

Department of the Interior  
U.S. Geological Survey

# **HYPERION LEVEL 1GST (L1GST) PRODUCT OUTPUT FILES DATA FORMAT CONTROL BOOK (DFCB)**

## **Earth Observing-1 (EO-1)**

**Version 1.0**

**April 2006**



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## Earth Observing-1 (EO-1)

April 2006

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## Executive Summary

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This Hyperion Level 1Gst (L1Gst) Data Format Control Book (DFCB) presents detailed data formats of the output files generated by the Earth Observing-1 (EO-1) Product Generation (EPG) System. The Level 1 processing system produces Level 1 output files from Level 0R (L0R) images based on user requests. Images are available in the following formats from the Level 1 processing system: Hierarchical Data Format (HDF) and Geographic Tagged Image File Format (GeoTIFF).

For additional information on the Hyperion sensor or the Advanced Land Imager (ALI) sensor on the EO-1 satellite please visit the EO-1 website at <http://eo1.usgs.gov/>.

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## Document History

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# Section 1 Introduction

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## 1.1 Purpose

This Data Format Control Book (DFCB) provides the user with a high-level description of the Hyperion Level 1Gst (L1Gst) distribution product and product packaging.

## 1.2 Scope

This DFCB describes the formats and data contents of the L1Gst output files. The formats discussed are the Hierarchical Data Format (HDF) and Geographic Tagged Image File Format (GeoTIFF).

The HDF and GeoTIFF L1Gst product formats are primarily derived from the formats of the Landsat 7 and Advanced Land Imager (ALI) L1G products to minimize the impact on the user community and to provide general consistency in output.

The file formats contained in this DFCB are applicable to the product generated by L1Gst producing systems operated at the United States Geological Survey (USGS) National Center for Earth Resources Observation and Science (EROS).

## 1.3 Intended Users

This document is intended as a guide to recipients of L1Gst products. This document contains detailed information on the L1Gst output data file formats, which will allow users to proceed with independent development of L1Gst processing capability. It also provides detailed information on the packaging of the L1Gst product.

## 1.4 Definitions

Definitions are provided for the following levels of processing for reference purposes; their availability is noted.

This document does not address the following:

- **Level 0R (L0R)** - Data that has no corrections applied.
- **Level 1R (L1R)** - Radiometrically corrected only. No geometric corrections are applied.

These data are not currently offered:

- **Level 1Gs (L1Gs)** - Radiometrically corrected and resampled for geometric correction and registered to a geographic map projection.

This document addresses the following:

- **Level 1Gst (L1Gst)** - Radiometrically corrected and resampled for geometric correction and registration to a geographic map projection. The data image is ortho-corrected using digital elevation models (DEM) to correct parallax error due to local topographic relief. The source of DEM used will vary according to local availability of elevation information.

## Section 2 Overview of Level 1 Output Files

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The L1G digital image is radiometrically and geometrically corrected and is available in two format options: HDF version 4.1. and GeoTIFF.

Table 2-1 details the Level 1 product components.

Component
Level 1 image file (one for each band)
Level 1 metadata file
HDF directory file (HDF only)
FGDC metadata file
Readme file

**Table 2-1 Product Components**

### 2.1 GeoTIFF

The file naming convention for the GeoTIFF product is EO1spppprrrYYYYDDDXXXML\_BBBB\_TTT.TIF. See the Table 2-3 for the metadata file naming convention.

EO1	=	Earth Observing 1 mission
s	=	Sensor, A = ALI, H = Hyperion
ppp	=	Target WRS path of the product
rrr	=	Target WRS row of the product
YYYY	=	Acquisition year of the image
DDD	=	Acquisition Julian day of year
XXX	=	Hyperion, ALI, Atmospheric Corrector (AC), (1 = sensor on, 0 = sensor off)
M	=	Pointing Mode, P = Pointed within path/row, K = Pointed outside path/row, N = Nadir
L	=	Scene identifier which may be 0-9 or an upper or lower case alpha character.
BBBB	=	file type: B### = Band Designator, see Hyperion Spectral Coverage and Band Designator Appendix A
TTT	=	product type: L1G = systematic corrected L1T = systematic terrain corrected
.TIF	=	GeoTIFF file extension

**Table 2-2 GeoTIFF Product Naming Convention**



### **2.1.1 Level 1 Image File**

GeoTIFF defines a set of public domain TIFF tags that describe all cartographic and geodetic information associated with geographic TIFF imagery. GeoTIFF is a means for tying a raster image to a known model space or map projection and for describing those projections. A metadata format provides geographic information to associate with the image data, but the TIFF file structure allows both the metadata and the image data to be encoded into the same file. The L1G digital values represent absolute radiance values stored as 16-bit signed integers with a scaling factor of 40 for VNIR bands and 80 for SWIR bands. The actual radiance values vary from zero to approximately 32,767 (the value zero is used to indicate fill data).

### **2.1.2 Ancillary Data Files**

For a complete listing of the remaining files included with the GeoTIFF product see Section 3.3.

