

Department of the Interior
U.S. Geological Survey

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

Version 8.0

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Executive Summary

This Data Format Control Book (DFCB) presents detailed data formats of the output files that the Image Assessment System (IAS), Level 1 Product Generation System (LPGS), and National Land Archive Production System (NLAPS) generate. These Level 1 (L1) processing systems produce L1 output files from Level 0 Reformatted (LOR) images in the Geographic Tagged Image File Format (GeoTIFF).

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

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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 format discussed includes Geographic Tagged Image File Format (GeoTIFF).

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

1.3 Intended Users

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

1.4 Definitions

Level 0 Reformatted Archive (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 (MTL)

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

L0Rp product — L0Rp digital image plus radiometric, calibration, spacecraft attitude, and ephemeris data, consisting of the following files in Hierarchical Data Format (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
- MSCD — Scan direction and error information subset to the product size ordered
- 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 1 Radiometric (Corrected) (L1R) digital image — Radiometrically corrected but not geometrically resampled

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

L1G product — L1 product distributed by the Level 1 Product Generation System (LPGS) that includes, for all bands, GeoTIFF formatted L1G images and associated data

Level 1 Systematic Terrain (Corrected) (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 on the resolution of the best available DEM

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 on the availability of Ground Control Points (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 (L0) Pre-Archive Processing

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

The Landsat Ground System (LGS) acquires TM wideband data directly from the Landsat TM spacecraft. The Landsat Archive Conversion System (LACS) 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 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 reformat 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 Zero Reformatted (OR) data 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 L1 Output Files

This section provides an overview of the L1 output files.

2.1 L1G / L1T Output Files Overview

The L1G digital image is radiometrically and geometrically corrected and is available in LPGS GeoTIFF and National Land Archive Production System (NLAPS) GeoTIFF format. The L1T product includes radiometric, geometric, and precision correction, and uses a DEM to correct parallax error due to local topographic relief.

The on-demand L1 products available for download at no charge are generated using a standard set of parameters. These are the only processing parameters available for the L1 output products through the external ordering interface(s). These products are output using the best available processing level for that particular scene (L1T or L1G). The processing parameters and output product details used for all standard products are as follows:

- Pixel Size 30 meter (m)
- Output Format GeoTIFF
- Resampling Method Cubic Convolution (CC)
- Map Projection Universal Transverse Mercator (UTM)
Polar Stereographic (PS) for Antarctica scenes
- Datum World Geodetic System 1984 (WGS84)
- Image Orientation Map (North Up (NUP))
- Distribution Hypertext Transfer Protocol (HTTP) Download

Table 2-1 and Table 2-2 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	L1T
L1 image file (for each requested band)	X	X
L1 Metadata file (text [.txt] file)	X	X
GCP file (text [.txt] file)		X
Three Band Verification Browse Image (JPEG [.JPG] file)		X
Geometric Verification Statistics file (text [.txt] file)		X

Table 2-1. LPGS GeoTIFF Product Components

Component	L1G	L1T
L1 image file (for each requested band)	X	X
Work order report file	X	X

Table 2-2. NLAPS GeoTiff Product Components

2.2 Naming Convention

The file-naming convention for the LPGS GeoTIFF product is as follows:

<LANDSAT_SCENE_ID>_BN.XXX, where LANDSAT_SCENE_ID is LMSPPRRRRYYYYDOYGSIVV, where:

L	=	Landsat
M	=	Mission: T = Landsat TM
S	=	Satellite 4 = Landsat 4 5 = Landsat 5
PPP	=	Three-digit starting path
RRR	=	Three-digit starting row
YYYY	=	Four-digit acquisition year
DOY	=	Three-digit acquisition day of the year
GSI	=	Ground Station Identifier
VV	=	Two-digit version
BN	=	Product Component: B1 = Band 1 B2 = Band 2 B3 = Band 3 B4 = Band 4 B5 = Band 5 B6 = Band 6 B7 = Band 7 GCP = GCP File VER = Verification File MTL = Metadata File
XXX	=	File type: = TIF file extension for all image data = JPG file extension for the verification browse = .txt file extension for GCP, VER, and L1 Metadata (MTL) files

Table 2-3. LPGS GeoTIFF Product Naming Convention

The file-naming convention for the NLAPS GeoTIFF product files is as follows:

LLNppprrrOOYYDDMM_AA.XXX, where:

LL	=	L = Landsat sensor (LT for TM data)
N	=	Satellite number 4 = Landsat 4 5 = Landsat 5
ppp	=	Starting path of the product
rrr	=	Starting row of the product
OO	=	WRS row offset (set to 00)
YY	=	Last two digits of the acquisition year
DDD	=	Julian date of acquisition
MM	=	Instrument mode: 50 = TM
AA	=	File Type B1 = Band 1 B2 = Band 2 B3 = Band 3 B4 = Band 4 B5 = Band 5 B6 = Band 6 B7 = Band 7 WO = Processing history file
XXX	=	File Extension: .tif = GeoTIFF file .txt = American Standard Code for Information Interchange (ASCII) text file

Table 2-4. NLAPS GeoTIFF Naming Convention

Section 3 L1 Output File Formats

This section describes the storage format for the data.

3.1 LPGS GeoTIFF File Formats

GeoTIFF defines a set of public domain Tagged Image File Format (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. An MTL 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.

3.1.1 L1 Image File

The description of an image in GeoTIFF requires tags and keys as described in the GeoTIFF Specification document (see References). The L1 image files include these tags and keys, which TIFF readers automatically detect and read. The following sections describe the tags and keys.

Each Earth image band in the requested product is contained in a separate file. These 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 a DEM to correct parallax error due to local topographic relief.

3.1.1.1 GeoTIFF Tags

TIFF tags convey metadata information about the image. The tags describe the image with information that 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, 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 following 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 is often 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 specifies 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 DEM 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.

3.1.1.2 GeoTIFF Keys

In addition to tags, the description of a projection in GeoTIFF requires using keys. Table 3-1 lists the keys necessary to define the projections supported by the L1 production systems and the possible values of the keys.

Valid Keys	Possible Values	Meaning
Universal Transverse Mercator (UTM)		
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixellsArea
	2	RasterPixellsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	European Petroleum Survey Group (EPSG) Projection System Codes
	32767	User-defined
Polar Stereographic (PS)		
ProjCoordTransGeoKey	15	CT_PolarStereographic
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixellsArea
	2	RasterPixellsPoint
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
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG / Petrotechnical Open Software Corporation (POSC) Projection Codes
	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

Table 3-1. GeoTIFF Keys

3.1.2 L1 Metadata File

The L1 MTL file is created during product generation and contains information specific to the product ordered. Table 3-2 lists the full contents of the L1 MTL file. This file contains all applicable image description information from the LORp Metadata file and the Landsat Processing System (LPS) metadata provided with the LORp product. The MTL file complies with LSDS-524 Landsat Metadata Description Document (LMDD) (see References).

