS scene that were partially filled using a pre-determined fill data pattern.
END_GROUP PCD Q&A Data	9	= ETM_QA_NN where NN = 01-99	End of the third level ODL group. It indicates the end of the ETM+ Q&A data group records for WRS Scene NN.
PCD Q&A Data The following parameter values are repeated for each WRS scene included in the subinterval.			
GROUP	20	= PCD_QA_NN where NN = 01-99	Beginning of the third level ODL group. It indicates the beginning of the PCD Q&A data group records for WRS Scene NN.
PCD_WORDS_ RECEIVED	1-6	= 0-999999	The total number of PCD words, extracted from the unpacked PCD words (one sync byte, 3 repeated data bytes, and at least 4 fill bytes), received for this scene. Approximately 107,200 packed PCD words can be received by LPS for a 26.8-second scene.
PCD_BYTE_ VOTING_ERR	1-6	= 0-999999	The total number of PCD words that encountered byte-voting errors during packing (for a maximum of 107,200 words).
TOTAL_PCD_ MINOR_FRAMES	1-3	= 0-999	The total number of PCD minor frames constructed during this scene. Approximately 838 PCD minor frames can be received by LPS for a 26.8- second WRS scene.
PCD_MINOR_ FRAME_ERR	1-3	= 0-999	The total number of PCD minor frames that encountered sync errors during their construction for a scene. Up to 838 minor frames for a WRS scene are expected.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (15 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
FILLED_PCD_ MINOR_FRAMES	1-3	= 0-999	The total number of PCD minor frames that required a data fill during their construction.
Processed PCD Q&A Data			
FILLED_PCD_ MAJOR_FRAMES	1	= 0-9	The total number of PCD major frames that required a data fill during their construction. Approximately 7 major frames can be received by LPS for a 26.8-second long WRS scene.
END_GROUP	9	= PCD_QA_NN where NN = 01-99	End of the third level ODL group. It indicates the end of the PCD Q&A data group records for WRS Scene NN.
GROUP	19	= PROCESSED_PCD_QA_NN where NN = 01-99	Beginning of the third level ODL group. It indicates the beginning of the processed PCD Q&A data group records for WRS Scene NN.
TOTAL_ATTITUDE_ POINTS	1	= 0-9	The total number of spacecraft attitude data points (quaternations) received and processed from the PCD associated with this scene. Approximately 6.5 spacecraft attitude data points can be received for a 26.8-second WRS scene.
REJECTED_ ATTITUDE_POINTS	1	= 0-9	The total number of spacecraft attitude data points (quaternations) found to fail the PCD quality checks. The rejected data points are flagged and included in the PCD file associated with this WRS scene.
MISSING_ ATTITUDE_POINTS	1	= 0-9	The total number of spacecraft attitude data points (quaternations) found missing during PCD quality checks. The missing data points are flagged and included in the PCD file associated with this WRS scene.
TOTAL_EPHEMERIS_ POINTS	1	= 0-9	The total number of ephemeris data points received and processed from the PCD of this scene. Approximately 7 ephemeris data points can be received for a 26.8-second long WRS scene.
REJECTED_ EPHEMERIS_POINTS	1	= 0-9	The total number of spacecraft ephemeris data points found to fail LPS PCD quality checks. Rejected data points are flagged and included in the PCD file associated with this WRS scene.
MISSING_ EPHEMERIS_POINTS	1	= 0-9	The total number of spacecraft ephemeris data points found missing during PCD quality checks. The missing data points are flagged and included in the PCD file associated with this WRS scene.
END_GROUP	19	= PROCESSED_PCD_QA_NN where NN = 01-99	End of the third level ODL group. It indicates the end of the processed PCD Q&A data group records for WRS Scene NN.

Table 4.3-5. LPS Metadata File—ODL Parameter Values (16 of 16)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description/Remarks
END_GROUP	17	= METADATA_SCENE_NN where NN = 01-99 (Up to 35 full scenes are expected to be received by LPS in a 14-minute subinterval.)	End of the second level ODL group. It indicates the end of the ETM+ format 1 or format 2 Scene NN level metadata group records.
END_GROUP	26	= SUBINTERVAL_ METADATA_FMT_m where m = 1 for format 1 m = 2 for format 2	End of the second level ODL group. It indicates the end of the ETM+ format 1 or format 2 subinterval level metadata group records.
END_GROUP	13	= METADATA_FILE	End of the first level ODL group. It indicates the end of the LPS metadata file level group records for an ETM+ format 1 or format 2 subinterval.
END			Required standalone parameter signifying file end.

Table 4.3-6. LPGS Metadata File (1 of 8)

Vdata Name: "L71ppprrr_rrrYYYYMMDD.MTL"
Vdata Class: LPGS_Metadata
Interlace Type: FULL_INTERLACE
Bytes Per Logical Record: 65536
Number of Records: One record.

