LS-DFCB-20
Version 2.0

Department of the Interior
U.S. Geological Survey

LANDSAT THEMATIC MAPPER (TM)
LEVEL 1 (L1)
DATA FORMAT CONTROL BOOK (DFCB)

Version 2.0

September 2008

LANDSAT THEMATIC MAPPER (TM)
LEVEL 1 (L1)
DATA FORMAT CONTROL BOOK (DFCB)

September 2008

Prepared By:

_____

L. Johnson Date
LPGS & NLAPS Systems Engineer
SGT

Reviewed By:

_____

C. Torbert Date
Landsat Ground Segment Manager
SGT

Reviewed By:

_____

A. Meyerink Date
Landsat A&P Task Lead
SGT

Approved By:

_____

J. Lacasse Date
Landsat Mission Management Officer
U.S. Geological Survey

EROS
Sioux Falls, South Dakota

Executive Summary

This Data Format Control Book (DFCB) presents detailed data formats of the output files generated by the Image Assessment System (IAS), the Level 1 (L1) Product Generation System (LPGS), and the National Land Archive Production System (NLAPS). These L1 processing systems produce L1 output files from Level 0 Reformatted (L0R) images based on user requests. Images in the following formats are possible from the various L1 processing systems: Hierarchical Data Format (HDF), FAST, Geographic Tagged Image File Format (GeoTIFF), or NLAPS Data Format (NDF). IAS and LPGS do not generate products in NDF format. The NLAPS Systematic Format Description Document describes the NDF format (see References).

The Landsat Configuration Control Board (LCCB) maintains and controls this DFCB. Staff may update or revise this document only upon LCCB approval. Please direct comments and questions regarding this DFCB to the following:

Landsat Mission Management Officer
U.S. Geological Survey (USGS)
Earth Resources Observation and Science (EROS) Center
47914 252nd Street
Sioux Falls, SD 57198

Document History

Document Number	Document Version	Publication Date	Change Number
LS-DFCB-20	Version 1.0	December 2007	CCR 4622, CCR 4671, CCR 4708, CCR 4819, CCR 4821
LS-DFCB-20	Version 2.0	September 2008	CCR 4622, CCR 4671, CCR 4708, CCR 4709, CCR 4819, CCR 4821

Contents

List of Tables

Section 1 Introduction

1.1 Purpose

This Data Format Control Book (DFCB) provides a high-level description of the Landsat Thematic Mapper (TM) Level 1 (L1) distribution product, output product packaging, and viewing tools.

1.2 Scope

This DFCB describes the formats and data contents of the L1 output files. The formats discussed include Hierarchical Data Format (HDF), FAST, Geographic Tagged Image File Format (GeoTIFF), and National Land Archive Production System (NLAPS) Data Format (NDF). The NLAPS Precision and Terrain Formats Description Document at http://edc.usgs.gov/guides/images/landsat_tm/nlapsgeo2.html also describes NDF specifications.

The HDF L1 product formats are primarily derived from the formats of the Level 0Rp (L0Rp) products to lessen the impact on the user community and to provide general consistency in output. The Landsat TM System Zero-R Distribution Product Data Format Control Book, Volume 5, Book 1 (see References) describes the L0Rp product formats. (Note: L1 customers should obtain a copy of Book 1 because Book 2 references related tables to describe L1R output files.) In addition, the output files defined in this DFCB are based on the already established FAST and GeoTIFF standards. The Landsat 4 and 5 L1 products are in FAST format; this is the FAST-C format modified to resemble the FAST-Landsat 7 Format (FAST-L7A) used for the Enhanced Thematic Mapper Plus (ETM+) instrument.

The file formats contained in this DFCB are applicable to the product generated by L1 producing systems operated at the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center.

1.3 Intended Users

This document is intended as a guide for L1 product recipients. It also provides detailed information on the L1 product packaging.

1.4 Definitions

Level 0Ra (L0Ra) product - Raw Computer Compatible (RCC) data that have been reformatted to support data production and include individual band, Browse Data, a Mirror Scan Correction Data (MSCD) file, a Payload Correction Data (PCD) file, and Scene Metadata.

Level 0Rp (L0Rp) digital image— Spatially reformatted, demultiplexed, and unrectified interval data

Level 0Rp (L0Rp) product— L0Rp digital image plus radiometric, calibration, spacecraft attitude, and ephemeris data, consisting of the following files in HDF:

- L0Rp digital image (one file per band)
- Internal Calibrator (IC) data— Calibration data file containing all of the calibration data received on a major frame basis subset to the product size ordered
- Mirror Scan Correction Data (MSCD)— Scan direction and error information subset to the product size ordered
- Payload Correction Data (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 L0Rp image and names of appended files associated with the image
- Calibration Parameter File (CPF)— Formatted file containing radiometric and geometric correction parameters
- Scan Line Offsets (SLO)—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 of the pointers, file size information, and data objects required to process the L0Rp product

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

Level lR (L1R) product—L1 product distributed by the Product Distribution System (PDS) 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 of 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 L0 and L1 digital images and names of appended files associated with the images
- 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
- HDF directory—File containing all of the pointers, file size information, and data objects required to open and process the L1 product using the HDF library and interface routines

Consensus File— A single file created from the two original files included with the L0Rp product and errors corrected

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

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

Level 1Gt (L1Gt) product— L1Gt Terrain Correction product that includes radiometric and geometric corrections, and uses a Digital Elevation Model (DEM) to correct parallax error due to local topographic relief. The accuracy of the terrain corrected product depends upon the resolution of the best available DEM.

Level 1 Precision (L1P) product— Includes radiometric and geometric correction, and uses Ground Control Points (GCPs) to improve accuracy. Accuracy of the precision-corrected product depends upon the availability of local GCPs. NLAPS processes all L1P products.

Level 1 Terrain Corrected (L1T) product— Includes radiometric, geometric, and precision correction, and uses a DEM to correct parallax error due to local topographic relief. The accuracy of the terrain-corrected product depends upon the availability of GCPs, as well as the resolution of the best available DEM.

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

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 Level 0 Pre-Archive Processing

A basic knowledge of the pre-archive ground processing will enable the user to understand the L1 product.

The Landsat Ground System (LGS) acquires TM wideband data directly from the Landsat TM spacecraft. The Data Capture System (DCS) records all wideband data, at real-time rates, into its wideband data stores. A single channel represents a complete data set and holds Bands 1 through 7. The Landsat Archive Conversion System (LACS) retrieves and processes raw wideband data, at lower than real-time rates, into separate accumulations of Earth image data, calibration data, MSCD, and PCD.

The LACS spatially reformats Earth imagery and calibration data into L0Ra data. This involves shifting pixels by integer amounts to account for the alternating forward-reverse scanning pattern of the TM sensor, the odd-even detector arrangement within each

band, and the detector offsets inherent to the focal plane array engineering design. All LACS 0R corrections are reversible; the Image Assessment System (IAS) CPF documents the pixel parameters used.

During LACS processing, bands are duplicated, aligned, and used to assess cloud cover content and to generate scene-based browse data. 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 EROS for archiving in subinterval form. The browse files are sent to EROS search and order systems separately for use as an online aid to ordering.

Section 2 Overview of Level 1 Output Files

The L1R digital image is very similar to the L0Rp digital image, except that the L1R image data are radiometrically corrected. The L1R product is available in HDF only. The L1G digital image is radiometrically and geometrically corrected and is available in four format options: FAST, GeoTIFF, HDF, and NDF. The L1T product includes radiometric, geometric, and precision correction, and uses DEM to correct parallax error due to local topographic relief. The L1Gt product is radiometrically and geometrically corrected and uses DEM to correct parallax error due to local topographic relief.

Table 2-1 through Table 2-5 detail the L1 product components included with each format. The number of bands and optional data files that the user orders determines the number of components included with a specific product.

Component	L1G	L1Gt	L1P	L1T
L1 image file (for each requested band)	X	X	X	X
Header file (for each requested band group) (text file with a FAST [.FST] extension)	X	X	X	X
L1 Metadata file (text [.txt] file)	X	X	X	X
DEM header file (text file with a FAST [.FST] extension)		Optional		Optional
DEM data file		Optional		Optional
GCP file (text [.txt] file)				X
At-Satellite Reflectance files (TIFF [.TIF] file)	Optional	Optional	Optional	Optional
Tasseled cap file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional
Normalized Burn Ratio (NBR) file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional

Table 2-1. FAST Product Components

Component	L1G	L1Gt	L1P	L1T
L1 image file (for each requested band)	X	X	X	X
L1 Metadata file (text [.txt] file)	X	X	X	X
DEM data file (TIFF [.TIF] file)		Optional		Optional
GCP file (text [.txt] file)				X
At-Satellite Reflectance files (TIFF [.TIF] file)	Optional	Optional	Optional	Optional
Tasseled cap file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional
NBR file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional

Table 2-2. GeoTIFF Product Components

Component	L1R	L1G	L1Gt	L1P	L1T
L1 image file (for each requested band)	X	X	X	X	X
IC data (for Bands 1 through 7)	X				
Scan Line Offsets (for Bands 1 through 7)	X				
MSCD (consensus)	X				
PCD (consensus)	X				
CPF	X				
Metadata file (LPS) (text [.txt] file)	X				
L1 Metadata file (text [.txt] file)	X	X	X	X	X
DEM data file			Optional		Optional
Ground Control Points file (text [.txt] file)					X
At-Satellite Reflectance files (TIFF [.TIF] file)		Optional	Optional	Optional	Optional
Tasseled cap file (TIFF [.TIF] file)		Optional	Optional	Optional	Optional
Normalized Burn Ratio file (TIFF [.TIF] file)		Optional	Optional	Optional	Optional
Geolocation table	X				
HDF directory file	X	X	X	X	X

Table 2-3. HDF Product Components

Component	L1G	L1Gt	L1P	L1T
L1 image file (for each requested band)	X	X	X	X
Header file (text [.txt] file)	X	X	X	X
L1 Metadata file (text [.txt] file)	X	X	X	X
Work order report file	X	X	X	X
History and processing parameters file	X	X	X	X
DEM header file		Optional		Optional
DEM data file		Optional		Optional
At-Satellite Reflectance file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional
Tasseled cap file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional
Normalized Burn Ratio file (TIFF [.TIF] file)	Optional	Optional	Optional	Optional

Table 2-4. NDF Product Components

2.1 FAST

The file-naming convention for the FAST product files is:

LMppprrr_rrrYYYYMMDD_AAA.FST, where

L	=	Landsat
M	=	Mission 4 = Landsat 4 5 = Landsat 5
ppp	=	Product starting path
rrr_rrr	=	Product starting and ending rows
YYYYMMDD	=	Image acquisition date
AAA	=	File type: B10 = Band 1 B20 = Band 2 B30 = Band 3 B40 = Band 4 B50 = Band 5 B60 = Band 6 B70 = Band 7 HRF = Visible and Near Infrared (VNIR) / Short Wavelength Infrared (SWIR) bands header file HTM = Thermal band header file MTL = L1 metadata GCP = Ground Control Points DEM = Digital Elevation Model data file HDM = Digital Elevation Model header file
.FST .txt	= =	FAST file extension Only the GCP and MTL files end with .txt (e.g., LMppprrr_rrrYYYYMMDD_MTL.txt)

Table 2-5. FAST File Naming Convention

2.1.1 Level 1 Image File

Each L1 image file contains only one TM band of image pixels in Digital Number (DN) units. There are no header records within the L1 image file, nor are there prefix or suffix data in the individual image records. Image data are unblocked. The L1 image files are 8-bit unsigned integers.

2.1.2 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 (VNIR/SWIR) and thermal has a specific header file. Alphanumeric fields are left justified and numeric fields are right justified. This file also includes all processing options and map projection information.

2.1.3 Level 1 Metadata File

Please see 2.3.2 for L1 Metadata File details.

2.1.4 DEM Header File (Optional)

The DEM header files contain information describing the image data. The header is intended to be easy to read and uses only ASCII-text to represent the information (i.e., the header does not contain binary information).

2.1.5 DEM Data File (Optional)

The DEM data file contains elevation samples. There are no header records within the file, nor are there any prefix and/or suffix data to the individual image records. The DEM data file is a flat binary file containing 16-bit integer data (stored in big-endian byte order) and information for only one band. The image lines for that band are stored sequentially.

2.1.6 Ground Control Points (GCP) File

The GCP file contains the control source information and the specific GCP(s) used during product generation. The file, written in ASCII format, contains a header followed by records (one per line).

2.1.7 At-Satellite Reflectance (Optional)

At-Satellite Reflectance products for the reflective bands (Bands 1 to 5 and 7) are generated and distributed with all six bands in one GeoTIFF file, regardless of the image product format requested. Each band within the GeoTIFF file is 8-bit data. The At-Satellite Temperature product for the thermal band (Band 6) is also distributed in a GeoTIFF file containing only the one band. All bands for the At-Satellite Reflectance products are written as 8-bit unsigned integer data.

L	=	Landsat
m	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Product starting path
rrr_rrr	=	Product starting and ending rows
YYYYMMDD	=	Acquisition date of the image
AAA	=	File type: ASR = At-Satellite Reflectance AST = At-Satellite Temperature NBR = Normalized Burn Ratio TCP = Tasseled Cap
.TIF	=	TIF file extension

Table 2-6. LPGS Naming Convention Details for At-Satellite Reflectance Products

M	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Path
rrr	=	Row
00	=	WRS row offset (set to 00)
YY	=	Last 2 digits of acquisition year
DDD	=	Julian date of acquisition
N	=	Instrument mode: 0 = Night Acquisition 1 = TM Bands 1-7 9 = MSS Data
X	=	Instrument multiplexor (MUX) 0 = Original Scene 1 or 2 = Version Number
XXXX	=	File Type: B9 = At-Satellite Temperature NBR = Normalized Burn Ratio REFL = At-Satellite Reflectance TC = Tasseled Cap
.TIF	=	TIF file extension

Table 2-7. Current NLAPS Naming Convention Details for At-Satellite Reflectance Products

2.1.8 Tasseled Cap (Optional)

Tasseled Cap is a product generated using the 8-bit, At-Satellite Reflectance images (Bands 1 to 5 and 7). This transformation is a method used to enhance spectral information contents of Landsat TM data. The tasseled cap brightness, greenness, and wetness indexes are contained and distributed in one GeoTIFF file containing three separate bands, each written as 8-bit unsigned integer data. The brightness index is contained in Band 1, the greenness index is contained in Band 2, and the wetness index is contained in Band 3 of the GeoTIFF file. The tasseled cap product is output in a GeoTIFF file regardless of the image product format requested.

L	=	Landsat
m	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Product starting path
rrr_rrr	=	Product starting and ending rows
YYYYMMDD	=	Acquisition date of the image
AAA	=	File type: ASR = At-Satellite Reflectance AST = At-Satellite Temperature NBR = Normalized Burn Ratio TCP = Tasseled Cap
.TIF	=	TIF file extension

Table 2-8. LPGS Naming Convention Details for Tasseled Cap Products

M	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Path
rrr	=	Row
00	=	WRS row offset (set to 00)
YY	=	Last 2 digits of acquisition year
DDD	=	Julian date of acquisition
N	=	Instrument mode: 0 = Night Acquisition 1 = TM Bands 1-7 9 = MSS Data
X	=	Instrument multiplexor (MUX) 0 = Original Scene 1 or 2 = Version Number
XXXX	=	File Type: B9 = At-Satellite Temperature NBR = Normalized Burn Ratio REFL = At-Satellite Reflectance TC = Tasseled Cap
.TIF	=	TIF file extension

Table 2-9. Current NLAPS Naming Convention Details for Tasseled Cap Products

2.1.9 Normalized Burn Ratio (NBR) (Optional)

The NBR is a 16-bit signed integer image product generated from Bands 4 and 7 of Landsat TM imagery and distributed in a GeoTIFF format, regardless of the image product format requested. This product is generated for those Landsat images acquired and processed for the Monitoring Trends in Burn Severity (MTBS) project, which began in 2005. Preprocessing of scenes used for the MTBS project is the same as that used for Multi-Resolution Land Characteristics (MRLC) (i.e., terrain correction and projection, radiometric correction to At-Satellite Reflectance, tassel cap transformation). The NBR is derived from a ratio of Bands 4 and 7 (corrected to At-Satellite Reflectance).

L	=	Landsat
m	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Product starting path
rrr_rrr	=	Product starting and ending rows
YYYYMMDD	=	Acquisition date of the image
AAA	=	File type: ASR = At-Satellite Reflectance AST = At-Satellite Temperature NBR = Normalized Burn Ratio TCP = Tasseled Cap
.TIF	=	TIF file extension

Table 2-10. LPGS Naming Convention Details for Normalized Burn Ratio Products

M	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Path
rrr	=	Row
00	=	WRS row offset (set to 00)
YY	=	Last 2 digits of acquisition year
DDD	=	Julian date of acquisition
N	=	Instrument mode: 0 = Night Acquisition 1 = TM Bands 1-7 9 = MSS Data
X	=	Instrument multiplexor (MUX) 0 = Original Scene 1 or 2 = Version Number
XXXX	=	File Type: B9 = At-Satellite Temperature NBR = Normalized Burn Ratio REFL = At-Satellite Reflectance TC = Tasseled Cap
.TIF	=	TIF file extension

Table 2-11. Current NLAPS Naming Convention Details for Normalized Burn Ratio Products

2.2 GeoTIFF

The file-naming convention for the GeoTIFF product is:

LMppprrr_rrrYYYYMMDD_AAA.XXX, where

L	=	Landsat
M	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Product starting path
rrr_rrr	=	Product starting and ending rows
YYYYMMDD	=	Acquisition date of the image
AAA	=	File type: B10 = Band 1 B20 = Band 2 B30 = Band 3 B40 = Band 4 B50 = Band 5 B60 = Band 6 B70 = Band 7 MTL = L1 metadata GCP = Ground Control Points DEM = Digital Elevation Model
.TIF .txt	=	TIF file extension Only the GCP and MTL files end with .txt (e.g., LMppprrr_rrrYYYYMMDD_MTL.txt)

Table 2-12. GeoTIFF Product Naming Convention

2.2.1 Level 1 Image File

GeoTIFF defines a set of public domain TIFF tags that describe all cartographic and geodetic information associated with GeoTIFF 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, scan line, uncompressed, and 8-bit unsigned integers.