## **2.2 HDF**

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

The file naming convention for the HDF product files follows:

Example: EO1sppprrrYYYYDDDXXXML\_BBBB.TTT

EO1	=	Earth Observing 1 mission
s	=	Sensor, A = ALI, H = Hyperion
ppp	=	Target WRS path of the product
rrr	=	Target WRS row of the product
YYYY	=	Acquisition year of the image
DDD	=	Acquisition Julian day of year
XXX	=	Hyperion, ALI, Atmospheric Corrector (AC), (1 = sensor on, 0 = sensor off)
M	=	Pointing Mode, P = Pointed within path/row, K = Pointed outside path/row, N = Nadir
L	=	Scene identifier which may be 0-9 or an upper or lower case alpha character.
BBBB	=	file type: B### = Band Designator, see Hyperion Spectral Coverage and Band Designator Appendix A HDF = HDF directory MTL = Level 1 metadata
.TTT	=	product type: L1G = systematic corrected L1T = systematic terrain corrected

**Table 2-3. HDF Naming Convention**

### 2.2.1 Level 1 Image File

The L1G digital values represent absolute radiance values stored as 16-bit signed integers with a scaling factor of 40 for VNIR bands and 80 for SWIR bands. The actual radiance values vary from zero to approximately 32,767 (the value zero is used to indicate fill data). The L1G image files are constructed on a platform which is little-endian; the output data are big-endian.

### 2.2.2 Ancillary Data Files

For a complete listing of the remaining files included with the HDF product see Section 3.3.

## Section 3 Level 1 Output File Formats

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### 3.1 GeoTIFF File Formats

#### 3.1.1 Level 1 Image File

The description of an image in GeoTIFF requires tags and keys as described in the GeoTIFF Specification <http://www.remotesensing.org/geotiff/spec/geotiffhome.html>. These tags and keys are included in the Level 1 image files and are automatically detected and read by TIFF readers. They are described in the following subsections.

Each image band in the L1G product is provided in a separate file. The data are laid out in a line sequential format in left to right detector order. The L1G product is radiometrically corrected, geometrically resampled, and registered to a geographic map projection. In addition, the L1Gst product has elevation correction applied.

##### 3.1.1.1 GeoTIFF Tags

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

A complete description of the raster data requires georeferencing of the data, which is also accomplished through the use of tags. The EO-1 Level 1 production system uses the transformation raster and model space tie points and scaling parameters. ModelTiepointTag and ModelPixelScaleTag are used for this purpose.

##### 3.1.1.2 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. The relationship between the raster space and the model space often will be an exact, affine transformation; the relationship can be defined using one set of tiepoints and the ModelPixelScaleTag, which provides the vertical and horizontal raster grid cell size.

### 3.1.1.3 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; this tag consists of three values:

ModelPixelScaleTag = (ScaleX, ScaleY, ScaleZ),

where ScaleX and ScaleY provide the values used for the horizontal and vertical spacing of raster pixels, and ScaleZ provides the value mapping the pixel value of a DEM into the correct Z-scale.

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

### 3.1.1.4 GeoTIFF Keys

In addition to tags, the description of a projection in GeoTIFF requires the use of keys. The keys necessary to define the projections supported by the L1G production systems, and their possible values, are listed below.

Valid Keys	Possible Values	Meaning
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 (see Applicable Document 7 for values)
	32767	User defined

**Table 3-1. GeoTIFF Keys used for defining UTM projection**

## 3.2 HDF File Formats

### 3.2.1 Level 1 Image File

Each image band in the L1G product is provided in a separate file. The data are laid out in a line sequential format in left to right detector order. The L1G product is radiometrically corrected, geometrically resampled, and registered to a geographic map projection. In addition, the L1Gst product has elevation correction applied.

### 3.2.1.1 HDF Directory File

The directory file contains all the pointers, file size information, and data objects required to open and process the L1G product using the HDF library and interface routines.

### 3.2.1.2 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. Two classes are recognized for the L1G HDF product: image data and metadata.

The HDF Vgroup interface consists of routines for accessing and getting information about the L1G product Vgroup. This information is stored in the HDF data directory.

The Vgroup used to relate the different data objects that make up a complete L1G product are presented as example in Table 3-2. There are up to 242 possible bands. The object name ends with a .B and corresponding three digit band number.

Vgroup Name	Vgroup Class	Object Name	Type	Description
Scene_Data_Ref	Image_Data	EO1sppprrrYYYYDDDXXXML.B001	SDS	Hyperion band 1 data
		EO1sppprrrYYYYDDDXXXML.B002	SDS	Hyperion band 2 data
		EO1sppprrrYYYYDDDXXXML.B...	SDS	Hyperion band ...
Product_Metadata	Metadata	EO1sppprrrYYYYDDDXXXML.MTL	Vdata	Level 1 product-specific metadata

**Table 3-2. Vgroup Definitions: Level 1G Product**

## 3.3 Ancillary Data Files

### 3.3.1 L1G Metadata File

The Level 1 metadata file is created during product generation and contains information specific to the product ordered. Table 3-3 lists the full contents of the L1G metadata file. This file contains all applicable image description information from the Level 0 metadata file and the EO-1 Data Processing System (DPS) metadata provided with the L0R product.