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
GROUP	18	= LPGS_METADATA_FILE	Beginning of first level ODL group. It indicates start of LPGS metadata file level group
GROUP	18	= METADATA_FILE_INFO	Beginning of metadata file information group
REQUEST_ID	20	ASCII string	Unique product generation request ID generated by DORRAN
PRODUCT_CREATION_TIME	20	= YYYY-MM-DDThh:mm:ssZ where YYYY = 4-digit Julian year MM = month number of Julian year (01-12) DD = day of Julian month (01-31) T indicates start of time information in ODL ASCII time code format hh = hours (00-23) mm = minutes (00-59) ss = seconds (00-59) Z indicates "Zulu" time (same as GMT)	LPGS system date and time when metadata file for L1 product set was created. For ease of human readability, this date and time are presented in ODL ASCII format. Time is expressed as UTC (also known as GMT). Insertion of additional characters "T" and "Z" is required to meet ODL ASCII format
STATION_ID	3	= "EDC"	Unique 3-letter code identifying originating ground station
LANDSAT7_XBAND	1	= "1", "2", or "3"	Landsat 7 X-band used to downlink data to LGS
GROUND_STATION	3	= "NNN"	Ground station that received data
LPS_PROCESSOR_NUMBER	1	= 1-9	LPS processor number
DATEHOUR_CONTACT_ PERIOD	7	= "YYDOYHH"	Date and hour of contact period
SUBINTERVAL_NUMBER	2	= "00-99"	Subinterval number within contact period
END_GROUP	18	= METADATA_FILE_INFO	End of metadata information group
GROUP	16	= PRODUCT_METADATA	Beginning of product metadata group
PRODUCT_TYPE	3	= "L1G" or "L1R"	Identifier to inform user of product type
SPACECRAFT_ID	8	= "Landsat7"	Name of satellite platform
SENSOR_ID	4	= "ETM+"	Name of imaging sensor
ACQUISITION_DATE	20	= YYYY-MM-DD	Date image was acquired
WRS_PATH	3	= NNN, where NNN = path number (001-233)	WRS path value for product
STARTING_ROW	3	= NNN, where NNN = row of first full or partial scene in product (001-248)	Starting WRS row
ENDING_ROW	3	= NNN, where NNN = row of last full or partial scene in product (001-248)	Ending WRS row
BAND_COMBINATION	9	= "NNNNNNNNN", where NNNNNNNNN = e.g., 123456678 for all bands present, 123-----8 for bands 1, 2, 3, 8. A '-' is a position holder for absent bands	LPGS-generated indicator of bands present for product ordered. First 6 is format 1, band 6. Second 6 is format 2, band 6

Table 4.3-6. LPGS Metadata File (2 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
PRODUCT_UL_CORNER_LAT	8	= -90.0000 through +90.0000 degrees (with 7-digit precision) Positive (+) value indicates North latitude; negative (-) value indicates South latitude	Latitude value for upper left corner of product (LPGS calculated for 1G product)
PRODUCT_UL_CORNER_LON	9	= -180.0000 through +180.0000 degrees (with 7-digit precision) Positive (+) value indicates East longitude; negative (-) value indicates West longitude	Latitude value for upper left corner of product (LPGS calculated for 1G product)
PRODUCT_LR_CORNER_LAT	8	= -90.0000 through +90.0000 degrees (with 7-digit precision)	Latitude value for upper left corner of product (LPGS calculated for 1G product)
PRODUCT_LR_CORNER_LON	9	= -180.0000 through +180.0000 degrees (with 7-digit precision)	Latitude value for upper left corner of product (LPGS calculated for 1G product)
BAND1_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_B10.xxx”	LPGS-generated external element file name for band 1 if part of product
BAND2_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_B20.xxx”	LPGS-generated external element file name for band 2 if part of product
BAND3_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_B30.xxx”	LPGS-generated external element file name for band 3 if part of product
BAND4_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_B40.xxx”	LPGS-generated external element file name for band 4 if part of product
BAND5_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_B50.xxx”	LPGS-generated external element file name for band 5 if part of product
BAND6L_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_B61.xxx”	LPGS-generated external element file name for band 6, format 1 if part of product
BAND6H_FILE_NAME	29	“L72ppprrr_rrrYYYYMMDD_B62.xxx”	LPGS-generated external element file name for band 6, format 2 if part of product
BAND7_FILE_NAME	29	“L72ppprrr_rrrYYYYMMDD_B70.xxx”	LPGS-generated external element file name for band 7 if part of product
BAND8_FILE_NAME	29	“L72ppprrr_rrrYYYYMMDD_B80.xxx”	LPGS-generated external element file name for band 8 if part of product
IC_DATA_F1_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_CAL.xxx”	LPGS-generated external element file name for format 1 internal calibrator data (1R product only) if part of product
IC_DATA_F2_FILE_NAME	29	“L72ppprrr_rrrYYYYMMDD_CAL.xxx”	LPGS-generated external element file name for format 2 internal calibrator data (1R product only) if part of product
SCAN_SHIFTS_F1_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_SLO.xxx”	LPGS-generated external element file name for format 1 scan line shifts (1R product only) if part of product
SCAN_SHIFTS_F2_FILE_NAME	29	“L72ppprrr_rrrYYYYMMDD_SLO.xxx”	LPGS-generated external element file name for format 2 scan line shifts (1R product only) if part of product
MSCD_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_MSD.xxx”	LPGS-generated external element file name for consensus MSCD (1R product only)
PCD_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_PCD.xxx”	LPGS-generated external element file name for consensus PCD (1R product only)
METADATA_LPS1_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_MTA.xxx”	LPGS-generated external element file name for LPS format 1 metadata (1R product only)

Table 4.3-6. LPGS Metadata File (3 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
METADATA_LPS2_FILE_NAME	29	“L72ppprrr_rrrYYYYMMDD_MTA.xxx”	LPGS-generated external element file name for LPS format 2 metadata (1R product only)
METADATA_LPGS_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_MTL.xxx”	LPGS-generated external element file name for LPGS metadata
CPF_FILE_NAME	25	“L7CPFYYYYMMDD_YYYYMMDD_nn ” where YYYYMMDD = effective start date and effective end date, respectively nn = incrementing version number within a 90-day period (00-99)	ECS-generated external element file name for IAS calibration parameter file (1R product only)
GEOLOCATION_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_GEO.xxx”	LPGS-generated external element file name for geolocation table (1R product only)
HDF_DIR_FILE_NAME	29	“L71ppprrr_rrrYYYYMMDD_HDF.XXX”	LPGS-generated file name for HDF directory file
END_GROUP	16	= PRODUCT_METADATA	End of product metadata group
GROUP	16	= MIN_MAX_RADIANCE	Beginning of the min/max radiance group (1G product only)
MAX_DETECTED_RADIANCE_ LEVEL_BAND1	7	= NNN.NNN	Maximum detectable radiance value for band 1 if part of product
MIN_DETECTED_RADIANCE_ EVEL_BAND1	7	= NNN.NNN	Minimum detectable radiance value for band 1 if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND2	7	= NNN.NNN	Maximum detectable radiance value for band 2 if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND2	7	= NNN.NNN	Minimum detectable radiance value for band 2 if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND3	7	= NNN.NNN	Maximum detectable radiance value for band 3 if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND3	7	= NNN.NNN	Minimum detectable radiance value for band 3 if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND4	7	= NNN.NNN	Maximum detectable radiance value for band 4 if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND4	7	= NNN.NNN	Minimum detectable radiance value for band 4 if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND5	7	= NNN.NNN	Maximum detectable radiance value for band 5 if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND5	7	= NNN.NNN	Minimum detectable radiance value for band 5 if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND6L	7	= NNN.NNN	Maximum detectable radiance value for band 6 low if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND6L	7	= NNN.NNN	Minimum detectable radiance value for band 6 low if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND6H	7	= NNN.NNN	Maximum detectable radiance value for band 6 high if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND6H	7	= NNN.NNN	Minimum detectable radiance value for band 6 high if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND7	7	= NNN.NNN	Maximum detectable radiance value for band 7 if part of product