2.2.2 Level 1 Metadata File

Please see 2.3.2 for L1 Metadata File details.

2.2.3 DEM Data File (Optional)

The DEM data file contains elevation samples. Similar to the Level 1 Image file for the GeoTIFF product, the optionally distributed DEM data file is also output in a GeoTIFF format.

2.2.4 Ground Control Points (GCP) File

Please see 2.1.6 for GCP File details.

2.2.5 At-Satellite Reflectance (Optional)

Please see 2.1.7 for At-Satellite Reflectance details.

2.2.6 Tasseled Cap (Optional)

Please see 2.1.8 for tasseled cap details.

2.2.7 Normalized Burn Ratio (NBR) (Optional)

Please see 2.1.9 for NBR details.

2.3 HDF

The L1R, L1G, and L1T HDF products are packaged and distributed as a collection of external elements with an HDF directory. External elements are distinguished in that they exist as separate files and contain only data. The HDF directory includes information about their HDF structure and interrelationships.

The file-naming convention for the HDF product files (except the CPF) is as follows:

LMpppprrr_rrrYYYYMMDD_AAA.XXX

L	=	Landsat
M	=	Mission: 4 = Landsat 4 5 = Landsat 5
ppp	=	Product starting path
rrr_rrr	=	Product starting and ending rows
YYYYMMDD	=	Image acquisition date
AAA	=	file type: B10 = Band 1 B20 = Band 2 B30 = Band 3 B40 = Band 4 B50 = Band 5 B60 = Band 6 B70 = Band 7 CAL = Internal calibrator GEO =Geolocation HDF = HDF directory MSD =Consensus MSCD MTA = LPS metadata MTL = L1 metadata GCP = Ground Control Points PCD = Consensus PCD SLO = Scan Line Offset DEM = Digital Elevation Model
.XXX .txt	=	Product type (L1R, L1G, or L1T) The MTL, MTA, and GCP files end with .txt (e.g., LMppprrr_rrrYYYYMMDD_MTL.txt)

Table 2-13. HDF Naming Convention

The CPF file-naming convention is as follows:

LMCPFYYYYMMDD_YYYYMMDD_nn

L	=	Landsat
M	=	Mission: 4 = Landsat 4 5 = Landsat 5
CPF	=	Calibration parameter file
YYYY	=	Starting year of the CPF
MM	=	Starting month of the CPF
DD	=	Starting day of the CPF
_	=	Separator
YYYY	=	Ending year of the CPF
MM	=	Ending month of the CPF
DD	=	Ending day of the CPF
_	=	Separator
nn	=	01-99 (CPF version number)

Table 2-14. CPF Naming Convention Table

2.3.1 Level 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 and output in big-endian byte order. The L1G images are 8-bit unsigned integers that exploit the full 0-255 numeric range.

2.3.2 Level 1 Metadata File

The L1 metadata file is created during product generation and contains information specific to the product ordered. This file also contains all applicable image description information from the L0Rp metadata and the LPS L0Ra metadata provided with the L0Rp product. Section 3.3.2 describes these files in detail.

2.3.3 DEM Data File (Optional)

Please see 2.1.5 for DEM data file details.

2.3.4 Ground Control Points (GCP) File

Please see 2.1.6 for GCP file details.

2.3.5 At-Satellite Reflectance (Optional)

Please see 2.1.7 for At-Satellite Reflectance details.

2.3.6 Tasseled Cap (Optional)

Please see 2.1.8 for tasseled cap details.

2.3.7 Normalized Burn Ratio (NBR) (Optional)

Please see 2.1.9 for NBR details.

2.3.8 Ancillary Data Files (L1R Products Only)

The remaining files included with the HDF product include the IC data, scan line offsets, MSCD, PCD, CPF, metadata, geolocation table, and the HDF directory file. See Table 2-3 for a complete listing of the files included with each product. Section 3.3.4 describes these files in detail.

2.4 NLAPS Data Format (NDF)

The product composition for geometrically and radiometrically corrected Landsat data includes up to eight file types. These types include one or more L1 image files, header files, a Work Order report file, a processing history, and some optional DEM header and data files. In Band Sequential (BSQ) format, each band of satellite imagery is stored in a separate file (i.e., scan lines are sequentially written to the same image file).

One or more image header files describe the product delivered and provide necessary information for further processing. One or more image files contain the binary image data. If a DEM is used for terrain correction, a DEM header and DEM image file is included as well, if requested. In addition, each NDF product includes a Correction Processing Report file (formerly known as a Work Order Report) and a history file indicating the processing parameters.

The file-naming convention for the NDF product files is:

LMPPPRRRSSYYDDDMV.XXX

L	=	L = Landsat
M	=	Mission: 4 = Landsat 4 5 = Landsat 5
PPP	=	Starting WRS path
RRR	=	Starting WRS row
SS	=	WRS row offset (used for “shifted” scenes) 00 = No shift
YY	=	Last two digits of the acquisition year
DDD	=	Day Of Year (DOY) of acquisition
M	=	Instrument mode: T = TM
V	=	0 = Multiplexer (MUX)
.XXX	=	I1 = TM band (1 – 7) 01 = Band 1 02 = Band 2 03 = Band 3 04 = Band 4 05 = Band 5 06 = Band 6 07 = Band 7 H1 = Product header # (1,2, or 3) WO = Job report file HI = Job history file DH = DEM header (optional) DD = DEM data (optional) MTL = L1 metadata
.txt	=	Only the MTL file ends with .txt (e.g., LMPPPRRRSSYYDDDMV.MTL.txt)

Table 2-15. NDF Naming Convention

2.4.1 Level 1 Image File

The L1 image files contain the raw image pixels. There are no header records within the file, nor are there any prefix and/or suffix data to the individual image records. If the L1 image file is part of a BSQ product, then it contains information for only one band, and the image lines for that band are stored sequentially.

2.4.2 Header File

The first file on each volume, a Read-Me-First file, contains header data. It is in ASCII, and complies with American National Standards Institute (ANSI) and International Standards Organization (ISO) standards. The image header files contain information describing the image data in the image. The header is intended to be easy to read and uses only ASCII-text to represent information (i.e., the header does not contain binary information).

To accommodate multi-resolution products, one header file is written for each resolution in the output product. This is in contrast to previous versions of the NDF format in which all data files in the same volume (data set) were required to have the same pixel spacing and pixel format, with different resolutions requiring a separate volume set.

2.4.3 Level 1 Metadata File

Please see 2.3.2 for L1 Metadata File details.

2.4.4 Work Order Report File

The Work Order Report file is an ASCII-text file that contains information specific to the history and processing parameters used to process the NDF product.

2.4.5 History Processing Parameters File

Each NLAPS data product contains a processing history file. This ASCII-text file provides documentation about the original customer request and the processing parameters used to produce the NLAPS digital product.

2.4.6 DEM Header File (optional)

The image and DEM header files contain information describing the image data in the image or DEM files. This format is more general than earlier versions of Fast Format headers but is enhanced by additional sensors, DEM data, and non-satellite imagery information. The header is intended to be easy to read and uses only ASCII-text to represent information (i.e., the header does not contain binary information).

2.4.7 DEM Data File (optional)

The image and DEM files contain the raw image pixels or elevation samples. No header records are within the file, nor are there any prefix and/or suffix data to the individual image records. If the image file is part of a BSQ product, then it contains information for only one band, and the image lines for that band are stored sequentially.

2.4.8 Ground Control Points (GCP) File

Please see 2.1.6 for GCP File details.

2.4.9 At-Satellite Reflectance (Optional)

Please see 2.1.7 for At-Satellite Reflectance details.

2.4.10 Tasseled Cap (Optional)

Please see 2.1.8 for tasseled cap details.

2.4.11 Normalized Burn Ration (NBR) (Optional)

Please see 2.1.9 for NBR details.

Section 3 Level 1 Output File Formats

3.1 FAST File Formats

3.1.1 Level 1 Image File

Each Earth image band in the requested product is in a separate file. The data are laid out in a scan line sequential format in descending detector order (e.g., 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. The L1T image is radiometrically, geometrically, and precision corrected, and uses DEM to correct parallax error due to local topographic relief.

3.1.2 Header File

There is one header file for each band group in the product. The two possible band groups are 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.

Table 3-1 through Table 3-6 describe the formats of the three records for each of the two band groups (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 blank 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 PDS-distributed L1 products.

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 TM, the values are 1, 2, 3, 4, 5, and 7 for the VNIR/SWIR bands, and 6 for the thermal band. The sequence terminates with blanks.

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	8	A8	REQbIDb=
	2	9	28	A20	Data producer-defined request number that uniquely identifies each product. USGS products use: NNNYYMMDDSSSS_UUUUUb format where: NNNYYMMDDSSSS = 13-digit EROS Billing and Accounting System (EBAS) order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = 5-digit EBAS unit number
	3	29	34	A6	bLOCb=
	4	35	51	A17	First scene starting location in: ppp/rrrffssbbbbbb format where ppp = path / = / rrr = row ff = fraction ss = subscene
	5	52	70	A19	bACQUISITIONbDATEb=
	6	71	78	A8	First scene acquisition date in yyyymmdd format
	7	79	79	1X	Blank fill
	8	80	80	A1	Carriage return
2	9	81	91	A11	SATELLITEb=
	10	92	101	A10	First scene satellite Name: LANDSAT4 or LANDSAT5
	11	102	110	A9	bSENSORb=
	12	111	120	A10	First scene sensor Name: TM
	13	121	134	A14	bSENSORbMODEb=
	14	135	140	A6	First scene sensor Mode: NORMAL
	15	141	153	A13	bLOOKbANGLEb=
	16	154	159	F6.2	First scene 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	Last scene ending location in: ppp/rrrffssbbbbbb format where ppp = path / = / rrr = row ff = fraction ss = subscene
	21	212	230	A19	bACQUISITIONbDATEb=
	22	231	238	A8	Last scene acquisition date in yyyymmdd format
	23	239	239	1X	Blank fill
	24	240	240	A1	Carriage return
4	25	241	251	A11	SATELLITEb=
	26	252	261	A10	Last scene satellite Name: LANDSAT4 or LANDSAT5
	27	262	270	A9	bSENSORb=
	28	271	280	A10	Last scene sensor Name: TM
	29	281	294	A14	bSENSORbMODEb=
	30	295	300	A6	Last scene sensor Mode: NORMAL
	31	301	313	A13	bLOOKbANGLEb=

Line	Field	Start Byte	End Byte	Format	Description
	32	314	319	F6.2	Last scene off-nadir angle in degrees: 0.0
	33	320	320	A1	Carriage return
5	34	321	343	23X	Blank fill
	35	344	354	A11	bLOCATIONb=
	36	355	371	A17	N/A
	37	372	390	A19	bACQUISITIONbDATEb=
	38	391	398	A8	N/A
	39	399	399	1X	Blank fill
	40	400	400	A1	Carriage return
6	41	401	411	A11	SATELLITEb=
	42	412	421	A10	N/A
	43	422	430	A9	bSENSORb=
	44	431	440	A10	N/A
	45	441	454	A14	bSENSORbMODEb=
	46	455	460	A6	N/A
	47	461	473	A13	bLOOKbANGLEb=
	48	474	479	F6.2	N/A
	49	480	480	A1	Carriage return
7	50	481	503	23X	Blank fill
	51	504	514	A11	bLOCATIONb=
	52	515	531	A17	N/A
	53	532	550	A19	bACQUISITIONbDATEb=
	54	551	558	A8	N/A
	55	559	559	1X	Blank fill
	56	560	560	A1	Carriage return
8	57	561	571	A11	SATELLITEb=
	58	572	581	A10	N/A
	59	582	590	A9	bSENSORb=
	60	591	600	A10	N/A
	61	601	614	A14	bSENSORbMODEb=
	62	615	620	A6	N/A
	63	621	633	A13	bLOOKbANGLEb=
	64	634	639	F6.2	N/A
	65	640	640	A1	Carriage return
9	66	641	654	A14	PRODUCTbTYPEb=
	67	655	672	A18	Product type: MAPbORIENTEDbbbbbb ORBITbORIENTEDbbbb USERbORIENTEDbbbbb (NLAPS only) TRUENORTHbORIENTED (NLAPS only)
	68	673	687	A15	bPRODUCTbSIZEb=
	69	688	697	A10	Product size: SUBSCENEbb <374 scans, <1 scene FULLbSCENE =374 scans, =1 scene MULTISCENE >374 scans, >1 scene
	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 SYSTERRAINb PRECISIONbb TERRAINbbbb

Line	Field	Start Byte	End Byte	Format	Description
	74	752	764	A13	bRESAMPLINGb=
	75	765	766	A2	Resampling algorithm used: NN - Nearest Neighbor CC - Cubic Convolution MF - Modulation Transfer Function (LPGS only) BI - Bilinear (NLAPS only) KD - Kaiser Damped (NLAPS only) 16 - 16 Point Sinc (NLAPS only) 8b - 8 Point Sinc (NLAPS only) DW - Damped Window (NLAPS only)
	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 the tape set (for multivolume product): N/A
	80	822	822	A1	/
	81	823	824	I2	Number of volumes in the 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 reflective 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	931	A12	bRECbSIZEbb=
	95	932	940	I9	Length of the 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 the first band
	111	1160	1169	A10	FILENAMEb=
	112	1170	1198	A29	Filename for the second band

Line	Field	Start Byte	End Byte	Format	Description
	113	1199	1199	1X	Blank fill
	114	1200	1200	A1	Carriage return
16	115	1201	1210	A10	FILENAMEb=
	116	1211	1239	A29	Filename for the third band
	117	1240	1249	A10	FILENAMEb=
	117	1250	1278	A29	Filename for the 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 the fifth band
	123	1320	1329	A10	FILENAMEb=
	124	1330	1358	A29	Filename for the 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	A3	Format version code: TMb
	133	1536	1536	A1	Carriage return

Table 3-1. Administrative Record for the VNIR and SWIR Bands

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	50	A50	BIASESbANDbGAINSbINbASCENDINGbBANDbNUMBER bORDERbbb
	2	51	79	29X	Blank fill
	3	80	80	A1	Carriage return
2	4	81	104	D24.15	Bias for the first band
	5	105	105	1X	Blank fill
	6	106	129	D24.15	Gain for the first band
	7	130	159	30X	Blank fill
	8	160	160	A1	Carriage return
3	9	161	184	D24.15	Bias for the second band
	10	185	185	1X	Blank fill
	11	186	209	D24.15	Gain for the second band
	12	210	239	30X	Blank fill
	13	240	240	A1	Carriage return
4	14	241	264	D24.15	Bias for the third band
	15	265	265	1X	Blank fill
	16	266	289	D24.15	Gain for the third band
	17	290	319	30X	Blank fill
	18	320	320	A1	Carriage return
5	19	321	344	D24.15	Bias for the fourth band
	20	345	345	1X	Blank fill
	21	346	369	D24.15	Gain for the fourth band
	22	370	399	30X	Blank fill
	23	400	400	A1	Carriage return
6	24	401	424	D24.15	Bias for the fifth band
	25	425	425	1X	Blank fill
	26	426	449	D24.15	Gain for the 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	639	79X	Blank Fill
	35	640	640	A1	Carriage return
9	36	641	719	79X	Blank fill
	37	720	720	A1	Carriage return
10	38	721	799	79X	Blank fill
	39	800	800	A1	Carriage return
11	40	801	879	79X	Blank fill
	41	880	880	A1	Carriage return
12	42	881	959	79X	Blank fill
	43	960	960	A1	Carriage return
13	44	961	1039	79X	Blank fill
	45	1040	1040	A1	Carriage return
14	46	1041	1119	79X	Blank fill
	47	1120	1120	A1	Carriage return
15	48	1121	1199	79X	Blank fill
	49	1200	1200	A1	Carriage return
16	50	1201	1279	79X	Blank fill
	51	1280	1280	A1	Carriage return

Line	Field	Start Byte	End Byte	Format	Description
17	52	1281	1359	79X	Blank fill
	53	1360	1360	A1	Carriage return
18	54	1361	1439	79X	Blank fill
	55	1440	1440	A1	Carriage return
19	56	1441	1519	79X	Blank fill
	57	1520	1520	A1	Carriage return
20	58	1521	1535	15X	Blank fill
	59	1536	1536	A1	Carriage return

Table 3-2. Radiometric Record for the VNIR and SWIR Bands

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 a list of mnemonics)
	4	36	47	A12	bELLIPSOIDb=
	5	48	65	A18	Earth ellipsoid used
	6	66	73	A8	bDATUMb=
	7	74	79	A6	Datum name
	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	Blank fill
	46	506	520	A15	USGSbMAPbZONEb=
	47	521	526	I6	Zone Number
	48	527	559	33X	Blank fill
	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 the upper-left corner

Line	Field	Start Byte	End Byte	Format	Description
					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 the upper-left corner 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 the upper-left corner of the product in projection units (meters only)
	57	606	606	1X	Blank fill
	58	607	619	F13.3	Northing of the upper-left corner of the product in projection units (meters only)
	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 the upper-right corner of the product
	64	659	659	1X	Blank fill
	65	660	671	A12	Geodetic latitude of the upper-right corner of the product
	66	672	672	1X	Blank fill
	67	673	685	F13.3	Easting of the upper-right corner of the product in projection units (meters only)
	68	686	686	1X	Blank fill
	69	687	699	F13.3	Northing of the upper-right corner of the product in projection units (meters only)
	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 the lower-right corner of the product
	75	739	739	1X	Blank fill
	76	740	751	A12	Geodetic latitude of the lower-right corner of the product
	77	752	752	1X	Blank fill
	78	753	765	F13.3	Easting of the lower-right corner of the product in projection units (meters only)
	79	766	766	1X	Blank fill
	80	767	779	F13.3	Northing of the lower-right corner of the product in projection units (meters only)
	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 the lower-left corner of the product
	86	819	819	1X	Blank fill