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 MTL 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: "NNYYMMDDSSSS_UUUUU" format Where: NNYYMMDDSSSS = 13-digit Tracking, Routing, and Metrics (TRAM) order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = Five-digit TRAM unit number	Data producer-defined request number that uniquely identifies each product. USGS products use a unique product generation TRAM-generated request ID.
LANDSAT_SCENE_ID	21	= "LMSPPRRRYYYYDDDGSIVV" Where: L = Landsat M = Mission (T = TM)) S = Satellite (4 or 5) PPP = WRS path RRR = WRS row YYYY = Year of acquisition DDD = Day of acquisition year GSI = Ground Station Identifier VV = Version	Unique Landsat scene identifier. (Earth-imaging), orbital Path/Row.
FILE_DATE	20	= YYYY-MM-DDTHH:MI:SSZ Where: YYYY = Four-digit Julian year MM = Month number of the Julian year (01-12) DD = Day of the Julian month (01-31)F T = Start of time information in ODL ASCII time code format HH = Hours (00-23) MI = Minutes (00-59)	L1 system date and time when the Metadata file for the L1 product set was created.

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
		SS = Seconds (00-59) Z = Zulu time (same as Greenwich Mean Time (GMT))	
STATION_ID	3	= "NNN"	Ground Station that received the data.
PROCESSING_SOFTWARE_VERSION	20	= "SYSTEM_VERSION" Where: SYSTEM = LPGS, IAS VERSION = Version of software	Software name followed by version number(s) and separated by underscores. Example: LPGS_8.2.3
DATA_CATEGORY	11	= "NOMINAL" = "VALIDATION" = "EXCHANGE" = "TEST" = "ENGINEERING"	Current data category assigned to the data. Values: NOMINAL = Nominal data that exists within expected, acceptable limits. VALIDATION = Validation data obtained from an International Ground Station (IGS) in order to validate that the IGS data are of equivalent quality to those that the USGS maintains. EXCHANGE = Exchange data (between an IGS and the USGS) that require a quarantine period and have been successfully validated to be of equivalent quality to the corresponding USGS data. TEST = Test data. ENGINEERING = Engineering data that typically results from an inclination change to the spacecraft or Delta I Maneuver. Refer to LSDS-293 Landsat Data Management Policy.
END_GROUP	18	= METADATA_FILE_INFO	End of the MTL information group.
GROUP	16	= PRODUCT_METADATA	Beginning of the product metadata group.
DATA_TYPE	20	= "L1G" = "L1GT" = "L1T"	Identifier to inform the user of the data type.
DATA_TYPE_LORP	20	= "TMA_LORP"	Data type identifier string

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
		= "TMR_LORP"	used to create the LORp product.
ELEVATION_SOURCE	7	= "NED" = "SRTM1" = "SRTM3" = "GTOPO30" = "GLS2000"	Identifies the digital elevation data set used to terrain correct the product.
OUTPUT_FORMAT	10	= "GEOTIFF"	The output format.
EPOCH_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	= "LANDSAT_4" = "LANDSAT_5"	Name of the satellite platform.
SENSOR_ID	4	= "TM"	Name of the imaging sensor.
SENSOR_MODE	6	= "SAM" = "BUMPER"	Scan Angle Monitor (SAM) Mode and Bumper (BUMPER) Mode.
WRS_PATH	3	= NNN, where NNN = the path number (001-251)	WRS-defined nominal Landsat satellite track (path). (orbital)
WRS_ROW	3	= NNN, where NNN = the row of the first full or partial scene in the product (001-248)	WRS-defined nominal Landsat satellite row, based on the latitudinal center frame of a Landsat image. (orbital)
DATE_ACQUIRED	10	= YYYY-MM-DD	Date that this scene was imaged.
SCENE_CENTER_TIME	14	= "HH:MI:SS.SSSSSSZ" Where: HH = Hour (00-23) MI = Minutes SS.SSSSSS = Fractional seconds Z = Constant (indicates "Zulu" time (same as GMT))	Scene center time of the date the image was acquired.
CORNER_UL_LAT_PRODUCT	7	= -90.00000 through +90.00000 degrees. 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).
CORNER_UL_LON_PRODUCT	8	= -180.00000 through +180.00000 degrees. 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).
CORNER_UR_LAT_PRODUCT	7	= -90.00000 through +90.00000 degrees.	Latitude value for the upper-right corner of the

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			product (the L1 systems recalculate for the 1G product).
CORNER_UR_LON_PRODUCT	8	= -180.00000 through +180.00000 degrees.	Longitude value for the upper-right corner of the product (the L1 systems recalculate for the 1G product).
CORNER_LL_LAT_PRODUCT	7	= -90.00000 through +90.00000 degrees.	Latitude value for the lower-left corner of the product (the L1 systems recalculate for the 1G product).
CORNER_LL_LON_PRODUCT	8	= -180.00000 through +180.00000 degrees.	Longitude value for the lower-left corner of the product (the L1 systems recalculate for the 1G product).
CORNER_LR_LAT_PRODUCT	7	= -90.00000 through +90.00000 degrees.	Latitude value for the lower-right corner of the product (the L1 systems recalculate for the 1G product).
CORNER_LR_LON_PRODUCT	8	= -180.00000 through +180.00000 degrees.	Longitude value for the lower-right corner of the product (the L1 systems recalculate for the 1G product).
CORNER_UL_PROJECTION_X_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection X coordinate for the upper-left corner of the product (the L1 systems calculated, 1G only).
CORNER_UL_PROJECTION_Y_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection Y coordinate for the upper-left corner of the product (L1 systems calculated, 1G only).
CORNER_UR_PROJECTION_X_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection X coordinate for the upper-right corner of the product (L1 systems calculated, 1G only).
CORNER_UR_PROJECTION_Y_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection Y coordinate for the upper-right corner of the product (L1 systems calculated, 1G only).
CORNER_LL_PROJECTION_X_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection X coordinate for the lower-left corner of the product (L1 systems calculated, 1G only).
CORNER_LL_PROJECTION_Y_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection Y coordinate for the lower-left corner of the product (L1 systems calculated, 1G only).