Table 4.3-6. LPGS Metadata File (4 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
MIN_DETECTED_RADIANCE_ LEVEL_BAND7	7	= NNN.NNN	Minimum detectable radiance value for band 7 if part of product
MAX_DETECTED_RADIANCE_ LEVEL_BAND8	7	= NNN.NNN	Maximum detectable radiance value for band 8 if part of product
MIN_DETECTED_RADIANCE_ LEVEL_BAND8	7	= NNN.NNN	Minimum detectable radiance value for band 8 if part of product
END_GROUP	16	= MIN_MAX_RADIANCE	End of the min/max radiance group
GROUP	19	= MIN_MAX_PIXEL_VALUE	Beginning of the min/max pixel value group (1G product only)
MAX_PIXEL_VALUE_BAND1	5	= NNN.N	Maximum detectable pixel value for band 1 if part of product
MIN_ PIXEL_VALUE _BAND1	5	= NNN.N	Minimum detectable pixel value for band 1 if part of product
MAX_ PIXEL_VALUE _BAND2	5	= NNN.N	Maximum detectable pixel value for band 2 if part of product
MIN_ PIXEL_VALUE _BAND2	5	= NNN.N	Minimum detectable pixel value for band 2 if part of product
MAX_ PIXEL_VALUE _BAND3	5	= NNN.N	Maximum detectable pixel value for band 3 if part of product
MIN_ PIXEL_VALUE _BAND3	5	= NNN.N	Minimum detectable pixel value for band 3 if part of product
MAX_ PIXEL_VALUE _BAND4	5	= NNN.N	Maximum detectable pixel value for band 4 if part of product
MIN_ PIXEL_VALUE _BAND4	5	= NNN.N	Minimum detectable pixel value for band 4 if part of product
MAX_ PIXEL_VALUE _BAND5	5	= NNN.N	Maximum detectable pixel value for band 5 if part of product
MIN_ PIXEL_VALUE _BAND5	5	= NNN.N	Minimum detectable pixel value for band 5 if part of product
MAX_ PIXEL_VALUE _BAND6L	5	= NNN.N	Maximum detectable pixel value for band 6 low if part of product
MIN_ PIXEL_VALUE _BAND6L	5	= NNN.N	Minimum detectable pixel value for band 6 low if part of product
MAX_ PIXEL_VALUE _BAND6H	5	= NNN.N	Maximum detectable pixel value for band 6 high if part of product
MIN_ PIXEL_VALUE _BAND6H	5	= NNN.N	Minimum detectable pixel value for band 6 high if part of product
MAX_ PIXEL_VALUE _BAND7	5	= NNN.N	Maximum detectable pixel value for band 7 if part of product
MIN_ PIXEL_VALUE _BAND7	5	= NNN.N	Minimum detectable pixel value for band 7 if part of product
MAX_ PIXEL_VALUE _BAND8	5	= NNN.N	Maximum detectable pixel value for band 8 if part of product
MIN_ PIXEL_VALUE _BAND8	5	= NNN.N	Minimum detectable pixel value for band 8 if part of product
END_GROUP	19	= MIN_MAX_PIXEL_VALUE	End of the min/max pixel value group
GROUP	18	= PRODUCT_PARAMETERS	Beginning of product parameters group (both 1R and 1G products)
CORRECTION_METHOD_GAIN	3	= “CPF” for CPF gains = “IC” for IC gains	Correction method used by LPGS in creating image
CORRECTION_METHOD_BIAS	3	= “CPF” for CPF gains = “IC” for IC gains	Correction method used by LPGS in creating image
BAND1_GAIN	1	= “L” for low or “H” for high	Gain state for band 1’s first data line if part of product