Line	Field	Start Byte	End Byte	Format	Description
	87	820	831	A12	Geodetic latitude of the lower-left corner of the product
	88	832	832	1X	Blank fill
	89	833	845	F13.3	Easting of the lower-left corner of the product in projection units (meters only)
	90	846	846	1X	Blank fill
	91	847	859	F13.3	Northing of the lower-left corner of the product in projection units (meters only)
	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. This is the true center of the input imagery from which the product was made, and does not necessarily fall inside of the product.
	97	903	903	1X	Blank fill
	98	904	915	A12	Product center geodetic latitude expressed in degrees, minutes, seconds. 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 (meters only)
	101	930	930	1X	Blank fill
	102	931	943	F13.3	Product center Northing in projection units (meters only)
	103	944	944	1X	Blank fill
	104	945	949	I5	Product center pixel number measured from the product upper-left corner, rounded to the 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 the 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	Nominal (path-oriented) orientation angle in degrees (may be negative) referenced from North Up (map-oriented). North Up (map-oriented) orientation angle always has a value of 0.0.
	113	1001	1039	39X	Blank fill
	114	1040	1040	A1	Carriage return
14	115	1041	1061	21A	SUNbELEVATIONbANGLEb=
	116	1062	1066	F4.1	Sun elevation angle in degrees at the product center

Line	Field	Start Byte	End Byte	Format	Description
	117	1067	1086	A20	bSUNbAZIMUTHbANGLEb=
	118	1087	1092	F5.1	Sun azimuth in degrees at the product center
	119	1093	1119	27X	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	15X	Blank fill
	132	1536	1536	A1	Carriage return

Table 3-3. Geometric Record for the VNIR and SWIR Bands

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	8	A8	REQbIDb=
	2	9	28	A20	Data producer-defined request number that uniquely identifies each product. USGS products use: NNNYYMMDDSSSS_UUUUUb format where: NNNYYMMDDSSSS = 13-digit EBAS order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = 5-digit EBAS unit number
	3	29	34	A6	bLOCb=
	4	35	51	A17	First scene starting location in: ppp/rrrffssbbbbbb format where ppp = path / = / rrr = row ff = fraction ss = subscene
	5	52	70	A19	bACQUISITIONbDATEb=
	6	71	78	A8	First scene acquisition date in yyyymmdd format
	7	79	79	1X	Blank fill
	8	80	80	A1	Carriage return
2	9	81	91	A11	SATELLITEb=
	10	92	101	A10	First scene satellite name: LANDSAT4 or LANDSAT5
	11	102	110	A9	bSENSORb=
	12	111	120	A10	First scene sensor name: TM
	13	121	134	A14	bSENSORbMODEb=
	14	135	140	A6	First scene sensor mode: NORMAL
	15	141	153	A13	bLOOKbANGLEb=
	16	154	159	F6.2	First scene 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	Last scene ending location in: ppp/rrrffssbbbbbb format where ppp = path / = / rrr = row ff = fraction ss = subscene
	21	212	230	A19	bACQUISITIONbDATEb=
	22	231	238	A8	Last scene acquisition date in yyyymmdd format
	23	239	239	1X	Blank fill
	24	240	240	A1	Carriage return
4	25	241	251	A11	SATELLITEb=
	26	252	261	A10	Last scene satellite name: LANDSAT4 or LANDSAT5
	27	262	270	A9	bSENSORb=
	28	271	280	A10	Last scene sensor name: TM
	29	281	294	A14	bSENSORbMODEb=
	30	295	300	A6	Last scene sensor mode: NORMAL
	31	301	313	A13	bLOOKbANGLEb=

Line	Field	Start Byte	End Byte	Format	Description
	32	314	319	F6.2	Last scene off-nadir angle in degrees: 0.0
	33	320	320	A1	Carriage return
5	34	321	343	23X	Blank fill
	35	344	354	A11	bLOCATIONb=
	36	355	371	A17	N/A
	37	372	390	A19	bACQUISITIONbDATEb=
	38	391	398	A8	N/A
	39	399	399	1X	Blank fill
	40	400	400	A1	Carriage return
6	41	401	411	A11	SATELLITEb=
	42	412	421	A10	N/A
	43	422	430	A9	bSENSORb=
	44	431	440	A10	N/A
	45	441	454	A14	bSENSORbMODEb=
	46	455	460	A6	N/A
	47	461	473	A13	bLOOKbANGLEb=
	48	474	479	F6.2	N/A
	49	480	480	A1	Carriage return
7	50	481	503	23X	Blank fill
	51	504	514	A11	bLOCATIONb=
	52	515	531	A17	N/A
	53	532	550	A19	bACQUISITIONbDATEb=
	54	551	558	A8	N/A
	55	559	559	1X	Blank fill
	56	560	560	A1	Carriage return
8	57	561	571	A11	SATELLITEb=
	58	572	581	A10	N/A
	59	582	590	A9	bSENSORb=
	60	591	600	A10	N/A
	61	601	614	A14	bSENSORbMODEb=
	62	615	620	A6	N/A
	63	621	633	A13	bLOOKbANGLEb=
	64	634	639	F6.2	N/A
	65	640	640	A1	Carriage return
9	66	641	654	A14	PRODUCTbTYPEb=
	67	655	672	A18	Product type: MAPbORIENTEDbbbbbb ORBITbORIENTEDbbbb USERbORIENTEDbbbbb (NLAPS only) TRUENORTHbORIENTED (NLAPS only)
	68	673	687	A15	bPRODUCTbSIZEb=
	69	688	697	A10	Product size: SUBSCENEbb <374 scans, <1 scene FULLbSCENE =374 scans, =1 scene MULTISCENE >374 scans, >1 scene
	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 SYSTERRAINb PRECISIONbb TERRAINbbbb

Line	Field	Start Byte	End Byte	Format	Description
	74	752	764	A13	bRESAMPLINGb=
	75	765	766	A2	Resampling algorithm used: NN - Nearest Neighbor CC - Cubic Convolution MF - Modulation Transfer Function (LPGS only) BI - Bilinear (NLAPS only) KD - Kaiser Damped (NLAPS only) 16 - 16 Point Sinc (NLAPS only) 8b - 8 Point Sinc (NLAPS only) DW - Damped Window (NLAPS only)
	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 the tape set (for multivolume product): N/A
	80	822	822	A1	/
	81	823	824	I2	Number of volumes in the tape set (for multivolume product): N/A
	82	825	842	A18	bPIXELSbPERbLINEb=
	83	843	847	I5	Number of pixels per product line for the 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 the 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 a multivolume product): N/A
	92	900	917	A18	bBLOCKINGbFACTORb=
	93	918	919	I2	Tape blocking factor: N/A
	94	920	931	A12	bRECbSIZEbb=
	95	932	940	I9	Length of the physical file record in bytes per thermal band
	96	941	953	A13	bPIXELbSIZEb=
	97	954	959	F6.2	Pixel size in meters for the 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: 6
	107	1088	1119	32X	Blank fill
	108	1120	1120	A1	Carriage return
15	109	1121	1130	A10	FILENAMEb=
	110	1131	1159	A29	Filename for the first band
	111	1160	1169	A10	FILENAMEb=
	112	1170	1198	A29	Filename for the second band

Line	Field	Start Byte	End Byte	Format	Description
	113	1199	1199	1X	Blank fill
	114	1200	1200	A1	Carriage return
16	115	1201	1210	A10	FILENAMEb=
	116	1211	1239	A29	Filename for the third band
	117	1240	1249	A10	FILENAMEb=
	117	1250	1278	A29	Filename for the 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 the fifth band
	123	1320	1329	A10	FILENAMEb=
	124	1330	1358	A29	Filename for the 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	A3	Format version code: TMb
	133	1536	1536	A1	Carriage return

Table 3-4. Administrative Record for the Thermal Band

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	50	A50	BIASESbANDbGAINSbINbASCENDINGbBANDbNUMBERbORDERbbb
	2	51	79	29X	Blank fill
	3	80	80	A1	Carriage return
2	4	81	104	D24.15	Bias for the first band
	5	105	105	1X	Blank fill
	6	106	129	D24.15	Gain for the first band
	7	130	159	30X	Blank fill
	8	160	160	A1	Carriage return
3	9	161	184	D24.15	Bias for the second band
	10	185	185	1X	Blank fill
	11	186	209	D24.15	Gain for the second band
	12	210	239	30X	Blank fill
	13	240	240	A1	Carriage return
4	14	241	264	D24.15	Bias for the third band
	15	265	265	1X	Blank fill
	16	266	289	D24.15	Gain for the third band
	17	290	319	30X	Blank fill
	18	320	320	A1	Carriage return
5	19	321	344	D24.15	Bias for the fourth band
	20	345	345	1X	Blank fill
	21	346	369	D24.15	Gain for the 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 the fifth band
	27	450	479	30X	Blank fill
	28	480	480	A1	Carriage return
7	29	481	504	D24.15	Bias for the sixth band
	30	505	505	1X	Blank fill
	31	506	529	D24.15	Gain for the sixth band
	32	530	559	30X	Blank fill
	33	560	560	A1	Carriage return
8	34	561	639	79X	Blank Fill
	35	640	640	A1	Carriage return
9	36	641	719	79X	Blank fill
	37	720	720	A1	Carriage return
10	38	721	799	79X	Blank fill
	39	800	800	A1	Carriage return
11	40	801	879	79X	Blank fill
	41	880	880	A1	Carriage return
12	42	881	959	79X	Blank fill
	43	960	960	A1	Carriage return
13	44	961	1039	79X	Blank fill
	45	1040	1040	A1	Carriage return
14	46	1041	1119	79X	Blank fill
	47	1120	1120	A1	Carriage return
15	48	1121	1199	79X	Blank fill
	49	1200	1200	A1	Carriage return
16	50	1201	1279	79X	Blank fill
	51	1280	1280	A1	Carriage return

Line	Field	Start Byte	End Byte	Format	Description
17	52	1281	1359	79X	Blank fill
	53	1360	1360	A1	Carriage return
18	54	1361	1439	79X	Blank fill
	55	1440	1440	A1	Carriage return
19	56	1441	1419	79X	Blank fill
	57	1420	1420	A1	Carriage return
20	58	1521	1535	15X	Blank fill
	59	1536	1536	A1	Carriage return

Table 3-5. Radiometric Record for the Thermal Band

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
	6	66	73	A8	bDATUMb=
	7	74	79	A6	Datum name
	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	Blank fill
	46	506	520	A15	USGSbMAPbZONEb=
	47	521	526	I6	Zone Number
	48	527	559	33X	Blank fill
	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 the upper-left corner,

Line	Field	Start Byte	End Byte	Format	Description
					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 the upper-left corner 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 the upper-left corner of the product in projection units (meters only)
	57	606	606	1X	Blank fill
	58	607	619	F13.3	Northing of the upper-left corner of the product in projection units (meters only)
	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 the upper-right corner of the product
	64	659	659	1X	Blank fill
	65	660	671	A12	Geodetic latitude of the upper-right corner of the product
	66	672	672	1X	Blank fill
	67	673	685	F13.3	Easting of the upper-right corner of the product in projection units (meters only)
	68	686	686	1X	Blank fill
	69	687	699	F13.3	Northing of the upper-right corner of the product in projection units (meters only)
	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 the lower-right corner of the product
	75	739	739	1X	Blank fill
	76	740	751	A12	Geodetic latitude of the lower-right corner of the product
	77	752	752	1X	Blank fill
	78	753	765	F13.3	Easting of the lower-right corner of the product in projection units (meters only)
	79	766	766	1X	Blank fill
	80	767	779	F13.3	Northing of the lower-right corner of the product in projection units (meters only)
	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 the lower-left corner of the product
	86	819	819	1X	Blank fill
	87	820	831	A12	Geodetic latitude of the lower-left corner of the

Line	Field	Start Byte	End Byte	Format	Description
					product
	88	832	832	1X	Blank fill
	89	833	845	F13.3	Easting of the lower-left corner of the product in projection units (meters only)
	90	846	846	1X	Blank fill
	91	847	859	F13.3	Northing of the lower-left corner of the product in projection units (meters only)
	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. This is the true center of the input imagery from which the product was made. It 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. This is the true center of the input imagery from which the product was made. It does not necessarily fall inside the product.
	99	916	916	1X	Blank fill
	100	917	929	F13.3	Product center easting in projection units (meters only)
	101	930	930	1X	Blank fill
	102	931	943	F13.3	Product center northing in projection units (meters only)
	103	944	944	1X	Blank fill
	104	945	949	I5	Product center pixel number measured from the product upper-left corner, rounded to the 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 the 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	Nominal (path-oriented) orientation angle in degrees (may be negative) referenced from North Up (map-oriented). A North Up (map-oriented) orientation angle always has a value of 0.0.
	113	1001	1039	39X	Blank fill
	114	1040	1040	A1	Carriage return
14	115	1041	1061	21A	SUNbELEVATIONbANGLEb=
	116	1062	1066	F4.1	Sun elevation angle in degrees at the product center
	117	1067	1086	A20	bSUNbAZIMUTHbANGLEb=
	118	1087	1091	F5.1	Sun azimuth in degrees at the product center

Line	Field	Start Byte	End Byte	Format	Description
	119	1092	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	15X	Blank fill
	132	1536	1536	A1	Carriage return

Table 3-6. Geometric Record for Thermal Band

3.1.3 Level 1 Metadata File

Please see 3.3.2 for L1 Metadata File details.

3.1.4 DEM Header File (Optional)

Line	Field	Start Byte	End Byte	Format	Description
1	1	1	8	A8	REQbIDb=
	2	9	28	A20	Data producer-defined request number that uniquely identifies each product; USGS products use the NNNYYMMDDSSSS_UUUUUb format, where: NNNYYMMDDSSSS = 13-digit EBAS order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = 5-digit EBAS unit number
	3	29	34	A6	bLOCb=
	4	35	51	A17	First scene starting location in ppp/rrrffssbbbbbb format, where: ppp = path / = / rrr = row ff = fraction ss = subscene
	5	52	70	A19	bACQUISITIONbDATEb=
	6	71	78	A8	First scene acquisition date in yyyymmdd format
	7	79	79	1X	Blank fill
	8	80	80	A1	Carriage return
2	9	81	91	A11	SATELLITEb=
	10	92	101	A10	First scene satellite name: LANDSAT7
	11	102	110	A9	bSENSORb=
	12	111	120	A10	First scene sensor name: ETM+
	13	121	134	A14	bSENSORbMODEb=
	14	135	140	A6	First scene sensor mode: NORMAL
	15	141	153	A13	bLOOKbANGLEb=
	16	154	159	F6.2	First scene 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	Last scene ending location in ppp/rrrffssbbbbbb format, where: ppp = path / = / rrr = row ff = fraction ss = subscene
	21	212	230	A19	bACQUISITIONbDATEb=
	22	231	238	A8	Last scene acquisition date in yyyymmdd format
	23	239	239	1X	Blank fill
	24	240	240	A1	Carriage return
4	25	241	251	A11	SATELLITEb=
	26	252	261	A10	Last scene satellite name: LANDSAT7
	27	262	270	A9	SENSORb=
	28	271	280	A10	Last scene sensor name: ETM+
	29	281	294	A14	bSENSORbMODEb=
	30	295	300	A6	Last scene sensor mode: NORMAL
	31	301	313	A13	bLOOKbANGLEb=

Line	Field	Start Byte	End Byte	Format	Description
	32	314	319	F6.2	Last scene off-nadir angle in degrees: 0.0
	33	320	320	A1	Carriage return
5	34	321	343	23X	Blank fill
	35	344	354	A11	bLOCATIONb=
	36	355	371	A17	N/A
	37	372	390	A19	bACQUISITIONbDATEb=
	38	391	398	A8	N/A
	39	399	399	1X	Blank fill
	40	400	400	A1	Carriage return
6	41	401	411	A11	SATELLITEb=
	42	412	421	A10	N/A
	43	422	430	A9	bSENSORb=
	44	431	440	A10	N/A
	45	441	454	A14	bSENSORbMODEb=
	46	455	460	A6	N/A
	47	461	473	A13	bLOOKbANGLEb=
	48	474	479	F6.2	N/A
	49	480	480	A1	Carriage return
7	50	481	503	23X	Blank fill
	51	504	514	A11	bLOCATIONb=
	52	515	531	A17	N/A
	53	532	550	A19	bACQUISITIONbDATEb=
	54	551	558	A8	N/A
	55	559	559	1X	Blank fill
	56	560	560	A1	Carriage return
8	57	561	571	A11	SATELLITEb=
	58	572	581	A10	N/A
	59	582	590	A9	bSENSORb=
	60	591	600	A10	N/A
	61	601	614	A14	bSENSORbMODEb=
	62	615	620	A6	N/A
	63	621	633	A13	bLOOKbANGLEb=
	64	634	639	F6.2	N/A
	65	640	640	A1	Carriage return
9	66	641	654	A14	PRODUCTbTYPEb=
	67	655	672	A18	Product type: MAPbORIENTEDbbbbbb ORBITbORIENTEDbbbb USERbORIENTEDbbbbb (NLAPS only) TRUENORTHbORIENTED (NLAPS only)
	68	673	687	A15	bPRODUCTbSIZEb=
	69	688	697	A10	Product size: SUBSCENEbb < 374 scans, < 1 scene FULLbSCENE = 374 scans, = 1 scene MULTISCENE > 374 scans, > 1 scene
	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 SYSTERRAINb PRECISIONbb TERRAINbbbb

Line	Field	Start Byte	End Byte	Format	Description
	74	752	764	A13	bRESAMPLINGb=
	75	765	766	A2	Resampling algorithm used: NN = Nearest Neighbor CC = Cubic Convolution MF = Modulation Transfer Function (LPGS only) BI = Bilinear (NLAPS only) KD = Kaiser Damped (NLAPS only) 16 = 16-Point Sinc (NLAPS only) 8b = 8-Point Sinc (NLAPS only) DW = Damped Window (NLAPS only)
	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 the tape set (for a multivolume product): N/A
	80	822	822	A1	/
	81	823	824	I2	Number of volumes in the tape set (for a multivolume product): N/A
	82	825	842	A18	bPIXELSbPERbLINEb=
	83	843	847	I5	Number of pixels per product line for the DEM
	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 a multivolume product): N/A
	92	900	917	A18	bBLOCKINGbFACTORb=
	93	918	919	I2	Tape blocking factor: N/A
	94	920	931	A12	bRECbSIZEbb=
	95	932	940	I9	Length of a physical file record in bytes per DEM bands
	96	941	953	A13	bPIXELbSIZEb=
	97	954	959	F6.2	Pixel size in meters for the DEM
	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 DEM band group: D
	107	1088	1119	32X	Blank fill
	108	1120	1120	A1	Carriage return
15	109	1121	1130	A10	FILENAMEb=
	110	1131	1159	A29	File name for the first band
	111	1160	1169	A10	FILENAMEb=
	112	1170	1198	A29	File name for the second band
	113	1199	1199	1X	Blank fill
	114	1200	1200	A1	Carriage return
16	115	1201	1210	A10	FILENAMEb=
	116	1211	1239	A29	File name for the third band
	117	1240	1249	A10	FILENAMEb=
	117	1250	1278	A29	File name for the fourth band
	119	1279	1279	1X	Blank fill