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
_Y_PRODUCT		132000000.000 Units are feet or meters	for the lower-left corner of the product (L1 systems calculated, 1G only).
CORNER_LR_PROJECTION_X_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection X coordinate for the lower-right corner of the product (L1 systems calculated, 1G only).
CORNER_LR_PROJECTION_Y_PRODUCT	14	= -132000000.000 - 132000000.000 Units are feet or meters	Projection Y coordinate for the lower-right corner of the product (L1 systems calculated, 1G only).
REFLECTIVE_LINES	5	= NNNNN	Number of product lines for the reflective bands.
REFLECTIVE_SAMPLES	5	= NNNNN	Number of product samples for the reflective bands.
THERMAL_LINES	5	= NNNNN	Product lines for the thermal band.
THERMAL_SAMPLES	5	= NNNNN	Product samples for the thermal band.
FILE_NAME_BAND_1	256	"<LANDSAT_SCENE_ID>_B1.TIF"	L1-generated external element file name for Band 1.
FILE_NAME_BAND_2	256	"<LANDSAT_SCENE_ID>_B2.TIF"	L1-generated external element file name for Band 2.
FILE_NAME_BAND_3	256	"<LANDSAT_SCENE_ID>_B3.TIF"	L1-generated external element file name for Band 3.
FILE_NAME_BAND_4	256	"<LANDSAT_SCENE_ID>_B4.TIF"	L1-generated external element file name for Band 4.
FILE_NAME_BAND_5	256	"<LANDSAT_SCENE_ID>_B5.TIF"	L1-generated external element file name for Band 5.
FILE_NAME_BAND_6	256	"<LANDSAT_SCENE_ID>_B6.TIF"	L1-generated external element file name for Band 6.
FILE_NAME_BAND_7	256	"<LANDSAT_SCENE_ID>_B7.TIF"	L1-generated external element file name for Band 7.
GROUND_CONTROL_POINT_FILE_NAME	256	"<LANDSAT_SCENE_ID>_GCP.txt"	L1-generated external element file name for the GCP, if part of the product.
REPORT_VERIFY_FILE_NAME	256	"<LANDSAT_SCENE_ID>_VER.txt"	L1-generated external element file name where information from the scoring of geometric verification is located.
BROWSE_VERIFY_FILE_NAME	256	"<LANDSAT_SCENE_ID>_VER.jp"	L1-generated external

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
AME		g”	element file name for the Three Band Browse file (JPEG file), if part of the product.
METADATA_FILE_NAME	256	"<LANDSAT_SCENE_ID>_MTL.txt"	Name of the Metadata file.
CPF_NAME	256	LMCPFYYYYMMDD_YYYYMMD D.nn Where: L = Landsat M = Mission 4 = Landsat 4 5 = Landsat 5 YYYYMMDD = effective_date_begin and effective_date_end respectively nn = version (00-99)	Archive-generated external element file name for the IAS CPF.
END_GROUP	16	= PRODUCT_METADATA	End of the product metadata group.
GROUP	17	= IMAGE_ATTRIBUTES	Beginning of the image attributes group.
CLOUD_COVER	5	0.00-100.00, -1	Cloud coverage (percent) assigned to a WRS scene. Values: -1 = Cloud cover not calculated or assessed.
IMAGE_QUALITY	1	0-9, -1	Composite image quality for the bands. Values: 9 = Best. 0 = Worst. -1 = Image quality not calculated or assessed.
SUN_AZIMUTH	11	= -180.00000000 - 180.00000000 degrees. 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	10	= -90.00000000 - 90.00000000 degrees. A positive value indicates a daytime scene. A negative value (-) indicates a nighttime scene. Leading zeros are not required.	Sun elevation angle in degrees for the image center location at the image center acquisition time.
EARTH_SUN_DISTANCE		= N.NNNNNNN	Measurement (astronomical unit) of the

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			earth to sun distance at the particular day and time of imagery acquisition.
GROUND_CONTROL_POINTS_VERSION	3	= 0 - 999	GCP version used for processing.
GROUND_CONTROL_POINTS_MODEL	3	= 1 - 999	Number of GCPs used in the precision correction process.
GEOMETRIC_RMSE_MODEL	7	= 0.000 – 9999.999	Combined Root Mean Square Error (RMSE) of the geometric residuals (meters) in both across-track and along-track directions measured on the GCPs used in geometric precision correction.
GEOMETRIC_RMSE_MODEL_Y	7	= 0.000 – 9999.999	RMSE of the geometric residuals (meters) measured on the GCPs used in geometric precision correction.
GEOMETRIC_RMSE_MODEL_X	7	= 0.000 – 9999.999	RMSE of the geometric residuals (meters) measured on the GCPs used in geometric precision correction.
GROUND_CONTROL_POINTS_VERIFY	4	= 1 - 9999	Number of GCPs used in the verification of the terrain-corrected product.
GEOMETRIC_RMSE_VERIFY	7	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
GEOMETRIC_RMSE_VERIFY_Y_QUAD_UL	7	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the upper-left quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
GEOMETRIC_RMSE_VERIFY_Y_QUAD_UR	7	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the upper-right quadrant in both line and sample directions measured on the terrain-corrected product independently

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			using GLS2000.
GEOMETRIC_RMSE_VERIF Y_QUAD_LL	7	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the lower-left quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
GEOMETRIC_RMSE_VERIF Y_QUAD_LR	7	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the lower-right quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
END_GROUP	17	= IMAGE_ATTRIBUTES	End of the image attributes group.
GROUP	16	= MIN_MAX_RADIANCE	Beginning of the minimum / maximum radiance group (1G product only).
RADIANCE_MAXIMUM_BAND_1	6	= 0.000 – 999.999	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 QUANTIZE_CAL_MAX_BAND_1.
RADIANCE_MINIMUM_BAND_1	6	= -999.999 through +999.999	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 QUANTIZE_CAL_MAX_BAND_1.
RADIANCE_MAXIMUM_BAND_2	6	= 0.000 – 999.999	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 QUANTIZE_CAL_MAX_BAND_2.
RADIANCE_MINIMUM_BAND_2	6	= -999.999 through +999.999	Minimum achievable spectral radiance value for Band 2, if part of the

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			product (w/(m ² sr micron)). In addition, the spectral radiance corresponding to QUANTIZE_CAL_MAX_BAND_2.
RADIANCE_MAXIMUM_BAND_3	6	= 0.000 – 999.999	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 QUANTIZE_CAL_MAX_BAND_3.
RADIANCE_MINIMUM_BAND_3	6	= -999.999 through +999.999	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 QUANTIZE_CAL_MAX_BAND_3.
RADIANCE_MAXIMUM_BAND_4	6	= 0.000 – 999.999	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 QUANTIZE_CAL_MAX_BAND_4.
RADIANCE_MINIMUM_BAND_4	6	= -999.999 through +999.999	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 QUANTIZE_CAL_MAX_BAND_4.
RADIANCE_MAXIMUM_BAND_5	6	= 0.000 – 999.999	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 QUANTIZE_CAL_MAX_BAND_5.
RADIANCE_MINIMUM_BAND_5	6	= -999.999 through +999.999	Minimum achievable spectral radiance value

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			for Band 5, if part of the product (w/(m ² sr micron)). In addition, the spectral radiance corresponding to QUANTIZE_CAL_MAX_BAND_5.
RADIANCE_MAXIMUM_BAND_6	6	= 0.000 – 999.999	Maximum achievable spectral radiance value for Band 6, if part of the product (w/(m ² sr micron)). In addition, the spectral radiance corresponding to QUANTIZE_CAL_MAX_BAND_6.
RADIANCE_MINIMUM_BAND_6	6	= -999.999 through +999.999	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 QUANTIZE_CAL_MAX_BAND_6.
RADIANCE_MAXIMUM_BAND_7	6	= 0.000 – 999.999	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 QUANTIZE_CAL_MAX_BAND_7.
RADIANCE_MINIMUM_BAND_7	6	= -999.999 through +999.999	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 QUANTIZE_CAL_MAX_BAND_7.
END_GROUP	16	= MIN_MAX_RADIANCE	End of the minimum / maximum radiance group.
GROUP	16	= MIN_MAX_REFLECTANCE	Beginning of the minimum / maximum reflectance group.
REFLECTANCE_MAXIMUM_BAND_1	8	= 0.000000-1.000000	Maximum achievable reflectance value for Band 1.
REFLECTANCE_MINIMUM_	9	= -1.000000-1.000000	Minimum achievable