Table 4.3-6. LPGS Metadata File (5 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
BAND2_GAIN	1	= “L” for low or “H” for high	Gain state for band 2’s first data line if part of product
BAND3_GAIN	1	= “L” for low or “H” for high	Gain state for band 3’s first data line if part of product
BAND4_GAIN	1	= “L” for low or “H” for high	Gain state for band 4’s first data line if part of product
BAND5_GAIN	1	= “L” for low or “H” for high	Gain state for band 5’s first data line if part of product
BAND6_GAIN1	1	= “L” for low or “H” for high	Gain state for band 6’s first data line if part of product-format 1
BAND6_GAIN2	1	= “L’”for low or “H” for high	Gain state for band 6’s first data line if part of product-format 2
BAND7_GAIN	1	= “L” for low or “H” for high	Gain state for band 7’s first data line if part of product
BAND8_GAIN	1	= “L” for low or “H” for high	Gain state for band 8’s first data line if part of product
SUN_AZIMUTH	8	= -180.0 through 180.0 degrees (with 7-digit precision) A positive value indicates angles to the east or clockwise from north. A negative value (-) indicates angles to the west or counterclockwise from north. Leading zeros are not required.	Sun azimuth angle in degrees for image center location at image center acquisition time
SUN_ELEVATION	8	= -90.0 through 90.0 degrees (with 7-digit precision) A positive value indicates a daytime scene. A negative value (-) indicates a nighttime scene. Leading zeros are not required.	Sun elevation angle in degrees for image center location at image center acquisition time
OUTPUT_FORMAT	3	= “HDF”	Output format of image
END_GROUP	18	= PRODUCT_PARAMETERS	End of product parameters group
GROUP	19	= CORRECTIONS_APPLIED	Beginning of corrections applied group
STRIPING	1	= “Y” or “N”	Indicator of whether image was corrected for striping
BANDING	1	= “Y” or “N”	Indicator of whether image was corrected for banding
COHERENT_NOISE	1	= “Y” or “N”	Indicator of whether image was corrected for coherent noise (band 8 only)
MEMORY_EFFECT	1	= “Y” or “N”	Indicator of whether image was corrected for memory effect
SCAN_CORRELATED_SHIFT	1	= “Y” or “N”	Indicator of whether image was corrected for scan correlated shift
INOPERABLE_DETECTORS	1	= “Y” or “N”	Indicator of whether image was corrected for inoperable detectors
DROPPED_LINES	1	= “Y” or “N”	Indicator of whether image was corrected for dropped lines
END_GROUP	19	= CORRECTIONS_APPLIED	End of corrections applied group
GROUP	21	= PROJECTION_PARAMETERS	Beginning of projection parameters group (1G product only)
REFERENCE_DATUM	5	= “WGS84”	Datum used by LPGS in creating image

Table 4.3-6. LPGS Metadata File (6 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
REFERENCE_ELLIPSOID	5	= "WGS84"	Ellipsoid used by LPGS in creating image
GRID_CELL_SIZE_PAN	6	= 15.000 through 60.000 meters, in increments of .001 meters	Size of grid cell used by LPGS in creating image for pan band if part of product
GRID_CELL_SIZE_THM	6	= 15.000 through 60.000 meters, in increments of .001 meters	Size of grid cell used by LPGS in creating image for thermal bands if part of product
GRID_CELL_SIZE_REF	6	= 15.000 through 60.000 meters, in increments of .001 meters	Size of grid cell used by LPGS in creating image for VNIR/SWIR bands if part of product
ORIENTATION	3	= "NOM" for nominal path = "NUP" for North up	Orientation used by LPGS in creating image
RESAMPLING_OPTION	3	= "NN" for nearest neighbor = "CC" for cubic convolution = "MTF" for modulation transfer function	Resampling option used by LPGS in creating image
MAP_PROJECTION	3	= "SOM" for space oblique mercator = "UTM" for universal transverse mercator = "LCC" for Lambert conformal conic = "TM" for transverse mercator = "OM" for oblique mercator = "PC" for polyconic = "PS" for polar stereographic	Map projection used by LPGS in creating image
END_GROUP	21	= PROJECTION_PARAMETERS	End of projection parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of LCC**
GROUP	14	LCC_PARAMETERS	Beginning of LCC parameters group
LATITUDE_OF_FIRST_ STANDARD_PARALLEL	11	= -90.0 to +90.0	Latitude of first standard parallel
LATITUDE_OF_SECOND_ STANDARD_PARALLEL	11	= -90.0 to +90.0	Latitude of second standard parallel
LONGITUDE_OF_CENTRAL_ MERIDIAN	12	= -180.0 to +180.0	Longitude of central meridian
LATITUDE_OF_PROJECTION_ ORIGIN	11	= -90.0 to +90.0	Latitude of projection origin
FALSE_EASTING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False easting
FALSE _NORTHING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False northing
FALSE_EASTING_NORTHING_ UNITS	6	= "meters" or "feet"	Units for false easting and northing for LCC projection
END_GROUP	14	LCC_PARAMETERS	End of LCC parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of TM**
GROUP	13	TM_PARAMETERS	Beginning of TM parameters group
SCALE_FACTOR_AT_ CENTRAL_MERIDIAN	11	= 0.0 to 2.0	Scale factor at central meridian
LONGITUDE_OF_CENTRAL_ MERIDIAN	12	= -180.0 to +180.0	Longitude of central meridian
LATITUDE_OF_PROJECTION_ ORIGIN	11	= -90.0 to +90.0	Latitude of projection origin
FALSE_EASTING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False easting
FALSE _NORTHING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False northing

Table 4.3-6. LPGS Metadata File (7 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
FALSE_EASTING_NORTHING_ UNITS	6	= “meters” or “feet”	Units for false easting and northing for TM projection
END_GROUP	13	TM_PARAMETERS	End of TM parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of PC**
GROUP	13	PC_PARAMETERS	Beginning of PC parameters group
LONGITUDE_OF_CENTRAL_ MERIDIAN	12	= -180.0 to +180.0	Longitude of central meridian
LATITUDE_OF_PROJECTION_ ORIGIN	11	= -90.0 to +90.0	Latitude of projection origin
FALSE_EASTING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False easting
FALSE _NORTHING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False northing
FALSE_EASTING_NORTHING_ UNITS	6	= “meters” or “feet”	Units for false easting and northing for PC projection
END_GROUP	13	P C_PARAMETERS	End of PC parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of PS**
GROUP	13	PS_PARAMETERS	Beginning of PS parameters group
VERTICAL_LONGITUDE_ FROM_POLE	12	= -180.0 to +180.0	Vertical longitude from pole
LATITUDE_OF_TRUE_SCALE	11	= -90.0 to +90.0	Latitude of true scale
FALSE_EASTING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False easting
FALSE _NORTHING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False northing
FALSE_EASTING_NORTHING_ UNITS	6	= “meters” or “feet”	Units for false easting and northing for PS projection
END_GROUP	13	PS_PARAMETERS	End of PS parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of OM**
GROUP	13	OM_PARAMETERS	Beginning of OM parameters group
SCALE_FACTOR_AT_ CENTER_OF_PROJECTION	9	= 0.0 to 2.0	Scale factor at center of projection
LATITUDE_OF_PROJECTION_ ORIGIN	11	= -90.0 to +90.0	Latitude of projection origin
FALSE_EASTING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False easting
FALSE _NORTHING	18	= -1.0×10^8 to $+1.0 \times 10^8$	False northing
FALSE_EASTING_NORTHING_ UNITS	6	= “meters” or “feet”	Units for false easting and northing for OM projection
OM_TYPE	1	= “A” or “B”	Value used to indicate type of OM projection
END_GROUP	13	OM_PARAMETERS	End of OM parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of OMA**
GROUP	14	OMA_PARAMETERS	Beginning of OMA parameters group
LONGITUDE_FIRST_POINT_ GEODETIC	12	= -180.0 to +180.0	Longitude of first point defining central geodetic line of projection
LATITUDE_FIRST_POINT_ GEODETIC	11	= -90.0 to +90.0	Latitude of first point defining central geodetic line of projection
LONGITUDE_SECOND_ POINT_GEODETIC	12	= -180.0 to +180.0	Longitude of second point defining central geodetic line of projection