Line	Field	Start Byte	End Byte	Format	Description
	120	1280	1280	A1	Carriage return
17	121	1281	1290	A10	FILENAMEb=
	122	1291	1319	A29	File name for the fifth band
	123	1320	1329	A10	FILENAMEb=
	124	1330	1358	A29	File name for the 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	A3	Format version code: TMb
	133	1536	1536	A1	Carriage return

Table 3-7. Administrative Record for the DEM

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 a list of mnemonics)
	4	36	47	A12	bELLIPSOIDb=
	5	48	65	A18	Earth ellipsoid used
	6	66	73	A8	bDATUMb=
	7	74	79	A6	Datum name
	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	Blank fill
	46	506	520	A15	USGSbMAPbZONEb=
	47	521	526	I6	Zone number
	48	527	559	33X	Blank fill
	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 the upper-left corner,

Line	Field	Start Byte	End Byte	Format	Description
					expressed as degrees, minutes, seconds; e.g., 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 the upper-left corner, expressed as degrees, minutes, seconds; e.g., 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 the upper-left corner of the product in projection units (meters only)
	57	606	606	1X	Blank fill
	58	607	619	F13.3	Northing of the upper-left corner of the product in projection units (meters only)
	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 the upper-right corner of the product
	64	659	659	1X	Blank fill
	65	660	671	A12	Geodetic latitude of the upper-right corner of the product
	66	672	672	1X	Blank fill
	67	673	685	F13.3	Easting of the upper-right corner of the product in projection units (meters only)
	68	686	686	1X	Blank fill
	69	687	699	F13.3	Northing of the upper-right corner of the product in projection units (meters only)
	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 the lower-right corner of the product
	75	739	739	1X	Blank fill
	76	740	751	A12	Geodetic latitude of the lower-right corner of the product
	77	752	752	1X	Blank fill
	78	753	765	F13.3	Easting of the lower-right corner of the product in projection units (meters only)
	79	766	766	1X	Blank fill
	80	767	779	F13.3	Northing of the lower-right corner of the product in projection units (meters only)
	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 the lower-left corner of the product
	86	819	819	1X	Blank fill
	87	820	831	A12	Geodetic latitude of the lower-left corner of the product

Line	Field	Start Byte	End Byte	Format	Description
	88	832	832	1X	Blank fill
	89	833	845	F13.3	Easting of the lower-left corner of the product in projection units (meters only)
	90	846	846	1X	Blank fill
	91	847	859	F13.3	Northing of the lower-left corner of the product in projection units (meters only)
	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; 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; 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 (meters only)
	101	930	930	1X	Blank fill
	102	931	943	F13.3	Product center northing in projection units (meters only)
	103	944	944	1X	Blank fill
	104	945	949	I5	Product center pixel number measured from the product's upper-left corner, rounded to the nearest whole pixel
	105	950	950	1X	Blank fill
	106	951	955	I5	Product center line number measured from the product's upper-left corner, rounded to the 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	Nominal (path-oriented) orientation angle in degrees (may be negative) referenced from north up (map-oriented); north up (map-oriented) orientation angle always has a value of 0.0
	113	1001	1039	39X	Blank fill
	114	1040	1040	A1	Carriage return
14	115	1041	1061	21A	SUNbELEVATIONbANGLEb=
	116	1062	1066	F4.1	Sun elevation angle in degrees at the product center
	117	1067	1086	A20	bSUNbAZIMUTHbANGLEb=
	118	1087	1091	F5.1	Sun azimuth in degrees at the product center

Line	Field	Start Byte	End Byte	Format	Description
	119	1092	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	15X	Blank fill
	132	1536	1536	A1	Carriage return

Table 3-8. Geometric Record for the DEM

3.1.5 Ground Control Points (GCP) file

The GCP file is written in ASCII format and contains a header followed by records, one on each line. Each record corresponds to a single GCP. Each record has eight column headings and looks similar to the following example:

```
Example GCP Output File
========================================================================
Fri. Apr.  4, 2008             LANDSAT 5                 Time: 13:03
                           Image Assessment System
                             GCP Residual Report
------------------------------------------------------------------------
WOID: L8283            Path/Row: 038 / 038

L0R Reference Image: L51XXX1095175170100_HDF.073192111
Acquisition Date: Jun 24, 1995

Band Number:  5

GeoCover date for each WRS-2 path/row used:
Path  Row   Date
037   038   2000-04-19
038   037   2000-04-26
038   038   2000-04-10
039   037   2000-05-03

Point_ID      Latitude  Longitude    Height       Across    Along    Residual  Residual
                                                   Scan      Scan      In y      in x
                                                 Residual  Residual    dir       dir
                  (deg)     (deg)     (meters)    (meters)  (meters)  (meters)  (meters)

0370380008   32.110381 -113.562535   209.673      17.576     7.044    16.401     9.487
0370380089   31.875446 -113.446672   362.987     298.018    15.641    292.818    58.151
0370380105   31.944185 -113.532590   322.535     225.144    11.095    221.327    43.193
0370380140   31.925680 -113.645992   155.878     275.862    17.675    270.656    56.972
0370380145   32.298943 -113.566317   553.642    -230.079   -21.971   -224.602   -54.537
0370380163   31.908490 -113.681353   116.652     305.866    17.318    300.430    60.920
0370380170   32.338204 -113.594367   295.843    -278.135   -17.096   -272.971   -56.564
0370380198   32.250792 -113.519899   516.905    -181.500   -25.727   -175.997   -51.348
```

3.2 GeoTIFF File Formats

3.2.1 Level 1 Image File and DEM Data File (Optional)

The description of an image in GeoTIFF requires tags and keys as described at: http://www.remotesensing.org/geotiff/spec/geotiffhome.html (URL also noted in References). The L1 Image Files include these tags and keys, which TIFF readers automatically detect and read. The following subsections describe the tags and keys.

Each Earth image band in the requested product is contained in a separate file, as is the optionally available DEM data file. The data are laid out in a scan line sequential format in descending detector order (e.g., 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. The L1T image is radiometrically, geometrically, and precision corrected, and uses DEM to correct parallax error due to local topographic relief.

3.2.1.1 GeoTIFF Tags

TIFF tags convey metadata information about the image. 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 uses tags. Landsat TM L1 production systems use the transformation raster and model space tie points and scaling parameters. ModelTiepointTag and ModelPixelScaleTag are 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 is 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 maps the pixel value of a digital elevation model into the correct Z-scale. ScaleZ is not used for L1G data because 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.

3.2.1.2 GeoTIFF Keys

In addition to tags, the description of a projection in GeoTIFF requires using keys. Table 3-9 lists the keys necessary to define the projections supported by the L1 production systems, and their possible values.

Valid Keys	Possible Values	Meaning
Transverse Mercator (TM)		
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	GCS_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	European Petroleum Survey Group (EPSG) Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG/Petrotechnical Open Software Corporation (POSC) Projection Codes (see Applicable Document 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
ProjLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
ProjFalseNorthingGeoKey		Value entered in units of ProjLinearUnits
ProjFalseEastingGeoKey		Value entered in units of ProjLinearUnits
Universal Transverse Mercator (UTM)		
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	EPSG Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
Oblique Mercator, Type B (OMB)		
ProjCoordTransGeoKey	3	CT_ObliqueMercator
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	GCS_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
GeogAzimuthUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	EPSG Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG/POSC Projection Codes (see

Valid Keys	Possible Values	Meaning
		Applicable Document 7 for values)
	32767	User-defined
ProjLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
ProjAzimuthAngleGeoKey		Value in units of GeogAngularUnits
ProjScaleAtNatOriginGeoKey		Value entered as a ratio
ProjCenterLatGeoKey		Value in units of GeogAngularUnits
ProjCenterLongGeoKey		Value in units of GeogAngularUnits
ProjFalseNorthingGeoKey		Value entered in units of ProjLinearUnits
ProjFalseEastingGeoKey		Value entered in units of ProjLinearUnits
Lambert Conformal Conic (LCC)		
ProjCoordTransGeoKey	8	CT_LambertConfConic_2SP
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GT CitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	GCS_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 -32760	EPSG Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG/POSC Projection Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
ProjStdParallel1GeoKey		Value in units of GeogAngularUnits
ProjStdParallel2GeoKey		Value in units of GeogAngularUnits
ProjFalseOriginLongGeoKey		Value in units of GeogAngularUnits (default to 0)
ProjFalseOriginLatGeoKey		Value in units of GeogAngularUnits (default to 0)
ProjNatOriginLatGeoKey		Value in units of GeogAngularUnits
ProjNatOriginLongGeoKey		Value in units of GeogAngularUnits (IAS/ LPGS)
ProjCenterLongGeoKey		Value in units of GeogAngularUnits (NLAPS)
ProjFalseNorthingGeoKey		Value entered in units of ProjLinearUnits
ProjFalseEastingGeoKey		Value entered in units of ProjLinearUnits
Polar Stereographic (PS)		
ProjCoordTransGeoKey	15	CT_PolarStereographic
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	GCS_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree

Valid Keys	Possible Values	Meaning
ProjectedCSTypeGeoKey	20000 - 32760	EPSG Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG/POSC Projection Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
ProjStraightVertPoleLongGeoKey		Value 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)		
ProjCoordTransGeoKey	22	CT_Polyconic
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	GCS_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	EPSG Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG/POSC Projection Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjCenterLatGeoKey		Value in units of GeogAngularUnits
ProjCenterLongGeoKey		Value in units of GeogAngularUnits
ProjFalseNorthingGeoKey		Value entered in units of ProjLinearUnits
ProjFalseEastingGeoKey		Value entered in units of ProjLinearUnits
ProjLinearUnitsGeokey	9001	Linear_Meter
	9002	Linear_Foot
Albers Equal Area (AEA)		
ProjCoordTransGeoKey	8	CT_AlbersEqualArea
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixelIsArea
	2	RasterPixelIsPoint
GT CitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	AEA_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 -32760	EPSG Projection System Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG/POSC Projection Codes (see Applicable Document 7 for values)
	32767	User-defined
ProjLin earUnitsGeoKey	9001	Linear_Meter

Valid Keys	Possible Values	Meaning
	9002	Linear_Foot
ProjStdParallel1GeoKey		Value in units of GeogAngularUnits
ProjStdParallel2GeoKey		Value in units of GeogAngularUnits
ProjFalseOriginLongGeoKey		Value in units of GeogAngularUnits (default to 0)
ProjFalseOriginLatGeoKey		Value in units of GeogAngularUnits (default to 0)
ProjNatOriginLatGeoKey		Value in units of GeogAngularUnits
ProjNatOriginLongGeoKey		Value in units of GeogAngularUnits (IAS/ LPGS)
ProjCenterLongGeoKey		Value in units of GeogAngularUnits (NLAPS)
ProjFalseNorthingGeoKey		Value entered in units of ProjLinearUnits
ProjFalseEastingGeoKey		Value entered in units of ProjLinearUnits

Table 3-9. GeoTIFF Keys

3.2.2 Level 1 Metadata File

Please see 3.3.2 for L1 Metadata File details.

3.2.3 Ground Control Points (GCP) File

Please see 3.1.5 for GCP File details.

3.3 HDF File Formats

3.3.1 Level 1 Image File and DEM Data File (Optional)

Each Earth image band in the requested product is contained in a separate file, as is the optionally available DEM data file. Within each 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. The L1T image is radiometrically, geometrically, and precision corrected, and uses DEM to correct parallax error due to local topographic relief.

3.3.1.1 HDF Directory File

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

3.3.1.2 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. Vgroup employs 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 Vgroup. This information is stored in the HDF data directory. Table 3-10 and Table 3-11 present the Vgroup used to relate the different data objects that make up a complete L1 product.

Vgroup Name	Vgroup Class	Object Name	Type	Description
Scene_Data_Ref	Image_Data	LMppprrr_rrrYYYYMMDD.B10	SDS	TM Band 1 data
		LMppprrr_rrrYYYYMMDD.B20	SDS	TM Band 2 data
		LMppprrr_rrrYYYYMMDD.B30	SDS	TM Band 3 data
		LMppprrr_rrrYYYYMMDD.B40	SDS	TM Band 4 data
		LMppprrr_rrrYYYYMMDD.B50	SDS	TM Band 5 data
		LMppprrr_rrrYYYYMMDD.B70	SDS	TM Band 7 data
		LMppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scene_Data_Thm	Image_Data	LMppprrr_rrrYYYYMMDD.B60	SDS	TM Band 6 data
		LMppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
IC_Data_Ref	Correction_Data	LMppprrr_rrrYYYYMMDD.C10	SDS	IC data Band 1
		LMppprrr_rrrYYYYMMDD.C20	SDS	IC data Band 2
		LMppprrr_rrrYYYYMMDD.C30	SDS	IC data Band 3
		LMppprrr_rrrYYYYMMDD.C40	SDS	IC data Band 4
		LMppprrr_rrrYYYYMMDD.C50	SDS	IC data Band 5
		LMppprrr_rrrYYYYMMDD.C70	SDS	IC data Band 7
		LMppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
IC_Data_Thm	Correction_Data	LMppprrr_rrrYYYYMMDD.C60	SDS	IC data Band 6
		LMppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scan_Line_Offsets_Ref	Correction_Data	LMppprrr_rrrYYYYMMDD.O10	Vdata	Scan line offsets Band 1
		LMppprrr_rrrYYYYMMDD.O20	Vdata	Scan line offsets Band 2
		LMppprrr_rrrYYYYMMDD.O30	Vdata	Scan line offsets Band 3
		LMppprrr_rrrYYYYMMDD.O40	Vdata	Scan line offsets Band 4
		LMppprrr_rrrYYYYMMDD.O50	Vdata	Scan line offsets Band 5
		LMppprrr_rrrYYYYMMDD.O70	Vdata	Scan line offsets Band 7
		LMppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
Scan_Line_Offsets_Thm	Correction_Data	LMppprrr_rrrYYYYMMDD.O60	Vdata	Scan line offsets Band 6
		LMppprrr_rrrYYYYMMDD.GEO	Vdata	Geolocation table
PCD	Correction_Data	LMppprrr_rrrYYYYMMDD.PCD	Vdata	Consensus PCD
MSCD	Correction_Data	LMppprrr_rrrYYYYMMDD.MSD	Vdata	Consensus MSCD
Product_Metadata	Metadata	LMppprrr_rrrYYYYMMDD.MTA	Vdata	LACS metadata
		LMppprrr_rrrYYYYMMDD.MTL	Vdata	Level 1-product-specific metadata
CPF	Correction_Data	LMCPFYYYYMMDD_YYYYMMDD_nn	Vdata	IAS CPF

Table 3-10. Vgroup Definitions: L1R Product

Vgroup Name	Vgroup Class	Object Name	Type	Description
Scene_Data_Ref	Image_Data	LMppprrr_rrrYYYYMMDD.B10	SDS	TM Band 1 data
		LMppprrr_rrrYYYYMMDD.B20	SDS	TM Band 2 data
		LMppprrr_rrrYYYYMMDD.B30	SDS	TM Band 3 data
		LMppprrr_rrrYYYYMMDD.B40	SDS	TM Band 4 data
		LMppprrr_rrrYYYYMMDD.B50	SDS	TM Band 5 data
		LMppprrr_rrrYYYYMMDD.B70	SDS	TM Band 7 data
Scene_Data_Thm	Image_Data	LMppprrr_rrrYYYYMMDD.B60	SDS	TM Band 6 data
Elevation_Data	Image_Data	LMppprrr_rrrYYYYMMDD.DEM	SDS	DEM data
Product_Metadata	Metadata	LMppprrr_rrrYYYYMMDD.MTL	Vdata	Level 1-product-specific metadata

Table 3-11. Vgroup Definitions: L1G Product

3.3.2 Level 1 Metadata File

The L1 metadata file is created during product generation and contains information specific to the product ordered. Table 3-12 lists the full contents of the L1 metadata file. This file contains all applicable image description information from the L0Rp metadata file and the LPS metadata provided with the L0Rp product.

Vdata Name: LMppprrr_rrrYYYYMMDD.MTL
Vdata Class: LPGS_Metadata
Interlace Type: FULL_INTERLACE
Bytes Per Logical Record: 65535
Number of Records: One record.