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
BAND_1			reflectance value for Band 1.
REFLECTANCE_MAXIMUM_BAND_2	8	= 0.000000-1.000000	Maximum achievable reflectance value for Band 2.
REFLECTANCE_MINIMUM_BAND_2	9	= -1.000000-1.000000	Minimum achievable reflectance value for Band 2.
REFLECTANCE_MAXIMUM_BAND_3	8	= 0.000000-1.000000	Maximum achievable reflectance value for Band 3.
REFLECTANCE_MINIMUM_BAND_3	9	= -1.000000-1.000000	Minimum achievable reflectance value for Band 3.
REFLECTANCE_MAXIMUM_BAND_4	8	= 0.000000-1.000000	Maximum achievable reflectance value for Band 4.
REFLECTANCE_MINIMUM_BAND_4	9	= -1.000000-1.000000	Minimum achievable reflectance value for Band 4.
REFLECTANCE_MAXIMUM_BAND_5	8	= 0.000000-1.000000	Maximum achievable reflectance value for Band 5.
REFLECTANCE_MINIMUM_BAND_5	9	= -1.000000-1.000000	Minimum achievable reflectance value for Band 5.
REFLECTANCE_MAXIMUM_BAND_7	8	= 0.000000-1.000000	Maximum achievable reflectance value for Band 7.
REFLECTANCE_MINIMUM_BAND_7	9	= -1.000000-1.000000	Minimum achievable reflectance value for Band 7.
END_GROUP	16	= MIN_MAX_REFLECTANCE	End of the minimum / maximum reflectance group.
GROUP	19	= MIN_MAX_PIXEL_VALUE	Beginning of the minimum / maximum pixel value group (1G product only).
QUANTIZE_CAL_MAX_BAND_1	3	= 0 – 255	Maximum possible pixel value for Band 1, if part of the product (Digital Number (DN)).
QUANTIZE_CAL_MIN_BAND_1	1	= 0 – 1	Minimum possible pixel value for Band 1, if part of the product (DN).
QUANTIZE_CAL_MAX_BAND_2	3	= 0 – 255	Maximum possible pixel value for Band 2, if part of the product (DN).
QUANTIZE_CAL_MIN_BAND_2	1	= 0 – 1	Minimum possible pixel value for Band 2, if part of the product (DN).
QUANTIZE_CAL_MAX_BAND	3	= 0 – 255	Maximum possible pixel

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
D_3			value for Band 3, if part of the product (DN).
QUANTIZE_CAL_MIN_BAND_3	1	= 0 – 1	Minimum possible pixel value for Band 3, if part of the product (DN).
QUANTIZE_CAL_MAX_BAND_4	3	= 0 – 255	Maximum possible pixel value for Band 4, if part of the product (DN).
QUANTIZE_CAL_MIN_BAND_4	1	= 0 – 1	Minimum possible pixel value for Band 4, if part of the product (DN).
QUANTIZE_CAL_MAX_BAND_5	3	= 0 – 255	Maximum possible pixel value for Band 5, if part of the product (DN).
QUANTIZE_CAL_MIN_BAND_5	1	= 0 – 1	Minimum possible pixel value for Band 5, if part of the product (DN).
QUANTIZE_CAL_MAX_BAND_6	3	= 0 – 255	Maximum possible pixel value for Band 6, if part of the product (DN).
QUANTIZE_CAL_MIN_BAND_6	1	= 0 – 1	Minimum possible pixel value for Band 6, if part of the product (DN).
QUANTIZE_CAL_MAX_BAND_7	3	= 0 – 255	Maximum possible pixel value for Band 7, if part of the product (DN).
QUANTIZE_CAL_MIN_BAND_7	1	= 0 – 1	Minimum possible pixel value for Band 7, if part of the product (DN).
END_GROUP	19	= MIN_MAX_PIXEL_VALUE	End of the minimum / maximum pixel value group.
GROUP	18	= PRODUCT_PARAMETERS	Beginning of the product parameters group (both 1R and 1G products).
CORRECTION_GAIN_BAND_1	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Gain correction method used by L1 in creating the image for Band 1, if part of the product.
CORRECTION_GAIN_BAND_2	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Gain correction method used by L1 in creating the image for Band 2, if part of the product.
CORRECTION_GAIN_BAND_3	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Gain correction method used by L1 in creating the image for Band 3, if part of the product.
CORRECTION_GAIN_BAND_4	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Gain correction method used by L1 in creating the image for Band 4, if part of the product.
CORRECTION_GAIN_BAND_5	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION"	Gain correction method used by L1 in creating

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
		(for IC gains)	the image for Band 5, if part of the product
CORRECTION_GAIN_BAND_6	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Gain correction method used by L1 in creating the image for Band 6, if part of the product.
CORRECTION_GAIN_BAND_7	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Gain correction method used by L1 in creating the image for Band 7, if part of the product.
CORRECTION_BIAS_BAND_1	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 1, if part of the product.
CORRECTION_BIAS_BAND_2	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 2, if part of the product.
CORRECTION_BIAS_BAND_3	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 3, if part of the product
CORRECTION_BIAS_BAND_4	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 4, if part of the product.
CORRECTION_BIAS_BAND_5	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 5, if part of the product.
CORRECTION_BIAS_BAND_6	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 6, if part of the product.
CORRECTION_BIAS_BAND_7	20	= "CPF" (for CPF gains) = "INTERNAL_CALIBRATION" (for IC gains)	Bias correction method used by L1 in creating the image for Band 7, if part of the product.
END_GROUP	18	= PRODUCT_PARAMETERS	End of the product parameters group.
GROUP	21	= RADIOMETRIC_RESCALING	Beginning of the radiometric rescaling parameters group.
RADIANCE_MULT_BAND_1	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band 1 (w/(m ² sr micron) / DN).
RADIANCE_MULT_BAND_2	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			2 (w/(m ² sr micron) / DN)
RADIANCE_MULT_BAND_3	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band 3 (w/(m ² sr micron) / DN).
RADIANCE_MULT_BAND_4	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band 4 (w/(m ² sr micron) / DN).
RADIANCE_MULT_BAND_5	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band 5 (w/(m ² sr micron) / DN).
RADIANCE_MULT_BAND_6	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band 6 (w/(m ² sr micron) / DN).
RADIANCE_MULT_BAND_7	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to radiance units for Band 7 (w/(m ² sr micron) / DN).
RADIANCE_ADD_BAND_1	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 1.
RADIANCE_ADD_BAND_2	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 2.
RADIANCE_ADD_BAND_3	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 3.
RADIANCE_ADD_BAND_4	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 4.
RADIANCE_ADD_BAND_5	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 5.
RADIANCE_ADD_BAND_6	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 6.
RADIANCE_ADD_BAND_7	7	-9999.99999 through +9999.99999	Additive rescaling factor used to convert calibrated digital numbers to radiance units (W/(m ² sr um)) for Band 7.
REFLECTANCE_MULT_BAND_1	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to reflectance for Band 1 (DN ⁻¹).
REFLECTANCE_MULT_BAND_2	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to reflectance for Band 2 (DN ⁻¹).
REFLECTANCE_MULT_BAND_3	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to reflectance for Band 3 (DN ⁻¹).
REFLECTANCE_MULT_BAND_4	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to reflectance for Band 4 (DN ⁻¹).
REFLECTANCE_MULT_BAND_5	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to reflectance for Band 5 (DN ⁻¹).
REFLECTANCE_MULT_BAND_7	9	= N.NNNNENN	Multiplicative rescaling factor used to convert calibrated digital numbers to reflectance for Band 7 (DN ⁻¹).
REFLECTANCE_ADD_BAND_1	9	-9.999999 through +9.999999	Additive rescaling factor used to convert calibrated digital numbers to reflectance for Band 1.
REFLECTANCE_ADD_BAND_2	9	-9.999999 through +9.999999	Additive rescaling factor used to convert calibrated digital numbers to reflectance for Band 2.
REFLECTANCE_ADD_BAND_3	9	-9.999999 through +9.999999	Additive rescaling factor used to convert