Table 4.3-6. LPGS Metadata File (8 of 8)

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
LATITUDE_SECOND_POINT_ GEODETIC	11	= -90.0 to +90.0	Latitude of second point defining central geodetic line of projection
END_GROUP	14	OMA_PARAMETERS	End of OMA parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of OMB**
GROUP	14	OMB_PARAMETERS	Beginning of OMB parameters group
ANGLE_OF_AZIMUTH	12	= -180.0 to +180.0	Angle of azimuth east of north for central line of projection
LONGITUDE_ALONG_ PROJECTION	12	= -180.0 to +180.0	Longitude of point along central line of projection at which angle of azimuth is measured
END_GROUP	14	OMB_PARAMETERS	End of OMB parameters group
Projection parameters data (not an LPGS metadata parameter)			**The following parameters are included only with products that select a map projection of UTM**
GROUP	14	UTM_PARAMETERS	Beginning of UTM parameters group
ZONE_NUMBER	3	= 1 to 60 or -1 to -60	Value used to indicate zone number
END_GROUP	13	UTM_PARAMETERS	End of UTM parameters group
END_GROUP	148	LPGS_METADATA_FILE	End of LPGS metadata file level group
END			Required standalone parameter signifying file end

*ASCII bytes

Table 4.3-7. Vgroup Definitions—Level 1R Product (1 of 2)

Vgroup Name	Vgroup Class	Object Name	Type	Description
Scene_Data_Ref	Image_Data	L71ppprrr_rrrYYYYMMDD.B10	SDS	ETM+ band 1 data
		L71ppprrr_rrrYYYYMMDD.B20	SDS	ETM+ band 2 data
		L71ppprrr_rrrYYYYMMDD.B30	SDS	ETM+ band 3 data
		L71ppprrr_rrrYYYYMMDD.B40	SDS	ETM+ band 4 data
		L71ppprrr_rrrYYYYMMDD.B50	SDS	ETM+ band 5 data
		L72ppprrr_rrrYYYYMMDD.B70	SDS	ETM+ band 7 data
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scene_Data_Thm	Image_Data	L71ppprrr_rrrYYYYMMDD.B60	SDS	ETM+ band 6 low gain data
		L72ppprrr_rrrYYYYMMDD.B60	SDS	ETM+ band 6 high gain data
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scene_Data_Pan	Image_Data	L72ppprrr_rrrYYYYMMDD.B80	SDS	ETM+ band 8 data
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
IC_Data_Ref	Correction_Data	L71ppprrr_rrrYYYYMMDD.C10	SDS	IC data band 1
		L71ppprrr_rrrYYYYMMDD.C20	SDS	IC data band 2
		L71ppprrr_rrrYYYYMMDD.C30	SDS	IC data band 3
		L71ppprrr_rrrYYYYMMDD.C40	SDS	IC data band 4
		L71ppprrr_rrrYYYYMMDD.C50	SDS	IC data band 5
		L72ppprrr_rrrYYYYMMDD.C70	SDS	IC data band 7
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
IC_Data_Thm	Correction_Data	L71ppprrr_rrrYYYYMMDD.C60	SDS	IC data band 6 low gain
		L72ppprrr_rrrYYYYMMDD.C60	SDS	IC data band 6 high gain
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
IC_Data_Pan	Correction_Data	L72ppprrr_rrrYYYYMMDD.C80	SDS	IC data band 8
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scan_Line_Offsets_Ref	Correction_Data	L71ppprrr_rrrYYYYMMDD.O10	Vdata	Scan line offsets band 1
		L71ppprrr_rrrYYYYMMDD.O20	Vdata	Scan line offsets band 2
		L71ppprrr_rrrYYYYMMDD.O30	Vdata	Scan line offsets band 3
		L71ppprrr_rrrYYYYMMDD.O40	Vdata	Scan line offsets band 4
		L71ppprrr_rrrYYYYMMDD.O50	Vdata	Scan line offsets band 5
		L72ppprrr_rrrYYYYMMDD.O70	Vdata	Scan line offsets band 7
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scan_Line_Offsets_Thm	Correction_Data	L71ppprrr_rrrYYYYMMDD.O60	Vdata	Scan line offsets band 6 low gain
		L72ppprrr_rrrYYYYMMDD.O60	Vdata	Scan line offsets band 6 high gain
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scan_Line_Offsets_Thm	Correction_Data	L72ppprrr_rrrYYYYMMDD.O80	Vdata	Scan line offsets band 8
		L71ppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
PCD	Correction_Data	L71ppprrr_rrrYYYYMMDD.PCD	Vdata	Consensus PCD
MSCD	Correction_Data	L71ppprrr_rrrYYYYMMDD.MSD	Vdata	Consensus MSCD

Table 4.3-7. Vgroup Definitions—Level 1R Product (2 of 2)