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
GROUP	18	= L1_METADATA_FILE	Beginning of the first-level Object Description Language (ODL) group; it indicates the start of the L1 metadata file level group
GROUP	18	= METADATA_FILE_INFO	Beginning of the metadata file information group
ORIGIN	47	= “Image courtesy of the U.S. Geological Survey”	Establishes the origin of the image from the USGS
REQUEST_ID	20	USGS products use: “NNNYYMMDDSSSS_UUUUU” format where: NNNYYMMDDSSSS = 13-digit EBAS order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = 5-digit EBAS unit number	Data producer-defined request number that uniquely identifies each product. USGS products use a unique product generation EBAS-generated request ID.
PRODUCT_CREATION_TIME	20	= YYYY-MM-DDThh:mm:ssZ where	L1 system date and time when the metadata file for

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
		YYYY = 4-digit Julian year MM = the month number of the Julian year (01-12) DD = the day of the Julian month (01-31) T = the 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)	the L1 product set was created. For ease of human readability, this date and time is presented in ODL ASCII format. Time is expressed as Universal Time Coordinated (UTC) (also known as Greenwich Mean Time (GMT)). Insertion of additional characters T and Z is required to meet ODL ASCII format
STATION_ID	3	= “EDC”	Unique 3-letter code identifying the originating ground station
LANDSAT5_XBAND	1	= “0,” “1,” “2,” or “3” (“0” = unknown)	Landsat 5 (L5) X-band used to downlink data to the LGS
GROUND_STATION	3	= “NNN”	Ground station that received the data
LPS_PROCESSOR_NUMBER	1	= 1 through 9	LPS processor number
DATEHOUR_CONTACT_PERIOD	7	= “YYDOYHH”	Date and hour of the contact period
SUBINTERVAL_NUMBER	2	= “00”–“99”	Subinterval number within the contact period
END_GROUP	18	= METADATA_FILE_INFO	End of the metadata information group
GROUP	16	= PRODUCT_METADATA	Beginning of the product metadata group
PRODUCT_TYPE	3	= “L1G” = “L1Gt” = “L1R” = “L1P” (NLAPS only) = “L1T”	Identifier to inform the user of the product type
ELEVATION_SOURCE	7	= “NED” = “RAMP” = “SRTM1” = “SRTM3” = “GTOPO30” = “GLS2000”	Identifies the digital elevation data set that was used to terrain correct the product.
PROCESSING_SOFTWARE	15	= “SYSTEM_VERSION” where SYSTEM = IAS, LPGS, NLAPS VERSION = version of software	L1 processing system and software version. Examples: “IAS_4.5” “LPGS_4.3” “NLAPS_4.1.9”
EPHEMERIS_TYPE	10	= “DEFINITIVE” = “PREDICTIVE”	Identifier to inform the user of the orbital ephemeris type used. If the field is not present, the user should assume PREDICTIVE in all cases (1G product only)
SPACECRAFT_ID	8	= “Landsat5”	Name of the satellite

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			platform
SENSOR_ID	4	= “TM”	Name of the imaging sensor
SENSOR_MODE	6	= “SAM” = “BUMPER”	Scan Angle Monitor (SAM) Mode and Bumper (BUMPER) Mode
ACQUISITION_DATE	10	= YYYY-MM-DD	Date the image was acquired
REGISTRATION_ACQ_DATE	10	= YYYY-MM-DD	Acquisition date of the scene used for registration (1 scene only).
WRS_PATH	3	= NNN, where NNN = the path number (001-233)	WRS path value for the product
STARTING_ROW	3	= NNN, where NNN = row of the first full or partial scene in the product (001-248)	Starting WRS row
ENDING_ROW	3	= NNN, where NNN = row of the last full or partial scene in the product (001-248)	Ending WRS row
BAND_COMBINATION	9	= “NNNNNNN,” where “NNNNNNN” = e.g., “1234567” for all bands present, “123---7” for Bands 1, 2, 3, 7. A ‘-’ is a position holder for absent bands	L1-generated indicator of the bands present for the product ordered.
PRODUCT_UL_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision) Positive (+) value indicates north latitude; negative (-) value indicates south latitude	Latitude value for the upper-left corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_UL_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision) Positive (+) value indicates east longitude; negative (-) value indicates west longitude	Longitude value for the upper-left corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_UR_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	Latitude value for the upper-right corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_UR_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	Longitude value for the upper-right corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_LL_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	Latitude value for the lower left corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_LL_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit	Longitude value for the lower-left corner of the

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
		precision)	product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_LR_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	Latitude value for the lower-right corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_LR_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	Longitude value for the lower-right corner of the product (The L1 systems recalculate for the 1G product) (NLAPS Bands 1-5, 7 only)
PRODUCT_UL_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection X coordinate for the upper-left corner of the product (The L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_UL_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection Y coordinate for the upper-left corner of the product (L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_UR_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection X coordinate for the upper-right corner of the product (L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_UR_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection Y coordinate for the upper-right corner of the product (L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_LL_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection X coordinate for the lower-left corner of the product (L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_LL_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection Y coordinate for the lower-left corner of the product (L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_LR_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection X coordinate for the lower-right corner of the product (L1 systems calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_LR_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are feet or meters	Projection Y coordinate for the lower-right corner of the product (L1 systems

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			calculated, 1G only) (NLAPS Bands 1-5, 7 only)
PRODUCT_UL_CORNER_LAT_THM	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision) Positive (+) value indicates north latitude; negative (-) value indicates south latitude	NLAPS latitude value for the upper-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_UL_CORNER_LON_THM	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision) Positive (+) value indicates east longitude; negative (-) value indicates west longitude	NLAPS longitude value for the upper-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_UR_CORNER_LAT_THM	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	NLAPS latitude value for the upper-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_UR_CORNER_LON_THM	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	NLAPS longitude value for the upper-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LL_CORNER_LAT_THM	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	NLAPS latitude value for the lower-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LL_CORNER_LON_THM	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	NLAPS longitude value for the lower-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LR_CORNER_LAT_THM	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	NLAPS latitude value for the lower-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LR_CORNER_LON_THM	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	NLAPS longitude value for the lower-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_UL_CORNER_MAPX_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection X coordinate for the upper-left corner of the product

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			Band 6 (Not included with IAS and LPGS)
PRODUCT_UL_CORNER_MAPY_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection Y coordinate for the upper-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_UR_CORNER_MAPX_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection X coordinate for the upper-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_UR_CORNER_MAPY_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection Y coordinate for the upper-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LL_CORNER_MAPX_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection X coordinate for the lower-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LL_CORNER_MAPY_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection Y coordinate for the lower-left corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LR_CORNER_MAPX_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection X coordinate for the lower-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_LR_CORNER_MAPY_THM	14	= -132000000.000 through 132000000.000 Units are feet or meters	NLAPS projection Y coordinate for the lower-right corner of the product Band 6 (Not included with IAS and LPGS)
PRODUCT_SAMPLES_REF	6	NNNNNN	Product samples for the reflective bands
PRODUCT_LINES_REF	6	NNNNNN	Product lines for the reflective bands
PRODUCT_SAMPLES_THM	6	NNNNNN	Product samples for the thermal band
PRODUCT_LINES_THM	6	NNNNNN	Product lines for the thermal band

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
PRODUCT_SAMPLES_DEM	6	NNNNNN	Product samples for the Digital Elevation Model (optional)
PRODUCT_LINES_DEM	6	NNNNNN	Product lines for the Digital Elevation Model (optional)
BAND1_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B10.XXX" (XXX = L1R, L1G, L1T, TIF, or FST)	L1-generated external element file name for Band 1, if part of the product
BAND2_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B20.XXX" (XXX = L1R, L1G, L1T, TIF, or FST)	L1-generated external element file name for Band 2, if part of the product
BAND3_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B30.XXX" (XXX = L1R, L1G, L1T, TIF, or FST)	L1-generated external element file name for Band 3, if part of the product
BAND4_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B40.XXX" (XXX = L1R, L1G, L1T, TIF, or FST)	L1-generated external element file name for Band 4, if part of the product
BAND5_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B50.XXX" (XXX = L1R, L1G, L1T, TIF, or FST)	L1-generated external element file name for Band 5, if part of the product
BAND6_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B60.XXX" (XXX = L1R, L1G,L1T, TIF, or FST)	L1-generated external element file name for Band 6, if part of the product
BAND7_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_B70.XXX" (XXX = L1R, L1G,L1T, TIF, or FST)	L1-generated external element file name for Band 7, if part of the product
DEM_FILE_NAME	29	"LM1ppprrr_rrrYYYYMMDD_DEM.XXX" (XXX = L1R, L1G, L1T, TIF, or FST)	L1-generated external element file name for the Digital Elevation Model, if part of the product
IC_DATA_ FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_CAL.XXX" (XXX = L1R)	L1-generated external element file name for calibrator data (1R product only), if part of the product
SCAN_SHIFTS_ FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_SLO.XXX" (XXX = L1R)	L1-generated external element file name for scan line shifts (1R product only), if part of the product
MSCD_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_MSD.XXX" (XXX = L1R)	L1-generated external element file name for the consensus MSCD (1R product only)
PCD_FILE_NAME	29	"LMppprrr_rrrYYYYMMDD_PCD.XXX" (XXX = L1R)	L1-generated external element file name for the consensus PCD (1R product

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			only)
METADATA_LPS_FILE_NAME	29	"LMpppprrr_rrrYYYYMMDD_MTA.txt" (XXX = L1R)	L1-generated external element file name for LPS metadata (1R product only)
METADATA_L1_FILE_NAME	29	"LMpppprrr_rrrYYYYMMDD_MTL.txt"	L1-generated external element file name for L1 metadata
CPF_FILE_NAME	25	"LMCPFYYYYMMDD_YYYYMMDD_nn" where YYYYMMDD = effective start date and effective end date, respectively nn = incrementing version number within a 90-day period (00-99)	Archive-generated external element file name for the IAS CPF. NLAPS is populating the metadata file with the CPF used during processing.
GEOLOCATION_FILE_NAME	29	"LM1pppprrr_rrrYYYYMMDD_GEO.XXX" (XXX = L1R)	L1-generated external element file name for the geolocation table (1R product only)
HDF_DIR_FILE_NAME	29	"LM1pppprrr_rrrYYYYMMDD_HDF.XXX" (XXX = L1R, L1G, or L1T)	L1-generated file name for the HDF directory file (HDF products only)
END_GROUP	16	= PRODUCT_METADATA	End of the product metadata group
GROUP	16	= MIN_MAX_RADIANCE	Beginning of the min/max radiance group (1G product only)
LMAX _BAND1	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 1, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMAX_BAND1.
LMIN_ BAND1	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 1, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND1.
LMAX_ BAND2	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 2, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMAX_BAND2.
LMIN_ BAND2	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 2, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND2.

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
LMAX_ BAND3	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 3, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMAX_BAND3.
LMIN_ BAND3	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 3, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND3.
LMAX_ BAND4	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 4, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMAX_BAND4.
LMIN_ BAND4	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 4, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND4.
LMAX_ BAND5	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 5, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMAX_BAND5.
LMIN_ BAND5	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 5, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND5.
LMIN_ BAND6	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 6, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND6.
LMAX_ BAND6	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 6, if part of the product (w/(m^2 sr micron)). In

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			addition, the spectral radiance corresponding to QCALMAX_BAND6.
LMAX_ BAND7	7	= NNN.NNN	Maximum achievable spectral radiance value for Band 7, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMAX_BAND7.
LMIN_ BAND7	7	= NNN.NNN	Minimum achievable spectral radiance value for Band 7, if part of the product (w/(m^2 sr micron)). In addition, the spectral radiance corresponding to QCALMIN_BAND7.
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)
QCALMAX_BAND1	5	= NNN.N	Maximum possible pixel value for Band 1, if part of the product (DN).
QCALMIN_BAND1	5	= NNN.N	Minimum possible pixel value for Band 1, if part of the product (DN).
QCALMAX_BAND2	5	= NNN.N	Maximum possible pixel value for Band 2, if part of the product (DN).
QCALMIN_BAND2	5	= NNN.N	Minimum possible pixel value for Band 2, if part of the product (DN).
QCALMAX_BAND3	5	= NNN.N	Maximum possible pixel value for Band 3, if part of the product (DN).
QCALMIN_BAND3	5	= NNN.N	Minimum possible pixel value for Band 3, if part of the product (DN).
QCALMAX_BAND4	5	= NNN.N	Maximum possible pixel value for Band 4, if part of the product (DN).
QCALMIN_BAND4	5	= NNN.N	Minimum possible pixel value for Band 4, if part of the product (DN).
QCALMAX_BAND5	5	= NNN.N	Maximum possible pixel value for Band 5, if part of the product (DN).
QCALMIN_BAND5	5	= NNN.N	Minimum possible pixel value for Band 5, if part of the product (DN).
QCALMIN_BAND6	5	= NNN.N	Minimum possible pixel

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			value for Band 6, if part of the product (DN).
QCALMIN_BAND6	5	= NNN.N	Minimum possible pixel value for Band 6, if part of the product (DN).
QCALMAX_BAND7	5	= NNN.N	Maximum possible pixel value for Band 7, if part of the product (DN).
QCALMIN_BAND7	5	= NNN.N	Minimum possible pixel value for Band 7, if part of the product (DN).
END_GROUP	19	= MIN_MAX_PIXEL_VALUE	End of the min/max pixel value group
GROUP	18	= PRODUCT_PARAMETERS	Beginning of the product parameters group (both 1R and 1G products)
CORRECTION_METHOD_GAIN_BAND1	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 1, if part of the product
CORRECTION_METHOD_GAIN_BAND2	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 2, if part of the product
CORRECTION_METHOD_GAIN_BAND3	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 3, if part of the product
CORRECTION_METHOD_GAIN_BAND4	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 4, if part of the product
CORRECTION_METHOD_GAIN_BAND5	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 5, if part of the product
CORRECTION_METHOD_GAIN_BAND6	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 6, if part of the product
CORRECTION_METHOD_GAIN_BAND7	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image for Band 7, if part of the product
CORRECTION_METHOD_BIAS	3	= “CPF” (for CPF gains) = “IC” (for IC gains)	Correction method used by L1 in creating the image
SUN_AZIMUTH	12	= -180.0000000 through 180.0000000 degrees (with 7-digit precision) A positive value indicates angles to the east or clockwise from the north. A negative value (-) indicates angles to the west or counterclockwise from the north. Leading zeros are not required.	Sun azimuth angle in degrees for the image center location at the image center acquisition time
SUN_ELEVATION	11	= -90.0000000 through 90.0000000 degrees (with 7-digit precision) A positive value indicates a daytime scene.	Sun elevation angle in degrees for the image center location at the image center acquisition time

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
		A negative value (-) indicates a nighttime scene. Leading zeros are not required.	
OUTPUT_FORMAT	10	= “FORMAT_VERSION,” where FORMAT = HDF, NDF, GEOTIFF, FAST VERSION = output format version	The output format and output format version of the image. Examples: “HDF_4r1” “NDF_2.00” “GEOTIFF” “FASTLTA” NOTE: no version included for GEOTIFF and FAST
END_GROUP	18	= PRODUCT_PARAMETERS	End of the product parameters group
GROUP	19	= CORRECTIONS_APPLIED	Beginning of the corrections applied group
STRIPING_BAND1	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 1 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND2	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 2 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND3	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 3 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND4	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 4 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND5	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 5 image, if part of the product. NLAPS: BAND_AVERAGE = NASA

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			REFERENCE_DETECTOR = CCRS
STRIPING_BAND61	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 6 format 1 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND62	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 6 format 2 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND7	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 7 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
STRIPING_BAND8	20	= “NONE” = “BAND_AVERAGE” = “REFERENCE_DETECTOR”	Indicator of the type of striping correction applied for the Band 8 image, if part of the product. NLAPS: BAND_AVERAGE = NASA REFERENCE_DETECTOR = CCRS
BANDING	1	= ”Y” or “N”	Indicator of whether the image was corrected for banding
COHERENT_NOISE	1	= ”Y” or “N”	Indicator of whether the image was corrected for coherent noise
MEMORY_EFFECT	1	= ”Y” or “N”	Indicator of whether the image was corrected for memory effect
SCAN_CORRELATED_SHIFT	1	= ”Y” or “N”	Indicator of whether the image was corrected for scan correlated shift
INOPERABLE_DETECTORS	1	= ”Y” or “N”	Indicator of whether the image was corrected for inoperable detectors
DROPPED_LINES	1	= ”Y” or “N”	Indicator of whether the image was corrected for dropped lines
END_GROUP	19	= CORRECTIONS_APPLIED	End of the corrections applied group
GROUP	21	= PROJECTION_PARAMETERS	Beginning of the projection

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			parameters group (1G product only)
REFERENCE_DATUM	5	= “WGS84”	Datum used in creating the image
REFERENCE_ELLIPSOID	5	= “WGS84”	Ellipsoid used in creating the image
GRID_CELL_SIZE_THM	6	= 10.0 through 100.00 meters, in increments of 0.001 meters 25.00 – 60.00 (IAS/LPGS) 10.00 – 100.00 (NLAPS)	Grid cell size used in creating the image for the thermal band, if part of the product
GRID_CELL_SIZE_REF	6	= 10.00 through 60.000 meters, in increments of 0.001 meters 25.00 – 60.00 (IAS/LPGS) 10.00 – 50.00 (NLAPS)	Grid cell size used in creating the image for VNIR/SWIR bands, if part of the product
ORIENTATION	3	= “NOM” (Nominal Path) = “NUP” (North Up) = “TN” (True North*) = “USR” (User*)	Orientation used in creating the image *NLAPS Only
RESAMPLING_OPTION	3	= “NN” (Nearest Neighbor) = “CC” (Cubic Convolution) = “MTF” (Modulation Transfer Function*) = “BI” (Bilinear**) = “KD” (Kaiser Damped**) = “16” (16-Point Sinc**) = “8” (8-Point Sinc**) = “DW” (Damped Window**)	Resampling option used in creating the image * IAS/LPGS Only ** NLAPS Only
MAP_PROJECTION	4	= “AKC” (Alaska Conformal*) = “AEA” (Albers Equal Area) = “AZIM” (Azimuthal*) = “EQC” (Equidistant Conic [Type A & B]*) = “EQUI” (Equirectangular*) = “GVNP” (General Vertical Near Side Perspective*) = “GNOM” (Gnomonic*) = “HAMM” (Hammer*) = “IGH” (Interrupted Goodes Homolosine*) = “IM” (Interrupted Mollweide*) = “LAEA” (Lambert Azimuthal Equal Area*) = “LCC” (Lambert Conformal Conic) = “MERC” (Mercator*) = ”MCYL” (Miller Cylindrical*) = ”MOLL” (Mollweide*) = “OEA” (Oblated Equal Area*) = “OM” (Oblique Mercator [Type A and B]) = “ORTH” (Orthographic*) = “PC” (Polyconic) = “PS” (Polar Stereographic)	Map projection used in creating the image *NLAPS Only

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
		= “ROBN” (Robinson*) = “SINU” (Sinusoidal*) = “SOM” (Space Oblique Mercator [Type A* and B]) = “STPL” (State Plane*) = “STRG” (Stereographic*) = ”TM” Transverse Mercator [Gauss-Krueger]) = ”UTM” (Universal Transverse Mercator) = ”VDGR” (Van Der Grinten*) = “WIV” (Wagner IV*) = “WVII” (Wagner VII*)	
END_GROUP	21	= PROJECTION_PARAMETERS	End of projection parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of AKC**
GROUP	14	AKC_PARAMETERS	Beginning of the AKC parameters group
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 = Feet	Units for false easting and northing for AKC projection
END_GROUP	14	AKC_PARAMETERS	End of the AKC parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of AEA**
GROUP	14	AEA_PARAMETERS	Beginning of the AEA parameters group
LATITUDE_OF_FIRST_ STANDARD_PARALLEL	11	= -90.0 to +90.0	Latitude of the first standard parallel
LATITUDE_OF_SECOND_STAN DARD_PARALLEL	11	= -90.0 to +90.0	Latitude of the second standard parallel
LONGITUDE_OF_CENTRAL_ME RIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
LATITUDE_OF_PROJECTION_O RIGIN	11	= -90.0 to +90.0	Latitude of the 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 AEA projection
END_GROUP	14	AEA_PARAMETERS	End of the AEA parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of AZIM**
GROUP	15	AZIM_PARAMETERS	Beginning of the AZIM