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			calibrated digital numbers to reflectance for Band 3.
REFLECTANCE_ADD_BAND_4	9	-9.999999 through +9.999999	Additive rescaling factor used to convert calibrated digital numbers to reflectance for Band 4.
REFLECTANCE_ADD_BAND_5	9	-9.999999 through +9.999999	Additive rescaling factor used to convert calibrated digital numbers to reflectance for Band 5.
REFLECTANCE_ADD_BAND_7	9	-9.999999 through +9.999999	Additive rescaling factor used to convert calibrated digital numbers to reflectance for Band 7.
END_GROUP	21	= RADIOMETRIC_RESCALING	End of the radiometric rescaling parameters group.
GROUP		= THERMAL_CONSTANTS	Beginning of thermal constants group.
K1_CONSTANT_BAND_6	7	NNNN.NN	Calibration constant for Band 6 radiance to temperature conversion.
K2_CONSTANT_BAND_6	7	NNNN.NN	Calibration constant for Band 6 radiance to temperature conversion.
END_GROUP	17	= THERMAL_CONSTANTS	End of thermal constants group.
GROUP	21	= PROJECTION_PARAMETERS	Beginning of the projection parameters group (1G product only).
MAP_PROJECTION	4	= "PS" (Polar Stereographic) = "UTM" (Universal Transverse Mercator)	Map projection used in creating the image.
DATUM	5	= "WGS84"	Datum used in creating the image.
ELLIPSOID	5	= "WGS84"	Ellipsoid used in creating the image.
UTM_ZONE	2	= 1-60	UTM zone number in a map projection. A negative zone indicates that the false northing needs to be applied to the northing coordinate and a positive zone indicates that the false northing has been applied.
VERTICAL_LON_FROM_POLE	8	= -180.00000 through +180.00000	Vertical longitude (decimal degrees) from the pole.
TRUE_SCALE_LAT	7	= -90.00000 through +90.00000	Latitude of true scale in a

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description / Remarks
			map projection.
FALSE_EASTING	9	= -200000000 through +200000000	Value added to all "x" values in the rectangular coordinates for a map projection. Frequently assigned to eliminate negative numbers. Expressed in the unit of measure identified in the Planar Coordinate Unit.
FALSE_NORTHING	9	= -200000000 through +200000000	Value added to all "y" values in the rectangular coordinates for a map projection. Frequently assigned to eliminate negative numbers. Expressed in the unit of measure identified in the Planar Coordinate Unit.
GRID_CELL_SIZE_REFLECTIVE	5	= 0.00 - 120.00 meters, in increments of 0.01 meters 25.00 – 60.00 (IAS / LPGS)	Grid cell size used in creating the image for the reflective band.
GRID_CELL_SIZE_THERMAL	5	= 0.00 - 120.00 meters, in increments of 0.01 meters 25.00 – 60.00 (IAS / LPGS)	Grid cell size used in creating the image for the thermal band, if part of the product
ORIENTATION	10	= "NORTH_UP"	Orientation used in creating the image.
RESAMPLING_OPTION	28	= "CUBIC_CONVOLUTION"	Resampling option used in creating the image.
MAP_PROJECTION_L0RA	3	= "PS" (Polar Stereographic) = "UTM" (Universal Transverse Mercator) = "HOM" (Hotine Oblique Mercator) = "SOM" (Space Oblique Mercator) = "NA" (Not applicable)	L0Ra map projection selectively applied to High Density Tapes (HDTs) based on geographic location. Used for processed archive data.
END_GROUP	21	= PROJECTION_PARAMETERS	End of projection parameters group.
END_GROUP	148	L1_METADATA_FILE	End of the L1 Metadata file level group.
END			Required standalone parameter signifying the file end.

Table 3-2. L1 Metadata File

3.1.3 GCPs File

The GCP file included with an L1T product 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 Table 3-3.


```

Example GCP Output File
-----
Sat. Mar. 1, 2014          LANDSAT 5          Time: 04:27
                          Image Assessment System
                          GCP Residual Report
-----
WOID: L10217747          Path/Row: 025 / 029

LOR Reference Image: L51EDC1011320160100_HDF.140601021
Acquisition Date: Nov 16, 2011

Band Number: 5

GLS date for each WRS-2 path/row used:
Path Row Date
025 029 2001-08-08

Point_ID      Latitude Longitude Height Across Along Residual Residual
              (deg)      (deg)      (meters) Residual Scan Scan In y in x
              (deg)      (deg)      (meters) (meters) (meters) (meters) (meters)
0250290001_01 44.255715 -90.497797 272.000 -5.994 2.685 -6.359 1.636
0250290002_01 44.788274 -89.718681 318.000 -4.054 2.217 -4.371 1.504
0250290003_01 44.209159 -90.315026 270.868 -4.448 -0.402 -4.317 -1.146
0250290004_01 44.029828 -90.469141 259.313 -9.172 3.864 -9.690 2.259
0250290005_01 43.897801 -90.957349 195.000 1.044 4.474 0.273 4.585
0250290006_01 44.210944 -90.874078 190.266 -8.718 3.875 -9.242 2.349
0250290007_01 44.951069 -90.568913 347.500 0.207 2.509 -0.216 2.507
0250290009_01 44.341408 -90.563776 260.681 1.467 1.874 1.130 2.093
0250290010_01 44.333481 -90.376712 281.670 8.068 0.926 7.794 2.272
0250290011_01 45.058694 -89.693709 392.753 8.764 -0.402 8.703 1.071