Vgroup Name	Vgroup Class	Object Name	Type	Description
Product_ Metadata	Metadata	L71ppprrr_rrrYYYYMMDD.MTA	Vdata	LPS metadata format 1
		L72ppprrr_rrrYYYYMMDD.MTA	Vdata	LPS metadata format 2
		L71ppprrr_rrrYYYYMMDD.MTL	Vdata	LPGS-product-specific metadata
CPF	Correction_Data	L7CPFYYYYMMDD_YYYYMMDD.nn	Vdata	IAS CPF

Table 4.3-8. Vgroup Definitions—Level 1G Product

Vgroup Name	Vgroup Class	Object Name	Type	Description
Scene_Data_ Ref	Image_Data	L71ppprrr_rrrYYYYMMDD.B10	SDS	ETM+ band 1 data
		L71ppprrr_rrrYYYYMMDD.B20	SDS	ETM+ band 2 data
		L71ppprrr_rrrYYYYMMDD.B30	SDS	ETM+ band 3 data
		L71ppprrr_rrrYYYYMMDD.B40	SDS	ETM+ band 4 data
		L71ppprrr_rrrYYYYMMDD.B50	SDS	ETM+ band 5 data
		L72ppprrr_rrrYYYYMMDD.B70	SDS	ETM+ band 7 data
Scene_Data_ Thm	Image_Data	L71ppprrr_rrrYYYYMMDD.B60	SDS	ETM+ band 6 low gain data
		L72ppprrr_rrrYYYYMMDD.B60	SDS	ETM+ band 6 high gain data
Scene_Data_ Pan	Image_Data	L72ppprrr_rrrYYYYMMDD.B80	SDS	ETM+ band 8 data
Product_ Metadata	Metadata	L71ppprrr_rrrYYYYMMDD.MTL	Vdata	LPGS-product-specific metadata

Section 5. Product Packaging

Level 1R products are available on 8-mm tape and Compact Disc Read-Only Memory (CD-ROM). Level 1G products are available on 8-mm tape, CD-ROM, and electronic transfer. The following sections provide information on each of the distribution methods for the available Level 1 product formats.

5.1 HDF

The first file on 8-mm tape is the L1 volume descriptor (read-me file). See Appendix B for a sample of the read-me file. The second file is the product-specific metadata created by LPGS. This allows for instantaneous product recognition without encountering any data overhead. Similar rationale was employed in placing the HDF data directory next. These files are followed by the LPS metadata, PCD, MSCD, scan-line offsets, the CPF, IC data, and band files. The CD-ROM also contains the L1 volume descriptor (read-me file). See Appendix B for a sample of the read-me file.

5.2 FAST-L7A

The first file on 8-mm tape is the L1 volume descriptor (read-me file). The second file is the header file for the VNIR/SWIR bands followed by the corresponding image files. The thermal band header and image files are next, followed by the panchromatic band header and image file..

The CD-ROM also contains the L1 volume descriptor (read-me file

5.3 GeoTIFF

The first file on 8-mm tape is the L1 volume descriptor (read-me file). Next are the files for the VNIR/SWIR bands included in the product, followed by the thermal bands and the panchromatic band.

The CD-ROM also contains the L1 volume descriptor (read-me file).

Section 6. Software Tools

A variety of public domain software tools are available for processing the L1 distribution product in either an HDF or independent computing environment.

6.1 NCSA HDF Libraries

HDF is a library- and platform-independent data format for the storage and exchange of scientific data. It includes Fortran and C calling interfaces and utilities for analyzing and converting HDF data files. HDF is developed and supported by National Center for Supercomputing Applications (NCSA) and is available in the public domain.

The HDF library contains two parts: the base library and the multifile library. The base library contains a general purpose interface and application-level interfaces, one for each data structure type. Each application-level interface is specifically designed to read, write, and manipulate one type. The general purpose interface contains functions, such as file input/output (I/O), error handling, memory management, and physical storage. HDF library functions can be called from C or Fortran user application programs.

HDF source code for UNIX, Virtual Memory Storage (VMS), Windows NT/95, and Macintosh is available via anonymous file transfer protocol (ftp) from http://hdf.ncsa.uiuc.edu/obtain.html. HDF reference manuals, user guides, release notes, and newsletters are web accessible at http://hdf.ncsa.uiuc.edu.

6.2 HDF Libraries

HDF-EOS is standard HDF with ECS conventions and metadata added. The principal distinction is the specification of three geolocation data types: point, grid, and swath, which allow the file contents to be queried by Earth coordinates and time using the HDF-EOF application programming interface (API). The Landsat 7 0R distribution product does not employ either of these data structures. However, any application that makes use of the HDF-EOF API will, as a consequence of linking to the API, have access to the NCSA native base libraries that can be used to access the distribution 0R product.

EOSView is a file-viewing tool developed for the ECS Project to examine and verify HDF data files. This tool enables users of EOS data products to view the contents of HDF files and individual objects via straightforward product access and display tools. Supported record types for viewing and display capability include images, multidimensional arrays, text, Vdatas, and Vgroups. EOSView users see the underlying HDF structures and are prompted for which parts of the structure they wish to view.

Users of the Landsat 7 0R product may also find the Science Data Production (SDP) Toolkit useful for follow-on processing. The SDP Toolkit consists of a set of fully tested and reliable C and Fortran language functions, customized for application to ECS product generation software. Of particular interest to Landsat 7 data users is the ODL parser, which allows for reading, writing, and manipulating product metadata and the digital elevation model software tools.

The SDP Toolkit and HDF libraries are available via anonymous ftp from edhs1.gsfc.nasa.gov. Because this software was developed under a NASA contract and is intended for the use of EOS instrument teams and science investigators, access to download it is password protected. The password may be obtained by E-mail to pgstlkit@eos.hitc.com.

6.3 ODL Parser

The ODL parser (Version 1.0) incorporated into the SDP Toolkit was originally implemented bay the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP). The Jet Propulsion Laboratory (JPL) enhanced the ODL parser in building their Planetary Data System. The improved ODL software (Version 2.1) is now maintained by LASP and is available via anonymous ftp from miranda.colorado.edu (IP address: 128.128.137.33).