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			parameters group
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
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 AZIM projection
END_GROUP	15	AZIM_PARAMETERS	End of the AZIM parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of EQC**
GROUP	14	EQC_PARAMETERS	Beginning of the EQC parameters group
LONGITUDE_OF_CENTRAL_ME RIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
LATITUDE_OF_PROJECTION_O RIGIN	11	= -90.0 to +90.0	Latitude of the 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 EQC projection
EQC_TYPE	1	= A or B	Value used to indicate the type of EQC projection
END_GROUP	14	EQC_PARAMETERS	End of the EQC parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of EQCA**
GROUP	15	EQCA_PARAMETERS	Beginning of the EQCA parameters group
LATITUDE_OF_STANDARD_PA RALLEL	11	= -90.0 to +90.0	Latitude of the standard parallel
END_GROUP	15	EQCA_PARAMETERS	End of the EQCA parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of EQCB**
GROUP	15	EQCB_PARAMETERS	Beginning of the EQCB parameters group
LATITUDE_OF_FIRST_ STANDARD_PARALLEL	11	= -90.0 to +90.0	Latitude of the first standard parallel
LATITUDE_OF_SECOND_STAN DARD_PARALLEL	11	= -90.0 to +90.0	Latitude of the second standard parallel
END_GROUP	15	EQCB_PARAMETERS	End of the EQCB parameters group
Projection parameters data (not			**The following parameters**

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
a Level 1 metadata parameter)			**are included only with products that select a map projection of EQUI**
GROUP	15	EQUI_PARAMETERS	Beginning of the EQUI parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 EQUI projection
END_GROUP	15	EQUI_PARAMETERS	End of the EQUI parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of GNOM**
GROUP	15	GNOM_PARAMETERS	Beginning of the GNOM parameters group
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
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 GNOM projection
END_GROUP	15	GNOM_PARAMETERS	End of the GNOM parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of GVNP**
GROUP	15	GVNP_PARAMETERS	Beginning of the GVNP parameters group
HEIGHT	38	= 0 to	Height of the perspective point in meters
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
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 GVNP projection
END_GROUP	15	GVNP_PARAMETERS	End of the GVNP parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with**

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			products that select a map projection of HAMM
GROUP	15	HAMM_PARAMETERS	Beginning of the HAMM parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 HAMM projection
END_GROUP	15	HAMM_PARAMETERS	End of the HAMM parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of LAEA**
GROUP	15	LAEA_PARAMETERS	Beginning of the LAEA parameters group
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
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 LAEA projection
END_GROUP	15	LAEA_PARAMETERS	End of the LAEA parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of LCC**
GROUP	14	LCC_PARAMETERS	Beginning of the LCC parameters group
LATITUDE_OF_FIRST_STANDARD_PARALLEL	11	= -90.0 to +90.0	Latitude of the first standard parallel
LATITUDE_OF_SECOND_STANDARD_PARALLEL	11	= -90.0 to +90.0	Latitude of the second standard parallel
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
LATITUDE_OF_PROJECTION_ORIGIN	11	= -90.0 to +90.0	Latitude of the 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 the LCC parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map**

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			projection of MERC
GROUP	15	MERC_PARAMETERS	Beginning of the MERC parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 MERC projection
END_GROUP	15	MERC_PARAMETERS	End of the MERC parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of MCYL**
GROUP	15	MCYL_PARAMETERS	Beginning of the MCYL parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 MCYL projection
END_GROUP	15	MCYL_PARAMETERS	End of the MCYL parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of MOLL**
GROUP	15	MOLL_PARAMETERS	Beginning of the MOLL parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 MOLL projection
END_GROUP	15	MOLL_PARAMETERS	End of the MOLL parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of OEA**
GROUP	14	OEA_PARAMETERS	Beginning of the OEA parameters group
HORIZONTAL_FLATNESS			Horizontal flatness of the oblong region
VERTICAL_FLATNESS			Vertical flatness of the oblong region
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
FALSE_EASTING	18	= $-1.0x10^8$ to $+1.0x10^8$	False easting
FALSE _NORTHING	18	= $-1.0x10^8$ to $+1.0x10^8$	False northing
FALSE_EASTING_NORTHING_ UNITS	6	= meters or feet	Units for false easting and northing for OEA projection
ANGLE		= 0 to 360	Direction of an axis of the oblong region
END_GROUP	14	OEA_PARAMETERS	End of the OEA parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of OM**
GROUP	13	OM_PARAMETERS	Beginning of the OM parameters group
SCALE_FACTOR_AT_ CENTER_OF_PROJECTION	9	= 0.0 to 2.0	Scale factor at the center of projection
LATITUDE_OF_PROJECTION_O RIGIN	11	= -90.0 to +90.0	Latitude of the projection origin
FALSE_EASTING	18	= $-1.0x10^8$ to $+1.0x10^8$	False easting
FALSE _NORTHING	18	= $-1.0x10^8$ to $+1.0x10^8$	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 the type of OM projection
END_GROUP	13	OM_PARAMETERS	End of the OM parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of Oblique Mercator, Type A (OMA)**
GROUP	14	OMA_PARAMETERS	Beginning of the OMA parameters group
LONGITUDE_FIRST_POINT_GE ODETIC	12	= -180.0 to +180.0	Longitude of the first point defining the central geodetic line of projection
LATITUDE_FIRST_POINT_GEO DETIC	11	= -90.0 to +90.0	Latitude of the first point defining the central geodetic line of projection
LONGITUDE_SECOND_POINT_ GEODETIC	12	= -180.0 to +180.0	Longitude of the second point defining the central geodetic line of projection
LATITUDE_SECOND_POINT_G EODETIC	11	= -90.0 to +90.0	Latitude of the second point defining the central geodetic line of projection
END_GROUP	14	OMA_PARAMETERS	End of the OMA parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with**

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
			products that select a map projection of OMB
GROUP	14	OMB_PARAMETERS	Beginning of the OMB parameters group
ANGLE_OF_AZIMUTH	12	= -180.0 to +180.0	Angle of the azimuth east of north for the central line of projection
LONGITUDE_ALONG_PROJECTION	12	= -180.0 to +180.0	Longitude of the point along the central line of projection at which the angle of azimuth is measured
END_GROUP	14	OMB_PARAMETERS	End of the OMB parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of ORTH**
GROUP	15	ORTH_PARAMETERS	Beginning of the ORTH parameters group
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
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 ORTH projection
END_GROUP	15	ORTH_PARAMETERS	End of the ORTH parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of PC**
GROUP	13	PC_PARAMETERS	Beginning of the PC parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
LATITUDE_OF_PROJECTION_ORIGIN	11	= -90.0 to +90.0	Latitude of the 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	PC_PARAMETERS	End of the PC parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of PS**
GROUP	13	PS_PARAMETERS	Beginning of the PS parameters group

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
VERTICAL_LONGITUDE_FROM_POLE	12	= -180.0 to +180.0	Vertical longitude from the pole
LATITUDE_OF_TRUE_SCALE	11	= -90.0 to +90.0	Latitude of the 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 the PS parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of ROBN**
GROUP	15	ROBN_PARAMETERS	Beginning of the ROBN parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 the false easting and northing for ROBN projection
END_GROUP	15	ROBN_PARAMETERS	End of the ROBN parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of SINU**
GROUP	15	SINU_PARAMETERS	Beginning of the SINU parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 SINU projection
END_GROUP	15	SINU_PARAMETERS	End of the SINU parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of SOM**
GROUP	14	SOM_PARAMETERS	Beginning of the SOM parameters group
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 SOM projection
SOM_TYPE	1	= A or B	Value used to indicate the type of SOM projection
END_GROUP	14	SOM_PARAMETERS	End of the SOM parameters group

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of SOMA**
GROUP	15	SOMA_PARAMETERS	Beginning of the SOMA parameters group
INCLINATION_ANGLE	11	=	Inclination of the orbit at the ascending node
LONGITUDE_OF_ASCENDING	11	=	Longitude of the ascending orbit
SATELLITE_REVOLUTION			Period of the satellite revolution in minutes
LANDSAT_RATIO			Ratio to compensate for the northern end of orbit
PATH_FLAG	1	= 0 or 1	End of the path flag for Landsat
END_GROUP	15	SOMA_PARAMETERS	End of the SOMA parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of SOMB**
GROUP	15	SOMB_PARAMETERS	Beginning of the SOMB parameters group
LANDSAT_NUMBER	1		Number of the Landsat satellite
PATH	3	= 1 to 233	Path number the satellite was on
END_GROUP	15	SOMB_PARAMETERS	End of the SOMB parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of STRG**
GROUP	15	STRG_PARAMETERS	Beginning of the STRG parameters group
LONGITUDE_OF_CENTER	12	= -180.0 to +180.0	Longitude of the center of projection
LATITUDE_OF_CENTER	11	= -90.0 to +90.0	Latitude of the center of projection
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 STRG projection
END_GROUP	15	STRG_PARAMETERS	End of the STRG parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of TM**
GROUP	13	TM_PARAMETERS	Beginning of the TM parameters group

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
SCALE_FACTOR_AT_ CENTRAL_MERIDIAN	11	= 0.0 to 2.0	Scale factor at the central meridian
LONGITUDE_OF_CENTRAL_ME RIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
LATITUDE_OF_PROJECTION_O RIGIN	11	= -90.0 to +90.0	Latitude of the 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 TM projection
END_GROUP	13	TM_PARAMETERS	End of the TM parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of UTM**
GROUP	14	UTM_PARAMETERS	Beginning of the UTM parameters group
ZONE_NUMBER	3	= 1 to 60 or -1 to -60	Value used to indicate the zone number
END_GROUP	13	UTM_PARAMETERS	End of the UTM parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of VDGR**
GROUP	15	VDGR_PARAMETERS	Beginning of the VDGR parameters group
LONGITUDE_OF_CENTRAL_ME RIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
LATITUDE_OF_PROJECTION_O RIGIN	11	= -90.0 to +90.0	Latitude of the 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 EQC projection
END_GROUP	15	VDGR_PARAMETERS	End of the VDGR parameters group
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of WIV**
GROUP	14	WIV_PARAMETERS	Beginning of the WIV parameters group
LONGITUDE_OF_CENTRAL_ME RIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
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 WIV projection
END_GROUP	14	WIV_PARAMETERS	End of the WIV parameters group

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
Projection parameters data (not a Level 1 metadata parameter)			**The following parameters are included only with products that select a map projection of WVII**
GROUP	15	WVII_PARAMETERS	Beginning of the WVII parameters group
LONGITUDE_OF_CENTRAL_MERIDIAN	12	= -180.0 to +180.0	Longitude of the central meridian
FALSE_EASTING	18	= $-1.0x10^8$ to $+1.0x10^8$	False easting
FALSE _NORTHING	18	= $-1.0x10^8$ to $+1.0x10^8$	False northing
FALSE_EASTING_NORTHING_UNITS	6	= meters or feet	Units for false easting and northing for MOLL projection
END_GROUP	15	WVII_PARAMETERS	End of the WVII parameters group
END_GROUP	148	L1_METADATA_FILE	End of the Level 1 metadata file level group
END			Required standalone parameter signifying the file end
*ASCII bytes			

Table 3-12. Level 1 Metadata File

3.3.3 Ground Control Points (GCP) File

Please see 3.1.5 for GCP File details.

3.3.4 Ancillary Data Files

3.3.4.1 Internal Calibrator (IC) Data Files

The IC data files are included only with the L1R output product. The IC data consist of scan-line-ordered internal lamp and shutter data for Bands 1 through 7 and blackbody radiance and shutter data for Band 6. The data are collected once per scan and structured in a band sequential format in detector-descending order (e.g., detector 16 followed by detector 15 and so on for the 30-meter bands).

3.3.4.2 Mirror Scan Correction Data (MSCD) 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. 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. Also included in the MSCD file are scan-based values such as time code, gain status, and processing errors encountered by Level 0 processing systems. The MSCD are trimmed to fit the product ordered, although one additional record is added to the file during the subsetting process because scan error and direction information corresponds to the previous scan. Applicable document 4 (see References) describes the file structure for the consensus MSCD, with the exception of the L1-assigned Vdata Name and Vdata class, described below.

Vdata Name: LMpppprrr_rrrYYYYMMDD.MSD
Vdata Class: LPGS_MSCD

3.3.4.3 Payload Correction Data (PCD) File

The PCD data file is included only with the L1R output product. This file consists of attitude and ephemeris profiles and high-frequency jitter measurements. A PCD for the entire subinterval is included with U.S. generated L0Rp data. At a minimum, the PCD included covers the time of the imagery plus at least an additional six seconds before and 18 seconds after the imagery start and stop times, respectively (unless limited by the boundaries of the PCD in the subinterval). Applicable document 4 (see References) describes the file structure for the PCD, with the exception of the L1-assigned Vdata Name and Vdata classes, described in the following subsections.

Vdata Name: LMpppprrr_rrrYYYYMMDD.PCD
Vdata Class: LPGS_PCD

3.3.4.4 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 offset file is provided with products that include Bands 1 through 7. These data are subsetted to correspond to the user-requested product (i.e., by band and product size). Applicable document 4 (see References) describes the file structure for the scan line offset, with the exception of the L1-assigned Vdata Name and Vdata classes, described in the following subsections.

Vdata Name: LMpppprrr_rrrYYYYMMDD.ONN
Vdata Class: LPGS_SLO

3.3.4.5 Calibration Parameter File (CPF)

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 the L0Rp product file. The Landsat 5 Thematic Mapper (TM) Calibration Parameter File (CPF) Definition (see References) provides a complete description of this file.

3.3.4.6 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. Applicable document 4 (see References) describes the file structure for the geolocation table, with the exception of the L1-assigned Vdata Name and Vdata classes, described in the following subsections.

Vdata Name: LMpppprrr_rrrYYYYMMDD.GEO
Vdata Class: Index

3.3.4.7 LPS Metadata File

The LPS metadata files are included with the L1R output product without modification from the L0Rp product. The metadata file is provided with all L1R products. Some information in the LPS metadata file pertains to parent subintervals of the L1 product and may not be applicable to L1 products. Applicable document 4 (see References) describes the file structure for the LPS metadata, with the exception of the L1-assigned Vdata Name, described in the following subsections.

Vdata Name: LMppprrr_rrrYYYYMMDD.MTA

3.4 NLAPS Data Format (NDF)

3.4.1 Level 1 Image File

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 (e.g., detector 16 followed by detector 15 and so forth for the 30-m bands). The L1G image is radiometrically corrected and resampled for geometric correction and registration to geographic map projections.

3.4.2 Header File

The Image Header File contains information describing image data. The header file is an ASCII text file. Information in the header file consists of keyword/value entries in the format: <keyword> = <value1> [,<value2>,<value3>,...,<valueN>];

The characters , and ; serve as value and entry delimiters, respectively, whereas = separates the keyword field from value field(s). These special characters are not to be used in keyword and value fields. In rare instances when these special characters are required in keyword and value fields, the desired field must be enclosed in double quotes (i.e., <field>, where the <field> contains the above-mentioned special character(s).

In the rare event that the double quote character is required in a field, it is represented by a backslash, followed by a double quote (e.g., \). A backslash in a field is denoted by two consecutive backslashes (e.g., \\).

The first and last characters of keywords and values are non-blank characters. <Keywords> are unique and are single tokens. Words in keyword fields are connected by underscores. An example of a keyword is BITS_PER_PIXEL.

Where possible, each entry in the <value> field is a single token. The keyword in the first entry of the header is NDF_REVISION. All other header entries can appear in any order, except for the keyword END_OF_HDR, which has no parameters and presents the end of a header. A semicolon also terminates this entry.

Each keyword starts at the beginning of a new line. Any number, including zero, or white spaces may appear outside of the keyword and value fields. White spaces refer to space, tab, Carriage-Return (CR), and Line-Feed (LF) characters.

Only required parameters are entered in the file. The parameters that are not required may not be included. For example, NDF files containing mosaicked DEM data do not have BAND1-RADIOMETRIC_GAINS/BIAS entries. A parameter with a specified default value may not be included if it is to take on its default value.

- Within the parameter tables, the following notation is used:
  <type> specifies the type or format of data to be used as a keyword value
  [optional type] specifies the type or format of optional data for a keyword value
  | represents or, used for specifying alternative keyword values
  <character> specifies that the <character> must be included as part of the keyword value or value list, and the character set includes: _ , / = ; .

KEYWORD	DESCRIPTION
NDF_REVISION	Format version code <m>.<nn>. This document describes version 2.00.
DATA_SET_TYPE	The type of data. Format of data type: <company>_<sensor>|<data type>[FMT<nnn>] Valid types include: EDC_MSS, EDC_TM, EDC_ETM+, and NLAPS_DEM.
PRODUCT_NUMBER	Product order number in <NNNYYMMDDSSSSdddd> format with NNN = Node, YY = year, MM = month, DD = day, SSSS = Sequence Number, and dddd = unit number.
PIXEL_FORMAT	The format of the pixel. Valid values include: BIT. BYTE, 2BYTEINT, 4BYTEINT, REAL, DOUBLE. Note that integers may be signed or unsigned.
PIXEL_ORDER	Valid values include: NOT_INVERTED, [<n>-]BYTE_INVERTED, [<n>-]BIT_INVERTED. An example is: BYTE_INVERTED. Default value is NOT_INVERTED.
BITS_PER_PIXEL	Number of bits per pixel. Integer format.
PIXELS_PER_LINE	Number of pixels per line. Integer format.
LINES_PER_DATA_FILE	Number of data lines for each data/image file. For example, for a 3-band BIL imagery data file, the value of LINES_PER_DATA_FILE equals the number of lines in each band multiplied by 3. Integer format. For BSQ imagery, the value of LINES_PER_DATA_FILE equals the number of lines in each band.
DATA_ORIENTATION	Data orientation in <position>/ <direction> format. Valid values include: UPPER_LEFT/RIGHT, UPPER_LEFT/BOT, UPPER_RIGHT/LEFT, UPPER_RIGHT/BOT, BOTTOM_LEFT/RIGHT, BOTTOM_LEFT/TOP, BOTTOM_RIGHT/LEFT, BOTTOM_RIGHT/TOP.
NUMBER_OF_DATA_FILES	Total number of image/data files. Header, work order report, and history files are excluded. Integer format.
DATA_FILE_INTERLEAVING	Interleaving type. Valid values include: BSQ.
TAPE_SPANNING_FLAG	Tape-spanning flag for images that span multiple volumes in <n>/<m> format, where <n> is the current volume number and <m> is the total number of volumes.
START_LINE_NUMBER	First data/image line number on this volume (for multiple volumes). Integer format.