```

Table 3-3 Example GCP Output File

3.1.4 Verify File

The Geometric Verification Statistics file included with an L1T product is written in ASCII format and contains a header followed by records, one on each line. Each record has seven column headings and looks similar to Table 3-4. **Error! Reference source not found.** Each record corresponds to a single GCP marked with a colored dot in the Three Band Verification Browse Image. The contents of the Verify File look similar to Table 3-4.

```

Example Verify Output File
=====
Mon. Nov. 19 2012                LANDSAT                Time: 14:19
                                Image Assessment System
                                GEOMETRIC VERIFY Report
=====
Order ID: 0101211162488_00863    Path / Row - 30 / 36
Reference Image: L51PAC1006293170100_HDF.L1G

Color mapping per rank
-----
Rank 1 is Green: total residual <= 0.5
Rank 2 is Cyan: 0.5 < total residual <= 1
Rank 3 is Blue: 1 < total residual <= 2
Rank 4 is Yellow: 2 < total residual <= 3
Rank 5 is Red: 3 < total residual

Percentage of residuals by rank
-----
Rank 1 -- 90.9%
Rank 2 -- 9.1%
Rank 3 -- 0.0%
Rank 4 -- 0.0%
Rank 5 -- 0.0%

      GCP      Latitude      Longitude      Sample      Line      Total      Rank
      ID              (Degree)      (Degree)      Residual      Residual      Residual
                                     (Pixel)      (Pixel)      (Pixel)
-----
0300360093    35.52519    -102.08660    -0.16         0.02         0.16         1
0300360094    35.52608    -102.05157     0.03        -0.13         0.13         1
0300360095    35.52696    -102.01655     0.22         0.04         0.22         1
0300360096    35.52783    -101.98152    -0.01        -0.20         0.20         1
0300360168    35.49926    -102.08560     0.03         0.10         0.11         1
0300360169    35.50015    -102.05059    -0.24        -0.03         0.25         1
0300360170    35.50103    -102.01558    -0.19         0.01         0.19         1
0300360171    35.50190    -101.98056     0.01        -0.11         0.11         1
0300360172    35.50276    -101.94554    -0.46        -0.01         0.46         1
0300360174    35.50445    -101.87551    -0.02        -0.10         0.10         1
0300360175    35.50528    -101.84048    -0.07        -0.28         0.29         1
0300360176    35.50610    -101.80546     0.28        -0.36         0.45         1
0300360242    35.47243    -102.11961     0.08        -0.19         0.20         1
0300360245    35.47510    -102.01461     0.01         0.01         0.01         1
0300360246    35.47597    -101.97960    -0.10        -0.08         0.13         1
0300360247    35.47683    -101.94460    -0.04        -0.09         0.10         1
0300360248    35.47768    -101.90959     0.02        -0.01         0.02         1
0300360249    35.47852    -101.87458    -0.13         0.08         0.15         1
0300360250    35.47935    -101.83957     0.11        -0.18         0.21         1
0300360251    35.48017    -101.80456     0.24        -0.33         0.41         1

```

Table 3-4. Example Verify File

3.2 NLAPS GeoTIFF File Formats

3.2.1 NLAPS Work Order Report File

The work order report file provides a record of the work executed into a TRAM 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 a TRAM 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 the following:
 - 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 CORRECTION PROCESSING REPORT

NLAPS Version: 4_13_0e22
Work Order: 080090929013100001 Priority: 9
Satellite: Landsat-5 Sensor: TM
Camera Number: N/A Sensor Mode: N/A

Input Data Ident: /san/stk1/nlaps/diskIngest/080090929013100001
Input Media Type: Disk File Number: N/A
Orbit Number: 2399

Processing Level: Precision Geocorrection Resampling: CC
Map Projection: UTM Zone: 38
Earth Ellipsoid: WGS84 Panel Effect: FALSE
Product Orient.: Map North Pixel Origin: Center

Projection Params:
6.378137000000000e+06 6.356752314250000e+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

0.0000000000000000e+00 0.0000000000000000e+00 0.0000000000000000e+00
Line Spacing: 030.0 Pixel Spacing: 030.0

Path/Strip no.: 166 Start Row no.: 043.0
End Row no.: N/A

Image Lines: 6882 Image Pixels: 7418
Image Orientation: 0.00 deg from N Output Bands: 1234567
Viewing Angle: 0.01 deg Ephemeris Type: PREDICTIVE

Scene center lat: 24.564 deg Scene center long: 45.780 deg
Sun Elevation: 58.29 deg Sun Azimuth: 102.03 deg
Scene center date: 1984 08 13 Scene center time: 06:53:21.6681

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

Completion date: 2009 09 29 Completion time: 16:36:13

Termination Status: Successful Completion

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DETAILED PROCESSING RESULTS

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MODEL REFINEMENT STATISTICS

Number of CPs in model: 25

Error	Mean (m)	RMS (m)	Std Dev (m)
Along Track	0.02	11.19	11.19
Across Track	-0.01	10.34	10.34
Height	0.00	0.82	0.82
Combined	0.02	15.26	15.26

Location			Residuals						
Num	Mark	Kind	Lat	Long	Height	Along	Across	Height	Comb
4189268	Auto	RCP	24.59	45.74	705.53	-0.34	10.49	-0.07	10.50

1423826	Auto	RCP	23.67	46.46	886.57	-1.01	-8.01	-1.13	8.15
4189103	Auto	RCP	25.34	45.10	797.72	-3.06	5.13	-0.69	6.02
4189410	Auto	RCP	23.99	44.79	991.95	-13.41	-2.43	0.33	13.64
4189392	Auto	RCP	23.81	45.63	677.59	-8.57	-20.20	-0.09	21.95
1423312	Auto	RCP	25.19	46.84	680.89	-1.84	-2.91	-0.41	3.46
1423502	Auto	RCP	25.34	45.98	684.34	-13.52	-11.55	-0.03	17.78
1451381	Auto	RCP	24.70	44.97	769.55	9.94	-18.94	2.47	21.53
4176051	Auto	RCP	24.87	46.27	769.07	-14.30	7.95	0.51	16.36
1400328	Auto	RCP	24.30	46.59	761.47	3.14	3.50	0.48	4.73
4176184	Auto	RCP	24.10	46.04	694.36	-1.06	8.80	0.52	8.88
1423410	Auto	RCP	25.10	45.53	713.23	19.01	4.00	-0.25	19.43
1423555	Auto	RCP	24.71	46.73	607.43	17.02	1.65	0.22	17.10
1423590	Auto	RCP	24.49	46.15	658.05	2.71	2.94	0.18	4.00
4175985	Auto	RCP	25.26	46.39	631.22	-6.19	4.75	0.33	7.81
4176279	Auto	RCP	23.74	46.01	680.10	-5.01	8.38	0.56	9.78
1423575	Auto	RCP	24.92	45.87	710.20	-0.55	-14.47	-0.00	14.48
4189232	Auto	RCP	24.78	45.41	734.25	-9.95	-1.95	0.13	10.14
1451616	Auto	RCP	24.37	44.95	863.17	26.92	-3.16	0.39	27.11
4189331	Auto	RCP	24.20	45.40	728.08	-4.58	12.70	-0.57	13.52
4189378	Auto	RCP	23.91	45.18	907.50	-16.25	-0.91	0.07	16.28
1423481	Auto	RCP	23.99	46.37	981.38	12.81	-7.49	-0.86	14.86
1451185	Auto	RCP	25.42	45.50	798.83	-12.21	-13.84	1.06	18.48
4189281	Auto	RCP	24.49	45.29	731.81	12.60	21.19	-1.56	24.70
1451631	Auto	RCP	25.03	45.20	743.37	8.13	14.17	-1.53	16.41