Version 2.1 or later should be particularly useful to those operating in a non-HDF-EOS environment. The software stands alone and can be used to read the L0R or L1 metadata external elements and the CPF.

Appendix A. Projection Parameters

This appendix contains the map projection parameters used in the LPGS FAST-L7A L1G products (Table A-1) and the USGS Projection Parameters (Table A-2).

Table A-1. LPGS FAST-L7A Projection Parameters

Project Name	Mnemonic
Universal Transverse Mercator	UTM
Lambert Conformal Conic	LCC
Polar Stereographic	PS
Polyconic	PC
Transverse Mercator (Gauss-Krueger)	TM
Oblique Mercator (Type A & B)	OM
Space Oblique Mercator	SOM

Table A-2. USGS Projection Parameters

(A) Projection Transformation Package Projection Parameters Elements 1-8

	Array Element							
Code and Projection ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
UTM	Lon/Z	Lat/Z						
Lambert Conformal C	SMajor	SMinor	STDPR1	STDPR2	CentMer	OriginLat	FE	FN
Polar Stereographic	SMajor	SMinor			LongPol	TrueScale	FE	FN
Polyconic	SMajor	SMinor			CentMer	OriginLat	FE	FN
Transverse Mercator	SMajor	SMinor	Factor		CentMer	OriginLat	FE	FN
Hotine Oblique Merc A	SMajor	SMinor	Factor			OriginLat	FE	FN
Hotine Oblique Merc B	SMajor	SMinor	Factor	AziAng	AzmthPt	OriginLat	FE	FN
Space Oblique Merc B	SMajor	SMinor	Satnum	Path			FE	FN

(B) Projection Transformation Package Projection Parameters Elements 9-15

	Array Element				
Code and Projection ID	**9**	**10**	**11**	**12**	**13**
UTM					
Lambert Conformal C					
Polar Stereographic					
Polyconic					
Transverse Mercator					
Hotine Oblique Merc A	Long1	Lat1	Long2	Lat2	zero
Hotine Oblique Merc B					one
Space Oblique Merc B					one

where

Lon/Z	=	longitude of any point in the UTM zone or zero
Lat/Z	=	latitude of any point in the UTM zone or zero.
SMajor	=	semi-major axis of ellipsoid. If zero, Clarke 1866 in meters is assumed
SMinor	=	eccentricity squared of the ellipsoid if less than zero. If zero, a spherical form is assumed, or if greater than zero, the semi-major axis of ellipsoid
STDPR1	=	latitude of the first standard parallel
STDPR2	=	latitude of the second standard parallel
CentMer	=	longitude of the central meridian
OriginLat	=	latitude of the projection origin
FE	=	false easting in the same units as the semi-major axis
FN	=	false northing in the same units as the semi-major axis
LongPol	=	longitude down below pole of map
TrueScale	=	latitude of true scale
Factor	=	scale factor at central meridian (Transverse Mercator) or center of projection (Hotine Oblique Mercator)
Long1	=	longitude of first point on center line (Hotine Oblique Mercator, format A)
Long2	=	longitude of second point on center line (Hotine Oblique Mercator, format A)
Lat1	=	latitude of first point on center line (Hotine Oblique Mercator, format A)
Lat2	=	latitude of second point on center line (Hotine Oblique Mercator, format A)
AziAng	=	azimuth angle east of north of center line (Hotine Oblique Mercator, format B)
AzmthPt	=	longitude of point on central meridian where azimuth occurs (Hotine Oblique Mercator, format B)
Satnum	=	Landsat satellite number (SOM, format B)
Path	=	Landsat path number (use WRS-1 for Landsat 1, 2, and 3 and WRS-2 for Landsat 4, 5, 6, or 7) (SOM, format B)

NOTES: Array elements 14 and 15 are set to zero. All array elements with blank fields are set to zero. All angles (latitudes, longitudes, azimuths, etc.) are entered in packed degrees/minutes/seconds (DDDMMMSSS.SS) format.

Appendix B. Sample Read-Me File

Landsat 7 HDF-formatted Data Set

Satellite, Instrument, and Data Product Information

Information about the Landsat 7 satellite, the ETM+ payload, data characteristics, and product types can be found in the Landsat 7 Science Data Users' Handbook. A complete description of the contents of the Landsat 7 HDF files may be found in the Earth Science Data and Information system (ESDIS) Level 1 Product Generation System (LPGS) Output Files Data Format Control Book, Volume 5, Book 2 (see references below). The LPGS created this product.

Data Set Organization

The enclosed Landsat 7 data set is HDF (Version 4.0r2) formatted. HDF is a self-describing, platform independent format. The actual Landsat 7 data files are stored as external elements which means they are physically separated from the HDF directory. This directory exists as a separate file and contains the file names and pointers required to access and process the data files using the HDF library and interface routines. Tools for analysis of this data are described under "Data Access Information" below.

The root directory contains this Readme file and a set of subdirectories. There is one subdirectory for each product ordered. The product subdirectories are labeled product1, product2, product3, etc. All of the files associated with a product exist at a common level within the product subdirectory.