START_DATA_FILE	First data file number on this volume (for multiple volumes). Integer format.
LINES_PER_VOLUME	Number of data lines on this volume (for multiple volumes). Integer format.
BLOCKING_FACTOR	Blocking factor. Number of data records per block. Integer format. Default is 1.
RECORD_SIZE	Length of physical record in bytes. Integer format.
UPPER_LEFT_CORNER	<Longitude>, <Latitude>, <Easting>, <Northing>, where Longitude and Latitude represent geodetic coordinates in <DDDMMSS>.<SSSSC> format with DDD = degrees, MM = minutes, SS.SSSS = seconds, and C = N, S, E, or W. Easting and Northing are expressed in meters, in F13.3 format. These four measurements are taken at the center of the upper-left-most pixel. An example of longitude: 5 degrees, 13 min., 12.7 sec. west of prime meridian is expressed as 0051312.7000W. An example of latitude: 18 degrees, 12 min., 54.7 sec. north of the equator is expressed as 0181254.7000N.
UPPER_RIGHT_CORNER	<Longitude>, <Latitude>, <Easting>,<Northing>. The format is similar to that of UPPER_LEFT_CORNER. These four measurements are taken at the center of the upper-right-most pixel.
LOWER_RIGHT_CORNER	<Longitude>, <Latitude>, <Easting>,<Northing>. The format is similar to that of UPPER_LEFT_CORNER. These four measurements are taken at the center of the lower-right-most pixel.
LOWER_LEFT_CORNER	<Longitude>, <Latitude>, <Easting>,<Northing>. The format is similar to that of UPPER_LEFT_CORNER. These four measurements are taken at the center of the lower-left-most pixel.
REFERENCE_POINT	Valid values include: SCENE_CENTER, NONE.
REFERENCE_POSITION	<Longitude>,<Latitude>, <Easting>, <Northing>, <Pixel #>,<Line #>. Used to geographically reference the image to the ground. The longitude, latitude, easting, and northing formats are the same as those in UPPER_LEFT_CORNER. Pixel # and Line # refer to reference point pixel and line numbers respectively, with the first pixel in the image being 1,1. They both have F9.2 formats and can be negative. Integer line/pixel numbers correspond to the center of a pixel.
REFERENCE_OFFSET	<x-offset>,<y-offset>. Horizontal offset of the true reference point from the nominal WRS scene center in units of whole pixels. Both are F9.2 format.
ORIENTATION	Orientation angle in degrees measured clockwise from grid (map) north. May be negative. F11.6 format.
MAP_PROJECTION_NAME	Map projection name, as specified in GCTP documentation.
USGS_PROJECTION_NUMBER	USGS-supported projection number, as specified in GCTP documentation.
USGS_MAP_ZONE	USGS map zone code, for UTM and State Plan Cartographic System. (Negative numbers indicate the southern hemisphere for the UTM zone).
USGS_PROJECTION_ PARAMETERS	USGS map projection parameters. There are 15 PARAMETERS, all with the same format (D26.15).
HORIZONTAL_DATUM	Name of the horizontal datum used. Valid values include: NAD27, NAD83, WGS84, ELLIPSOID. See Appendix 6.
EARTH_ELLIPSOID_ SEMI-MAJOR_AXIS	Semi-major axis of Earth ellipsoid. F11.3 format, in meters.
EARTH_ELLIPSOID_ SEMI-MINOR_AXIS	Semi-minor axis of Earth ellipsoid. F11.3 format, in meters.
EARTH_ELLIPSOID_ ORIGIN_OFFSET	<x-offset>,<y-offset>,<z-offset> x-, y- & z-offsets of Earth ellipsoid in meters. F11.3 format.

EARTH_ELLIPSOID_ ROTATION_OFFSET	<x-plane offset>,<y-plane offset>, <z-plane offset> Angular offset from x-plane, y-plane & z-plane of Earth ellipsoid in degrees. F9.6 format.
WRS	WRS Path/Row in <ppp>/<rrr.n> format, where n is the fractional row value.
ACQUISITION_DATE/TIME	UTC date and time of acquisition of the reference point in ISO-compliant format:YYYY-MM-DDThh:mm:ssZ. ©
SATELLITE	Satellite number. Valid values are LANDSAT_<m>, where m is an integer 1 – 5 or 7.
SATELLITE_INSTRUMENT	Instrument type: <SSSSSS>, where <SSSSSS> is the sensor type. Valid values include: MSS, TM, and ETM+.
PRODUCT_SIZE	Valid values include: FULL_SCENE, SUBSCENE, MULTI_SCENE.
PIXEL_SPACING	<Horizontal pixel size>,<vertical pixel size>. Horizontal and vertical pixel size in PIXEL_SPACING_UNITS. F9.4 format.
PIXEL_SPACING_UNITS	Units of measure: METERS
PROCESSING_LEVEL	Processing level. For ETM+, TM, and MSS, valid values include: 01, 02, 03, 04, 05, 06, 07, 08, 09, and 10. These correspond to the standard Landsat processing levels.
RESAMPLING	Resampling kernel. Valid values include: NN, BL, CC, KD16,SINC8, SINC16, NONE, <user-defined>, where <user-defined> is a unique name for a user-definable kernel.
PROCESSING_DATE/TIME	Processing date, time in ISO-compliant format: YYYY-MM-DDThh:mm:ss. In local system time. ©
PROCESSING_SOFTWARE	Processing software version: NLAPS_<xx>, where xx = the software version number.
SUN_ELEVATION	Sun elevation in degrees at the reference point (acquisition time). F6.2 format.
SUN_AZIMUTH	Sun azimuth in degrees at the reference point (acquisition time). F6.2 format.
NUMBER_OF_BANDS_ IN_VOLUME	Number of bands in the volume. Integer format.

3.4.3 Level 1 Metadata File

Please see 3.3.2 for L1 Metadata File details.

3.4.4 DEM Header File (optional)

The Image Header File contains information describing image data. The header file is an ASCII text file. The header examples listed below demonstrate how the metadata appear in the first file of each digital product.

TM NLAPS DEM Header Example:

```
NDF_REVISION=2.00;
DATA_SET_TYPE=NLAPS_DEM;
PRODUCT_NUMBER=ndfetm;
PIXEL_FORMAT=2BYTEINT;
PIXEL_ORDER=NOT_INVERTED;
BITS_PER_PIXEL=16;
PIXELS_PER_LINE=9048;
LINES_PER_DATA_FILE=8577;
DATA_ORIENTATION=UPPER_LEFT/RIGHT;
NUMBER_OF_DATA_FILES=1;
DATA_FILE_INTERLEAVING=BSQ;
TAPE_SPANNING_FLAG=1/1;
START_LINE_NUMBER=1;
START_DATA_FILE=1;
LINES_PER_VOLUME=8577;
```

```
BLOCKING_FACTOR=1;
RECORD_SIZE=9048;
UPPER_LEFT_CORNER=0990225.1489W,0424435.5517N,496700.000,4732300.000;
UPPER_RIGHT_CORNER=0961642.3389W,0424239.1292N,722875.000,4732300.000;
LOWER_RIGHT_CORNER=0962131.5257W,0404654.7399N,722875.000,4517900.000;
LOWER_LEFT_CORNER=0990220.8586W,0404843.5776N,496700.000,4517900.000;
REFERENCE_POINT=SCENE_CENTER;
REFERENCE_POSITION=0974044.7685W,0414612.5447N,609787.500,4625100.000,4524.50,4289.00;
REFERENCE_OFFSET=207.83,12.21;
ORIENTATION=0.015359;
MAP_PROJECTION_NAME=UTM;
USGS_PROJECTION_NUMBER=1;
USGS_MAP_ZONE=14;
USGS_PROJECTION_PARAMETERS=0.000000000000000,0.000000000000000,0.000000000000000,0.000000000000000
0,0.000000000000000,0.000000000000000,0.000000000000000,0.000000000000000,0.000000000000000,0.000
000000000000,0.000000000000000,0.000000000000000,0.000000000000000,0.000000000000000,0.000000000
00000;
HORIZONTAL_DATUM=WGS84;
EARTH_ELLIPSOID_SEMI-MAJOR_AXIS=6378137.000;
EARTH_ELLIPSOID_SEMI-MINOR_AXIS=6356752.314;
EARTH_ELLIPSOID_ORIGIN_OFFSET=0.000,0.000,0.000;
EARTH_ELLIPSOID_ROTATION_OFFSET=0.000000,0.000000,0.000000;
PRODUCT_SIZE=FULL_SCENE;
PIXEL_SPACING=25.0000,25.0000;
PIXEL_SPACING_UNITS=METERS;
RESAMPLING=BL;
PROCESSING_DATE/TIME=1999-11-23T15:19:52;
PROCESSING_SOFTWARE=NLAPS_4_1_0;
NUMBER_OF_BANDS_IN_VOLUME=1;
DEM_NAME=DEM;
UNIT_OF_ELEVATION_MEASURE=METERS;
VERTICAL_DATUM=SEA_LEVEL;
END_OF_HDR;
```

3.4.5 DEM Data File (optional)

The DEM file contains elevation samples. There are no header records within the files, nor are there any prefix and/or suffix data to the individual image records. The DEM data file is in the same pixel spacing as the satellite data when all bands are the same resolution. The DEM data file is of the same resolution as the reflective bands when satellite data are multi-resolution. The data file is 16-bits per pixel.

3.4.6 Work Order Report File

The Work Order Report File provides a record of the work executed into an EBAS Product Order. This file is in ASCII format and contains information relative to the processing performed and the parameters used (e.g., latitudes and longitudes specified in degrees, and heights specified in meters).

The Correction Processing Report File provides a record of the work executed in response to an EBAS Product Order. It is in ASCII format for easy readability, and contains the following information: (Notes describing units and/or formats are used for latitude, longitude, heights, dates, etc.)

- Product order information
- Processing stage reports:
    - Name of the processing stage
    - Start and completion date/time of the processing stage
    - Summary/status information

- Processing stages may include:
  - Ingest
  - Precision Modeling
  - DEM Ingest
  - DEM Processing
  - Apply Despike Filter
  - Apply Deband Filter
  - Image Correction
  - Geometric Quality Assessment
  - Radiometric Quality Assessment
  - Product Formatting
- Summary Information (e.g., Work Order start and stop date/times and total Central Processing Unit (CPU) time)

NLAPS CORRECTION PROCESSING REPORT (Example)

```
NLAPS Version:      4_3_00e14
Work Order:         011040402008500001          Priority:           9
Satellite:          Landsat-5                   Sensor:             TM
Camera Number:      N/A                                    Sensor Mode:        N/A

Input Data Ident:   /diskIngest2/temp/01104040200850001/L51EDC1102226
Input Media Type:   Disk                        File Number:        N/A
Orbit Number:       98151

Processing Level:   Systematic Geocorrection    Resampling:         CC
Map Projection:     UTM                         Zone:               18
Earth Ellipsoid:    NAD83                       Panel Effect:       FALSE
Product Orient.:    Satellite

Projection Params:
   6.378137000000000e+06  6.356752314140000e+06  0.000000000000000e+00
   0.000000000000000e+00  0.000000000000000e+00  0.000000000000000e+00
   0.000000000000000e+00  0.000000000000000e+00  0.000000000000000e+00
   0.000000000000000e+00  0.000000000000000e+00  0.000000000000000e+00
   0.000000000000000e+00  0.000000000000000e+00  0.000000000000000e+00
Line Spacing:       030.0                       Pixel Spacing:      030.0

Path/Strip no.:     014                         Start Row no.:      029.0
                                                End Row no.:        N/A

Image Lines:        6000                        Image Pixels:       6493
Image Orientation:   10.46  deg from N          Output Bands:       123456789
Viewing Angle:        0.04  deg

Scene center lat:    44.606 deg                 Scene center long:   -73.516 deg
Sun Elevation:       54.09  deg                 Sun Azimuth:         139.84  deg
Scene center date:  2002 08 14                  Scene center time:  15:26:51.9275

Output Media:       Disk                        Output Product Id:  N/A
Product Format:     NDF                         Interleaving :      BSQ
Catalogued:         FALSE

Completion date:    2004 04 07                  Completion time:    10:59:52

Termination Status: Successful Completion

================================================================================
                     DETAILED PROCESSING RESULTS
================================================================================
```

==========

RADIOMETRIC CORRECTION

Algorithm: NASA

Band	Ref Detector	DN to Radiance gain	offset	Default Abs Calib?
1	15	0.778740	-6.97873	FALSE
2	12	0.798819	-7.19882	FALSE
3	8	0.621653	-5.62164	FALSE
4	7	0.969291	-6.06931	FALSE
5	14	0.126220	-1.12622	FALSE
6	8	0.067087	-0.06708	FALSE
7	10	0.043898	-0.39389	FALSE
8	27	0.975591	-5.67560	FALSE
9	8	0.037205	3.162800	FALSE

Band 1 Coefficients (Qcal = (Q - offset) / gain):

Gain Mode: HIGH

Detector	Forward gain	Forward offset	Backward gain	Backward offset
1	0.960342	6.911600	0.960342	6.906810
2	0.950054	7.094850	0.950054	7.090060
3	0.950495	6.740320	0.950495	6.735530
4	0.951127	6.574330	0.951127	6.569540
5	0.948987	6.653630	0.948987	6.648840
6	0.952194	6.498690	0.952194	6.493900
7	0.962207	6.228640	0.962207	6.223850
8	0.960842	6.117060	0.960842	6.112280
9	0.957314	6.066810	0.957314	6.062020
10	0.957566	5.990210	0.957566	5.985420
11	0.958945	6.083820	0.958945	6.079030
12	0.949041	6.329580	0.949041	6.324790
13	0.955021	6.502640	0.955021	6.497850
14	0.943699	6.743620	0.943699	6.738830
15	0.953371	6.724250	0.953371	6.719460
16	0.954400	6.630990	0.954400	6.626210

Band 2 Coefficients (Qcal = (Q - offset) / gain):

Gain Mode: HIGH

Detector	Forward gain	Forward offset	Backward gain	Backward offset
1	0.938977	6.804560	0.938977	6.794900
2	0.949396	6.920310	0.949396	6.910650
3	0.944009	7.010020	0.944009	7.000360
4	0.950580	6.783130	0.950580	6.773470
5	0.946023	6.838120	0.946023	6.828450
6	0.948274	6.569570	0.948274	6.559910
7	0.969289	6.107580	0.969289	6.097910
8	0.949267	6.283690	0.949267	6.274020
9	0.951517	6.304300	0.951517	6.294640
10	0.956479	6.160860	0.956479	6.151200
11	0.956445	6.198250	0.956445	6.188590
12	0.951680	6.352280	0.951680	6.342620
13	0.959374	6.442400	0.959374	6.432740
14	0.941859	6.725560	0.941859	6.715900
15	0.950497	6.748920	0.950497	6.739260
16	0.954122	6.620250	0.954122	6.610590

Band 3 Coefficients (Qcal = (Q - offset) / gain):

Gain Mode: HIGH

Detector	Forward		Backward	
	gain	offset	gain	offset
1	0.949206	6.226510	0.949206	6.220700
2	0.943181	6.432940	0.943181	6.427130
3	0.952270	6.269500	0.952270	6.263690
4	0.951920	6.134450	0.951920	6.128640
5	0.959897	5.942650	0.959897	5.936840
6	0.950786	5.930450	0.950786	5.924640
7	0.962914	5.731090	0.962914	5.725280
8	0.953018	5.876670	0.953018	5.870860
9	0.961008	5.718920	0.961008	5.713110
10	0.971431	5.582900	0.971431	5.577090
11	0.969670	5.563450	0.969670	5.557640
12	0.956630	5.878110	0.956630	5.872300
13	0.954672	6.059720	0.954672	6.053910
14	0.950138	6.240570	0.950138	6.234760
15	0.950500	6.094960	0.950500	6.089150
16	0.956894	6.032850	0.956894	6.027040

Band 4 Coefficients (Qcal = (Q - offset) / gain):

Gain Mode: LOW

Detector	Forward		Backward	
	gain	offset	gain	offset
1	0.976442	3.720750	0.976442	3.717350
2	0.957020	4.007190	0.957020	4.003790
3	0.966064	3.901490	0.966064	3.898090
4	0.964053	3.792050	0.964053	3.788660
5	0.965949	3.866010	0.965949	3.862620
6	0.957106	3.893960	0.957106	3.890560
7	0.965585	3.907260	0.965585	3.903870
8	0.958357	4.108360	0.958357	4.104960
9	0.974503	3.687160	0.974503	3.683770
10	0.964873	4.039750	0.964873	4.036360
11	0.968608	3.921370	0.968608	3.917980
12	0.971872	3.793350	0.971872	3.789950
13	0.956386	3.873310	0.956386	3.869920
14	0.975008	3.590030	0.975008	3.586640
15	0.968432	3.918960	0.968432	3.915570
16	0.972345	3.802490	0.972345	3.799090

Band 5 Coefficients (Qcal = (Q - offset) / gain):

Gain Mode: HIGH

Detector	Forward		Backward	
	gain	offset	gain	offset
1	0.956878	6.845350	0.956878	6.846000
2	0.952391	6.580580	0.952391	6.581230
3	0.953862	6.532760	0.953862	6.533410
4	0.948992	6.581110	0.948992	6.581770
5	0.950334	6.656560	0.950334	6.657210
6	0.957422	6.291610	0.957422	6.292260
7	0.969421	6.152000	0.969421	6.152650
8	0.963388	6.262720	0.963388	6.263370
9	0.963532	6.283690	0.963532	6.284340
10	0.955747	6.487410	0.955747	6.488060
11	0.958770	6.043970	0.958770	6.044620
12	0.965507	6.331850	0.965507	6.332500
13	0.957685	6.478740	0.957685	6.479390

14	0.960680	6.491520	0.960680	6.492170
15	0.957745	6.694090	0.957745	6.694740
16	0.954045	6.535280	0.954045	6.535930

Band 6 Coefficients (Qcal = (Q - offset) / gain):

Gain Mode: LOW

Detector	Forward		Backward	
	gain	offset	gain	offset
1	0.870418	25.57510	0.870418	25.57510
2	0.886202	23.79930	0.886202	23.79930
3	0.866645	25.77130	0.866645	25.77130
4	0.866342	25.80510	0.866342	25.80510
5	0.848437	27.61710	0.848437	27.61710
6	0.888179	23.53360	0.888179	23.53360
7	0.844112	28.16340	0.844112	28.16340
8	0.829109	29.72180	0.829109	29.72180

==========

DEM PROCESSING

Elevation Correction Applied: None

==========

RADIOMETRIC QUALITY ASSESSMENT

NOTE:
Mean, Std.Dev, Striping are in DNs (Digital Numbers).