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RADIOMETRIC CORRECTION

Algorithm: NASA CPF

Band	Ref Detector	DN to Radiance gain	offset	Default Abs Calib?	Average Gain Coeff.
1	15	0.668706	-1.520000	FALSE	1.483000
2	10	1.317020	-2.840000	FALSE	0.749900
3	2	1.039880	-1.170000	FALSE	0.978900
4	1	0.872588	-1.510000	FALSE	1.082000
5	2	0.119882	-0.370000	FALSE	8.159400
6	4	0.055158	1.237800	TRUE	0.000000
7	15	0.065294	-0.150000	FALSE	14.286600

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

Detector	Forward	Backward

	gain	offset	gain	offset
1	0.997041	-0.166788	1.003230	-1.037930
2	0.988642	0.538642	0.995202	-0.390149
3	0.983499	0.330880	0.988125	-0.305380
4	0.987967	0.677995	0.993673	-0.122499
5	0.990780	0.240924	0.993809	-0.171892
6	0.990719	0.414497	0.995247	-0.229455
7	0.992247	-0.181324	0.993827	-0.353781
8	0.981735	0.731380	0.984617	0.334618
9	0.985237	-0.334397	0.987997	-0.658971
10	0.984981	-1.235080	0.990308	-1.976320
11	0.984596	-0.383532	0.987562	-0.726588
12	0.992761	0.717494	0.997104	0.125648
13	0.991139	-0.657031	0.993839	-0.953968
14	0.996901	-2.116440	1.003100	-2.985210
15	0.987522	0.926554	0.991111	0.476986
16	0.996478	0.946786	1.003110	0.069706

Band 2 Coefficients ($Q_{cal} = (Q - \text{offset}) / \text{gain}$):

Detector	Forward	gain	Backward	offset
	gain	offset	gain	offset
1	0.966013	0.377819	0.987318	-1.577750
2	0.980474	0.466963	1.001530	-1.471860
3	0.968650	0.700510	0.986705	-0.968165
4	0.977171	0.317679	0.996087	-1.412030
5	0.979910	0.718208	0.997600	-0.903251
6	0.980578	0.539450	0.997470	-1.044890
7	0.980245	0.223949	0.996653	-1.275950
8	0.970621	0.364279	0.986127	-1.055330
9	0.991267	0.340162	1.006110	-1.050270
10	0.973679	0.305075	0.992323	-1.409610
11	0.988969	0.271510	1.005370	-1.249250
12	0.978690	0.111136	0.998131	-1.672310
13	0.987854	0.161662	1.005000	-1.410820
14	0.970990	0.854750	0.988872	-0.786657
15	0.979906	0.762195	0.999874	-1.060350
16	0.981591	0.915111	1.002490	-0.982883

Band 3 Coefficients ($Q_{cal} = (Q - \text{offset}) / \text{gain}$):

Detector	Forward	gain	Backward	offset
	gain	offset	gain	offset
1	1.019530	2.095860	1.039960	-0.594715

2		1.010140	1.949250	1.030050	-0.665955
3		1.010860	2.068940	1.029930	-0.453051
4		1.000890	2.152700	1.021180	-0.516327
5		1.013110	2.174130	1.033600	-0.542781
6		0.996306	2.205400	1.016790	-0.479851
7		1.009170	2.007650	1.029050	-0.571014
8		0.998093	1.889610	1.013790	-0.130237
9		1.009700	1.775900	1.027050	-0.546126
10		0.992648	2.030260	1.015660	-0.950857
11		0.998625	1.996620	1.020250	-0.837371
12		1.009710	1.827370	1.031250	-0.944115
13		1.017610	1.502160	1.039320	-1.340770
14		1.007350	1.824820	1.027740	-0.836445
15		1.020860	2.464360	1.044640	-0.645331
16		1.008860	2.570880	1.030390	-0.239438

Band 4 Coefficients ($Q_{cal} = (Q - \text{offset}) / \text{gain}$):

Detector		Forward		Backward	
		gain	offset	gain	offset

1		0.936945	1.550240	0.962337	-1.769380
2		0.924132	2.502810	0.951880	-1.123520
3		0.934846	1.991510	0.957351	-0.942778
4		0.931765	1.386180	0.949665	-0.952484
5		0.934413	1.311990	0.952206	-1.014550
6		0.932654	1.712240	0.953976	-1.070680
7		0.944152	1.260210	0.960027	-0.828482
8		0.922964	1.725490	0.943192	-0.883521
9		0.940736	1.728650	0.962629	-1.115520
10		0.932836	2.269000	0.951543	-0.176606
11		0.934108	1.539600	0.953752	-1.012040
12		0.930562	1.784310	0.952179	-1.001080
13		0.928130	1.049210	0.948346	-1.551040
14		0.929305	1.943850	0.954050	-1.273410
15		0.936383	1.532780	0.957961	-1.222890
16		0.939977	2.194590	0.967493	-1.345340

Band 5 Coefficients ($Q_{cal} = (Q - \text{offset}) / \text{gain}$):

Detector		Forward		Backward	
		gain	offset	gain	offset

1		0.984037	-0.279681	0.984485	-0.671829
2		0.985020	-0.795233	0.988606	-1.839910
3		0.978297	-0.510279	0.978121	-0.778441
4		0.983327	-0.874138	0.985901	-1.767180

5		0.978325	-0.402108	0.979210	-0.894588
6		0.976417	-0.579295	0.980556	-1.753710
7		0.980722	0.008572	0.982216	-0.520399
8		0.974564	0.092205	0.980379	-1.398960
9		0.993732	0.709737	0.998224	-0.533127
10		0.957363	0.094792	0.961091	-1.034390
11		0.965758	0.091964	0.968889	-0.884978
12		0.982942	-0.053410	0.990849	-2.085110
13		0.955806	0.518955	0.959030	-0.496924
14		0.974732	-0.176792	0.982496	-2.241240
15		0.969873	-0.248904	0.972263	-1.193500
16		0.979748	-0.112306	0.988400	-2.314080

Band 6 Coefficients ($Q_{cal} = (Q - \text{offset}) / \text{gain}$):

Detector		Forward		Backward	
		gain	offset	gain	offset

1		0.998992	0.256184	0.998992	0.256184
2		0.996739	0.632445	0.996739	0.632445
3		1.010460	-2.029880	1.010460	-2.029880
4		0.993806	1.145260	0.993806	1.145260