Landsat 7 File Naming Convention for 1R and 1G Products

The file naming convention for the HDF product files is:

L7fpppprrr_rrrYYYYMMDD_aaa.XXX where:

L7 = Landsat 7 mission
f = ETM+ format (1or 2) (data not pertaining to a specific format defaults to 1)
ppp = starting path of the product
rrr_rrr = starting and ending rows of the product
YYYYMMDD = acquisition date of the image
aaa = file type (see below)
XXX = product type (L1R or L1G)

The file type designators indicate file content. The number of files and type vary according to the type of product ordered (1R or 1G). These are:

File Type Designator (aaa)	File Content
B10	band 1 data
B20	band 2 data
B30	band 3 data
B40	band 4 data
B50	band 5 data
B61	band 6 data (format 1)
B62	band 6 data (format 2)
B70	band 7 data
B81	band 8 data
CAL	internal calibrator data (1R only)
SLO	scan line offset data (1R only)
MSD	mirror scan correction data (1R only)
PCD	payload correction data (1R only)
MTA	LPS metadata (1R only)
MTA	LPS metadata (1R only)
MTL	LPGS metadata
GEO	geolocation table (1R only)
HDF	HDF Directory

The calibration parameter file (CPF) also accompanies the 1R product. The parameters in this file are used to create Level 1R and Level 1G products. The CPF is recognized by the following label: "L7CPFYYYYMMDD_YYYYMMDD_nn " where
YYYYMMDD = Effective start date and effective end date, respectively
nn = Incrementing version number within a 90-day period (-99)

Data Access Information

LPGS products are delivered on 8mm tape, CD-ROM, or transferred electronically.

Reading Data on Tape

Data are available on high-density 8-mm (Exabyte) tapes. Tapes are created with the UNIX utility Tar(per IEEE POSIX standard 1003.1) on a
Silicon Graphics Origin 2000 computer. File names are thus preserved. The no-swap device and a blocking factor of 20 512-byte blocks is used to maximize portability between platforms.

To read a tar tape on a computer with a UNIX operating system:

First type the command: tar -xvbf <filename>.tar 20

where xvbf are tar command key arguments as follows:

x indicates that the data are to be read from tape
v requests verbose output; i.e., processed file names will be listed
b states that a blocking factor is specified
f states that an archive name is specified.

The fields in < > are system specific and may specify a device, such as a tape drive, or a file directory. The specific parameters depend on your local workstation configuration (e.g., this will be "/dev/8mm1nr" if you read the tape off the 8mm1 tape mdrive on the DAAC computer with the "no rewind" option). 20 is the blocking factor.

To read a "tar" format file received by FTP, use the command:

tar -xvf <filename>.tar

Reading Data on CD-ROM

Data files on CD-ROM require no unpacking. The files are ready for processing using HDF or other software tools.

HDF Information

HDF is the standard data format for Earth Observation System data products. HDF was developed by the National Center for Supercomputing Applications (NCSA) Software Development Group. The HDF group also supplies HDF utilities that allow file manipulation and conversion on a variety of platforms with UNIX-based operating systems.

HDF details, user documents, and software libraries can be found at the HDF Web site: http://hdf.ncsa.uiuc.edu/

The Goddard DAAC also has a discussion of HDF, HDF utilities, and links to several different software packages.

http://daac.gsfc.nasa.gov/REFERENCE_DOCS/HDF/gdaac_hdf.html

A site for information on HDF, featuring the HDF libraries for PC and Macintosh, HDF-capable software, and links to user groups, is found at:
http://www.hdfinfo.com

References

1. Landsat 7 Science Data Users' Handbook.
2. Earth Science Data and Information system (ESDIS) Level 1 Product Generation System (LPGS) Output Files Data Format Control Book, Volume 5, Book 2

Points of Contact:

EDC DAAC:

User Services Office
Goddard Distributed Active Archive Center
NASA Goddard Space Flight Center, Code 902
Greenbelt, MD 20771
USA

Email: daacuso@eosdata.gsfc.nasa.gov
Phone: 301-614-5224
Fax: 301-614-5268

EDC DAAC Helpdesk: daacuso@daac.gsfc.nasa.gov
Telephone: 301-614-5224 or 1-800-257-6151

Abbreviations and Acronyms

ACCA	automated cloud cover assessments
ADS	angular displacement center
API	application programming interface
ASCII	American Standard Code for Information Interchange
BCH	Bose-Chaudhuri-Hocquenghem
CADU	channel access data unit
CCA	cloud cover assessment
CFPA	cold focal plane assembly
CPF	calibration parameter file
DAAC	Distributed Active Archive Center
DCN	document change notice
DFCB	data format control book
ECI	Earth center inertial
ECS	EOSDIS Core System
EDC	EROS Data Center
EOL	end of line
EOS	Earth Observing System
EOSAT	Earth Observation Satellite Company
EOSDIS	EOS Data and Information System
EROS	Earth Resources Observation System
ESDIS	Earth Science Data and Information System
ETM+	Enhanced Thematic Mapper plus
FAST-L7A	FAST-Landsat 7 format
FHS	first half scan
F&PRS	Functional and Performance Requirements Specification
GeoTIFF	Geographic Tagged Image File Format

GMT	Greenwich mean time
GSFC	Goddard Space Flight Center
HDF	hierarchical data format
HDS	horizontal display shift
IAS	Image Assessment System
IC	internal calibrator
ICD	interface control document
IMU	inertial measurement unit
I/O	input/output
JPL	Jet Propulsion Laboratory
LASP	Laboratory for Atmospheric and Space Physics
L0R	Level 0 reformatted
L1	Level 1
L1G	Level 1 geometrically corrected
L1R	Level 1 radiometrically corrected
LCC	Lambert Conformal Conic
LPDS	Level 1 Product Distribution System
LPGS	Level 1 Product Generation System
LPS	Landsat Processing System
m	meter
MOC	Missions Operations Center
ms	millisecond
MSCD	mirror scan correction data
N/A	not applicable
NASA	National Aeronautics and Space Administration
NCSA	National Center for Supercomputing Applications
ODL	object description language
OMB	Oblique Mercator, Type B

PC	Polyconic
PCD	payload correction data
PCMB	Project Configuration Management Board
PS	Polar Stereographic
SDS	scientific dataset
SHS	second half scan
SLD	scan line data
SWIR	shortwave infrared
TBD	to be defined/determined
TBR	to be resolved
TBS	to be supplied
TM	Traverse Mercator
USGS	United States Geologic Survey
UTC	universal time coordinated
VCDU	virtual channel data unit
VNIR	visible and near infrared
WRS	Worldwide Reference System
0R	zero R data
Zulu	Greenwich mean time