Band	Chip Location		Chip Size		Mean	Std Dev	Striping
	Line	Pixel	Lines	Pixels			
1	1197.60	1268.00	128	128	101.33	1.531	0.0812
1	2394.20	2535.00	128	128	83.59	0.670	0.0582
1	3590.80	3802.00	128	128	95.35	0.585	0.0615
1	4787.40	5069.00	128	128	82.55	0.452	0.0663
2	1197.60	1268.00	128	128	74.63	2.158	0.1624
2	2394.20	2535.00	128	128	60.67	0.381	0.0851
2	3590.80	3802.00	128	128	63.76	0.506	0.1104
2	4787.40	5069.00	128	128	57.97	0.337	0.0749
3	1197.60	1268.00	128	128	62.47	3.483	0.2812
3	2394.20	2535.00	128	128	45.47	0.577	0.1072
3	3590.80	3802.00	128	128	50.61	0.570	0.0931
3	4787.40	5069.00	128	128	43.27	0.435	0.1155
4	1197.60	1268.00	128	128	94.72	12.800	1.1561
4	2394.20	2535.00	128	128	97.79	2.287	0.1293
4	3590.80	3802.00	128	128	20.81	0.582	0.0597
4	4787.40	5069.00	128	128	96.79	2.788	0.2992
5	1197.60	1268.00	128	128	92.25	4.370	0.3518
5	2394.20	2535.00	128	128	77.51	2.278	0.3962
5	3590.80	3802.00	128	128	16.54	0.501	0.1131
5	4787.40	5069.00	128	128	72.43	1.233	0.1374
6	599.20	634.40	128	128	137.22	1.435	0.0872
6	1197.40	1267.80	128	128	134.95	1.371	0.1068
6	1795.60	1901.20	128	128	128.01	0.640	0.0911
6	2393.80	2534.60	128	128	132.40	0.397	0.0545
7	1197.60	1268.00	128	128	45.98	4.676	0.4085
7	2394.20	2535.00	128	128	34.81	1.049	0.1295
7	3590.80	3802.00	128	128	13.76	0.552	0.0429

```
  7   4787.40     5069.00    128     128        32.09   0.605    0.0810

================================================================================

                                   PRODUCT FORMATTING
                                   ------------------

Product Scene Center Location (lat/long)   :  44.606   -73.516
Product Scene Center Date/Time (yyyy mm dd): 2002  8 14  15:26:51.9275

Product Extent:

  Lat:        45.57  ---------------------------------- Lat:        45.22
  Long:      -74.51                                     Long:      -72.07
  North: 5046390.96                                     North: 5011043.46
  East:   538302.56                                     East:   729828.04
  |                                                                      |
  |                                                                      |
  |                                                                      |
  |                                                                      |
  |                                                                      |
  |                                                                      |
  Lat:        43.98                                     Lat:        43.63
  Long:      -74.93                                     Long:      -72.56
  North: 4869409.85                                     North: 4834062.35
  East:   505639.33  ---------------------------------- East:   697164.82

================================================================================

                                   EXECUTION INFORMATION
                                   ---------------------

Stage              Start                      End                         CPU
--------------------------------------------------------------------------------
Ingest             Wed Apr  7 10:36:25 2004   Wed Apr  7 10:40:44 2004    137.74
ImCorr             Wed Apr  7 10:41:07 2004   Wed Apr  7 10:58:31 2004   1366.28
RadQa              Wed Apr  7 10:58:32 2004   Wed Apr  7 10:58:33 2004      0.67
Output             Wed Apr  7 10:58:36 2004   Wed Apr  7 10:59:46 2004     16.50
Catalog            Wed Apr  7 10:59:46 2004   Wed Apr  7 10:59:47 2004      0.61

                                 ---------
                                                                        1521.80
```

3.4.7 History Processing Parameters File

See References (LS-DFCB-19) for detailed file format description.

Section 4 Product Packaging

L1 products are available on Digital Linear Tape (DLT), Compact Disk-Read Only Memory (CD-ROM), Digital Versatile Disc-Read Only (DVD-R), and via electronic transfer. The following subsections provide information on each of the distribution methods for the available L1 product formats.

4.1 Digital Linear Tape (DLT)

Data products may be supplied on DLT. This includes a family of devices and media including DLT-IV, DLT8000, and Super DLT (SDLT). At this time, DLT-IV devices (DLT-7000) are no longer available from vendors. However, a large number of existing DLT-IV devices are in use. New tape devices include DLT8000 and SDLT. Both are read compatible with media written using DLT-IV devices.

Data are written using the UNIX tar (tape archive) utility format (per Institute of Electrical and Electronics Engineers (IEEE) Portable Operating System Interface (POSIX) standard 1003.1), thus preserving directory structure and file names. The no-swap device and a fixed blocking factor of 256 512-byte blocks are used to maximize portability between platforms. The root directory must contain a README and summary file, which describes product content, and a set of files or subdirectories. Depending on the distribution technique, orders with only one scene may place all files in the root directory. However, if there are multiple scene units, there must be one subdirectory for each product ordered. Product subdirectories are labeled with a unique name and referenced in the summary file. All of the files associated with a product exist at a common level within the product subdirectory.

Product orders with large scenes or a number of scene units may exceed the capacity of the media. If this occurs, distribution systems span scene units across multiple volumes; a copy of the HDF directory file is included on all output volumes for user convenience. If a FAST-TM product must be written to more than one DLT, relevant header records are replicated.

The DLT label includes the following information: mission indicator (e.g., L7 or Landsat 7), start path, start row, end row, acquisition date, and product type (e.g., L0Rp), the DLT format (e.g., DLT4000, DLT7000, DLT8000, SDLT), the type of Tape Archive (TAR) used (e.g., IRIX, GNU), and the blocking factor.

4.2 CD-ROM

Data products on CD-ROM are mastered using ISO 9660 Interchange level 2, the international standard for logical file formatting of a CD-ROM. Rock Ridge and Joliet extensions are present on the CD-ROM. No file unpacking is required. The files are ready for processing using HDF or other software tools.

The CD-ROM format also contains the L1 volume descriptor (readme file) with the same file names as listed in the previous section. Only single-scene (or less) products are written to CD-ROM due to the size of the Band 8 file. If an HDF L1 product must be

written to more than one CD, an HDF directory is written to each CD. If a FAST product must be written to more than one CD, relevant header records are replicated.

At least the following information is labeled directly onto the CD-ROM: product type (e.g., HDF, GeoTIFF, FAST, or NDF), EBAS order number, EBAS unit number, CD-ROM volume number, start path, start row, end row, acquisition date, and USGS logo. The path, row, and acquisition date information is supplied in the format of the naming convention of the base part of file names as defined in Section 2.

4.3 DVD-R

Data products on DVD-R (Digital Video Disk write once) are mastered using ISO 9660 Interchange level 2, the international standard for file formatting of a DVD-R. Rock Ridge and Joliet extensions are present on the DVD-R. No file unpacking is required. The files are ready for processing using HDF or other software tools. DVD-R products are mastered using single-sided, single-layered technology providing a capacity of 4.7 gigabytes. This configuration is compatible with most DVD-ROM readers.

The root directory contains a README and summary file, which describes product content, and a set of files or subdirectories. Depending on the distribution technique, orders with only one scene may place all files in the root directory. However, if there are multiple scene units, there must be one subdirectory for each product ordered. Product subdirectories are labeled with a unique name and referenced in the summary file. All of the files associated with a product exist at a common level within the product subdirectory.

Product orders with large scenes or a number of scene units may exceed the capacity of the media. If this occurs, distribution systems span scene units across multiple volumes; a copy of the HDF directory file is included on all output volumes for user convenience. If a FAST-TM product must be written to more than one DVD-R, then relevant header records are replicated.

The DVD-R label includes the following information: order and unit number, scene identifiers (granule or entity id), mission indicator (Landsat 4 (L4) or Landsat 5 (L5)), start path, start row, end row, acquisition date, and product type.

4.4 Electronic Transfer

Products available via electronic transfer also include the L1 volume descriptor (read-me file) with the same filenames as listed above. Electronic data transfer uses UNIX File Transfer Protocol (FTP). FTP, as described in Request For Comments (RFC) 959, is an Internet standard for file transfers that supports the retrieval of files from a remote server. This distribution method may not be available to all end users by all distribution systems. In some cases, special high-speed network requirements must be arranged. Various strategies and procedures to access data may vary significantly between distribution systems.

When FTP service is available, data are stored using the following standard. The home or initial login directory contains a set of files or subdirectories. Depending on the distribution technique, orders with only one scene may place all files in the home directory. However, if there are multiple scene units, there must be one subdirectory for each product ordered. The product subdirectories are labeled with a unique name. All of the files associated with a product exist at a common level within the product subdirectory.

The Bulk Processing Subsystem will GZip (compression) all Standard L1T scenes. Each individual file within the scene will be GZip.

Section 5 Software Tools

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

5.1 NCSA HDF Libraries

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

The HDF library contains two parts: the base library and the multi-file library. The base library contains a general-purpose interface and an application-level interface, 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, and Macintosh is available via anonymous FTP from http://www.hdfgroup.org/release4/obtain.html. HDF reference manuals, user guides, release notes, and newsletters are web accessible at http://hdf.ncsa.uiuc.edu. Several versions of HDF are available. HDF version 4 is the version to be used with the distributed L1 product.

5.2 HDF Libraries

HDF-EOS is standard HDF with Earth Observing System (EOS) Data and Information System (EOSDIS) Core System (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 Application Programming Interface (API). The L0Rp does not employ either of these data structures. However, any application that makes use of the HDF-EOS API (because of linking to the API) has 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, Vdata, and Vgroup. EOSView users see the underlying HDF structures and are prompted for which parts of the structure they wish to view. Landsat 0R product users 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 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 ftp://edhs1.gsfc.nasa.gov. Because this software was developed under a National Aeronautics and Space Administration (NASA) contract and was intended for use by EOS instrument teams and science investigators, access to download it is password-protected. To obtain the password, please send a message via e-mail to pgstlkit@eos.hitc.com.

5.3 ODL Parser

The University of Colorado's Laboratory for Atmospheric and Space Physics (LASP) originally implemented the ODL parser (Version 1.0) incorporated into the SDP Toolkit. The Jet Propulsion Laboratory (JPL) enhanced the ODL parser in building their Planetary Data System. IAS modified this enhanced version, available via anonymous FTP from ftp://miranda.colorado.edu (Internet Protocol (IP) address: 128.128.137.33). LPGS uses this IAS-modified version.

The IAS-modified version should be particularly useful to those operating in a non-HDF-EOS environment. The software stands alone and can be used to read the L0Rp or L1 metadata external elements and the CPF.

Appendix A Projection Parameters

This appendix contains the map projection parameters used in the L1 FAST L1G products (Table A-1) and the USGS Projection Parameters (Table A-2).

Project Name	Mnemonic
Alaska Conformal	AKC*
Albers Equal Area	AEA
Azimuthal	AZIM*
Equidistant Conic (Type A & B)	EQC*
Equirectangular	EQUI*
General Vertical Near Side Perspective	GVNP*
Gnomonic	GNOM*
Hammer	HAMM*
Interrupted Goodes Homolosine	IGH*
Interrupted Mollweide	IM*
Lambert Azimuthal Equal Area	LAEA*
Lambert Conformal Conic	LCC
Mercator	MERC*
Miller Cylindrical	MCYL*
Mollweide	MOLL*
Oblated Equal Area	OEA*
Oblique Mercator (Type A & B)	OM
Orthographic	ORTH*
Polar Stereographic	PS
Polyconic	PC
Robinson	ROBN*
Sinusoidal	SINU*
Space Oblique Mercator (Type A & B)	SOM
State Plane	STPL*
Stereographic	STRG*
Transverse Mercator (Gauss-Krueger)	TM
Universal Transverse Mercator	UTM
Van Der Grinten	VDGR*
Wagner IV	WIV*
Wagner VII	WVII*

Note: * = NLAPS Only

Table A-1. L1G Fast Projection Parameters

Projection Name Mnemonic	Array Element							
	1	2	3	4	5	6	7	8
AEA	SMajor	SMinor	Stdpr1	Stdpr2	CentMer	OriginLat	FE	FN
AKC	SMajor	SMinor					FE	FN
AZIM	Sphere				CentLon	CenterLat	FE	FN
EQCA	SMajor	SMinor	Stdpar		CentMer	OriginLat	FE	FN
EQCB	SMajor	SMinor	Stdpr1	Stdpr2	CentMer	OriginLat	FE	FN
EQUI	Sphere				CentMer	TrueScale	FE	FN
GNOM	Sphere				CentLon	CenterLat	FE	FN
GVNP	Sphere		Height		CentLon	CenterLat	FE	FN
HAMM	Sphere				CentMer		FE	FN
IGH	Sphere							
IM	Sphere							
LAEA	Sphere				CentLon	CenterLat	FE	FN
LCC	SMajor	SMinor	Stdpr1	Stdpr2	CentMer	OriginLat	FE	FN
MCYL	Sphere				CentMer		FE	FN
MERC	SMajor	SMinor			CentMer	TrueScale	FE	FN
MOLL	Sphere				CentMer		FE	FN
OEA	Sphere		Shape m	Shapen	CentLon	CenterLat	FE	FN
OMA	SMajor	SMinor	Factor			OriginLat	FE	FN
OMB	SMajor	SMinor	Factor	AziAng	AzmthPt	OriginLat	FE	FN
ORTH	Sphere				CentLon	CenterLat	FE	FN
PC	SMajor	SMinor			CentMer	OriginLat	FE	FN
PS	SMajor	SMinor			LongPol	TrueScale	FE	FN
ROBN	Sphere				CentMer		FE	FN
SINU	Sphere				CentMer		FE	FN
SOM	SMajor	SMinor	Satnu m	Path			FE	FN
STPL								
STRG	Sphere				CentLon	CenterLat	FE	FN
TM	SMajor	SMinor	Factor		CentMer	OriginLat	FE	FN
UTM	Lon/Z	Lat/Z						
VDGR	Sphere				CentMer	OriginLat	FE	FN
WIV	Sphere				CentMer		FE	FN
WVII	Sphere				CentMer		FE	FN

Table A-2. USGS Projection Parameters – Projection Transformation Package Projection Parameters (Elements 1-8)

Projection Name Mnemonic	Array Element						
	9	10	11	12	13	14	15
AEA							
AKC							
AZIM							
EQCA							
EQCB							
EQUI							
GNOM							
GVNP							
HAMM							
IGH							
IM							
LAEA							
LCC							
MCYL							
MERC							
MOLL							
OEA	Angle						
OMA	Long1	Lat1	Long2	Lat2			
OMB					one		
ORTH							
PC							
PS							
ROBN							
SINU							
SOM					one		
STPL							
STRG							
TM							
UTM							
VDGR							
WIV							
WVII							

Table A-3. USGS Projection Parameters - Projection Transformation Package Projection Parameters (Elements 9-15)

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 the 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 the ellipsoid.
	Sphere	=	Radius of the reference sphere. If zero, 6370997 meters is used.
	Stdpar	=	Latitude of the standard parallel
	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 the pole of the map
	TrueScale	=	Latitude of the true scale
	Factor	=	Scale factor at the central meridian (TM) or center of projection (OMA/OMB)
	CentLon	=	Longitude of the center of projection
	CenterLat	=	Latitude of the center of projection
	Height	=	Height of the perspective point
	Long1	=	Longitude of the first point on the center line
	Long2	=	Longitude of the second point on the center line
	Lat1	=	Latitude of the first point on the center line
	Lat2	=	Latitude of the second point on the center line
	AziAng	=	Azimuth angle east of north of the center line
	AzmthPt	=	Longitude of point on the central meridian where azimuth occurs
	Satnum	=	Landsat satellite number
	Path	=	Landsat path number (use WRS-1 for Landsat 1, 2, and 3; WRS-2 for Landsat 4, 5, 6, or 7)
	Shapem	=	Oval shape parameter m
	Shapen	=	Oval shape parameter n
	Angle	=	Oval rotation angle

Table A-4. USGS Projection Parameters Key

NOTE: 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.

References

Please see http://landsat.usgs.gov/tools_acronymns_ALL.php for a list of acronyms.

The following documents provide additional detail and reference information regarding the format of the L1 output files.

USGS/EROS. LS-DFCB-12. Landsat 5 L0Rp. DFCB. Version 4.0. May 2007.

USGS/EROS. LS-DFCB-19. National Land Archive Production System (NLAPS) Systematic Format Description Document. July 2000.

USGS/EROS. IAS-226. Landsat 5 Thematic Mapper (TM) Calibration Parameter File (CPF) Definition. Version 4.0. January 2008.

505-10-36. Earth Science Data and Information System (ESDIS) Project Mission Specific Requirements for the Landsat 7 Mission L1 Processing. November 1998.

GeoTIFF Specification. Revision 1.0. (http://www.remotesensing.org/geotiff/spec/geotiffhome.html).

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.

National Land Archive Production System (NLAPS) Systematic Format Description Document – U.S. Geological Survey Format Specifications for Geometrically Corrected Landsat L1 Digital Data Products. July 2000.