Band 7 Coefficients ($Q_{cal} = (Q - \text{offset}) / \text{gain}$):

Detector		Forward		Backward	
		gain	offset	gain	offset

1		0.933641	0.528931	0.938408	-0.221642
2		0.935909	0.049220	0.939324	-0.502637
3		0.927093	0.337670	0.930785	-0.272783
4		0.927238	0.514392	0.931516	-0.185765
5		0.926957	0.386971	0.931432	-0.348479
6		0.941456	0.295493	0.945620	-0.383702
7		0.920703	0.590684	0.924509	-0.032749
8		0.936790	0.371118	0.941993	-0.461006
9		0.924102	0.639311	0.929504	-0.235144
10		0.929947	0.308505	0.935604	-0.590204
11		0.916035	0.594275	0.921585	-0.295131
12		0.939992	0.947434	0.946348	-0.066852
13		0.934142	0.493432	0.940311	-0.505802
14		0.932896	0.831315	0.939841	-0.277913
15		0.922025	0.702901	0.929388	-0.464046
16		0.934385	0.833005	0.941113	-0.235215

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DEM PROCESSING

Elevation Correction Applied: Fine DEM
 LineSpacing: 3.000000000000000e+00
 LineSpacingUnits: seconds
 PixelSpacing: 3.000000000000000e+00
 PixelSpacingUnits: seconds

DEM Files Used

n23e044
 n23e045
 n23e046
 n24e044
 n24e045
 n24e046
 n25e044
 n25e045
 n25e046

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RADIOMETRIC QUALITY ASSESSMENT

NOTE:
 Mean, Std.Dev, Striping are in DN's (Digital Numbers).

Band	Chip Location Line Pixel	Chip Size Lines Pixels	Mean	Std Dev	Striping
1	1197.60 1268.00	128 128	1.53	0.014	0.0034
1	2394.20 2535.00	128 128	1.33	0.043	0.0032
1	3590.80 3802.00	128 128	1.43	0.026	0.0036
1	4787.40 5069.00	128 128	1.56	0.014	0.0044
2	1197.60 1268.00	128 128	0.92	0.021	0.0018
2	2394.20 2535.00	128 128	0.88	0.012	0.0012
2	3590.80 3802.00	128 128	0.89	0.021	0.0008
2	4787.40 5069.00	128 128	0.95	0.011	0.0013
3	1197.60 1268.00	128 128	1.29	0.025	0.0024
3	2394.20 2535.00	128 128	1.41	0.020	0.0011
3	3590.80 3802.00	128 128	1.35	0.067	0.0021

3	4787.40	5069.00	128	128	1.31	0.030	0.0012
4	1197.60	1268.00	128	128	1.26	0.023	0.0022
4	2394.20	2535.00	128	128	1.41	0.027	0.0017
4	3590.80	3802.00	128	128	1.36	0.065	0.0014
4	4787.40	5069.00	128	128	1.33	0.052	0.0022
5	1197.60	1268.00	128	128	2.54	0.066	0.0068
5	2394.20	2535.00	128	128	2.61	0.024	0.0089
5	3590.80	3802.00	128	128	2.59	0.039	0.0072
5	4787.40	5069.00	128	128	2.55	0.085	0.0105
6	300.00	318.40	128	128	2.01	0.018	0.0014
6	599.00	635.80	128	128	2.07	0.015	0.0016
6	898.00	953.20	128	128	2.08	0.007	0.0024
6	1197.00	1270.60	128	128	1.97	0.009	0.0010
7	1197.60	1268.00	128	128	1.46	0.026	0.0015
7	2394.20	2535.00	128	128	1.68	0.035	0.0039
7	3590.80	3802.00	128	128	1.59	0.093	0.0038
7	4787.40	5069.00	128	128	1.47	0.060	0.0034

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PRODUCT FORMATTING

Product Scene Center Location (lat/long) : 24.564 45.780
 Product Scene Center Date/Time (yyyy mm dd): 1984 8 13 06:53:21.6681

Product Extent:

Lat: 25.50 -----	Lat: 25.49
Long: 44.68	Long: 46.89
North: 2820135.00	North: 2820135.00
East: 467685.00	East: 690195.00
Lat: 23.63	Lat: 23.62
Long: 44.68	Long: 46.86
North: 2613705.00	North: 2613705.00
East: 467685.00 -----	East: 690195.00

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EXECUTION INFORMATION

Stage	Start	End	CPU
Ingest	Tue Sep 29 16:24:01 2009	Tue Sep 29 16:25:21 2009	67.13
ModelRefiner	Tue Sep 29 16:25:26 2009	Tue Sep 29 16:27:27 2009	66.15
MemEffect	Tue Sep 29 16:27:49 2009	Tue Sep 29 16:28:18 2009	23.26
DemIngest	Tue Sep 29 16:27:30 2009	Tue Sep 29 16:27:34 2009	1.18
WarpDem	Tue Sep 29 16:27:36 2009	Tue Sep 29 16:27:49 2009	19.15
ImCorr	Tue Sep 29 16:28:19 2009	Tue Sep 29 16:35:46 2009	824.39
RadQa	Tue Sep 29 16:35:47 2009	Tue Sep 29 16:35:48 2009	0.19
Output	Tue Sep 29 16:35:50 2009	Tue Sep 29 16:36:11 2009	4.80
Catalog	Tue Sep 29 16:36:12 2009	Tue Sep 29 16:36:12 2009	0.17

1006.42

Section 4 Product Packaging

L1 products are available for distribution via HTTP download. The following provides information on each distribution method for the available L1 product formats.

4.1 Electronic Transfer

Products available via electronic transfer also include the L1 volume descriptor (readme file) with the same file names as listed. When data are packaged and ready for distribution, they are stored in directories on the production online cache for retrieval.

The LPGS GZips (compression) all standard products for distribution. Each individual file within the scene is GZipped.

Section 5 Software Tools

5.1 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 Science Data Processing (SDP) Toolkit. The Jet Propulsion Laboratory (JPL) enhanced the ODL parser in building their Planetary Data System. IAS modified this enhanced version, available at <http://pds.nasa.gov/tools/>. LPGS uses this IAS-modified version.

The IAS-modified version should be particularly useful to those operating in a non-HDF-Earth Observing System (EOS) environment. The software stands alone and reads 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 products and the USGS Projection Parameters (Table A-2).

Project Name	Mnemonic
Polar Stereographic	PS
Universal Transverse Mercator	UTM

Table A-1. L1 Output Product Projection Parameters

Projection Name Mnemonic	Array Element							
	1	2	3	4	5	6	7	8
PS	SMajor	SMinor			LongPol	TrueScale	FE	FN
UTM	Lon/Z	Lat/Z						

**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
PS							
UTM							

**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. 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 (Oblique Mercator Type A (OMA) / Oblique Mercator Type B (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 and 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, and WRS-2 for Landsat 4, 5, 6, and 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 (DDMMSS.SS) format.

References

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

USGS/EROS. LSDS-43. Landsat 4-5 Thematic Mapper (TM) Calibration Parameter File (CPF) Definition.

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