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
GROUP	16	= L1_METADATA_FILE	Beginning of first Level object description language (ODL) group. It indicates start of L1G metadata file level group
GROUP	18	= METADATA_FILE_INFO	Beginning of metadata file information group
REQUEST_ID	19	USGS products use: "NNNYMMDDSSSS_UUUUU" format where: NNNYMMDDSSSS = 13-digit order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = 5-digit unit number	Data producer-defined request number that uniquely identifies each product. USGS products use a unique product generation request ID.

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
PRODUCT_CREATION_TIME	20	= YYYY-MM-DDThh:mm:ssZ where YYYY = 4-digit year MM = month number of year (01-12) DD = day of month (01-31) T indicates start of time information in ODL ASCII time code format hh = hours (00-23) mm = minutes (00-59) ss = seconds (00-59) Z indicates Zulu time (same as GMT)	L1G system date and time when metadata file for L1G product set was created. For ease of human readability, this date and time are presented in ODL American Standard Code for Information Interchange (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
EO1_XBAND	1	= "1"	EO-1 X-band used to downlink data to LGS
GROUND_STATION	3	= "XXX" where XXX = may be any combination of alpha or numeric characters i.e. PF1 = Poker Flat 1, AK LGS = Landsat Ground Station, SD LXS = Landsat Ground Station, SD SGS = Svalbard Ground Station, Norway AGS = Alaska Ground Station, AK AKS = DataLynx Ground Station, AK WGS = Wallops Ground Station, VA WPS = Wallops Ground Station, VA HGS = Tasmanian Earth Resources Satellite Station (Hobart), Australia GGS = Goddard Ground Station	Ground station that received data
DPS_VERSION_NUMBER	4	= "N.NN"	DPS processing version number
DATEHOURLY_CONTACT_PERIOD	7	= YYDOYHH	Date and hour of contact period start
END_GROUP	18	= METADATA_FILE_INFO	End of metadata information group
GROUP	16	= PRODUCT_METADATA	Beginning of product metadata group
PRODUCT_TYPE	5	= "L1GS" = "L1GST"	Identifier to inform user of product type
PROCESSING_SOFTWARE	8	= "SYSTEM_VERSION" where SYSTEM = EPG VERSION = version of software	L1G processing system and software version. Examples: EPG_4.5 EPG_4.3
EPIHEMERIS_TYPE	10	= "ACS" = "DEFINITIVE" = "GPS" = "PREDICTIVE"	Identifier to inform user of orbital ephemeris type used.
SPACECRAFT_ID	3	= "EO1"	Name of satellite platform
SENSOR_ID	3	= "HYPERION"	Name of imaging sensor
ACQUISITION_DATE	10	= YYYY-MM-DD	Date image was acquired
START_TIME	17	= YYYY DDD HH:MM:SS where YYYY = four digit year DDD = julian day of year (001-366) HH = hour (00-23) MM = minute (00-59) SS = second (00-59)	GMT sensor was turned on
END_TIME	17	= YYYY DDD HH:MM:SS where YYYY = four digit year DDD = julian day of year (001-366) HH = hour (00-23) MM = minute (00-59) SS = second (00-59)	GMT sensor was turned off
PRODUCT_UL_CORNER_LAT	11	= -90.000000 through +90.000000 degrees (with	Latitude value for upper left corner

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
		7-digit precision Positive (+) value indicates North latitude; negative (-) value indicates South latitude	of product (L1 systems recalculate for 1G product)
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 upper left corner of product (L1 systems recalculate for 1G product)
PRODUCT_UR_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	Latitude value for upper right corner of product (L1 systems recalculate for 1G product)
PRODUCT_UR_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	Longitude value for upper right corner of product (L1 systems recalculate for 1G product)
PRODUCT_LL_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	Latitude value for lower left corner of product (L1 systems recalculate for 1G product)
PRODUCT_LL_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	Longitude value for lower left corner of product (L1 systems recalculate for 1G product)
PRODUCT_LR_CORNER_LAT	11	= -90.0000000 through +90.0000000 degrees (with 7-digit precision)	Latitude value for lower right corner of product (L1 systems recalculate for 1G product)
PRODUCT_LR_CORNER_LON	12	= -180.0000000 through +180.0000000 degrees (with 7-digit precision)	Longitude value for lower right corner of product (L1 systems recalculate for 1G product)
PRODUCT_UL_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are meters	Projection X coordinate for upper left corner of product (L1 systems calculated, 1G only)
PRODUCT_UL_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are meters	Projection Y coordinate for upper left corner of product (L1 systems calculated, 1G only)
PRODUCT_UR_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are meters	Projection X coordinate for upper right corner of product (L1 systems calculated, 1G only)
PRODUCT_UR_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are meters	Projection Y coordinate for upper right corner of product (L1 systems calculated, 1G only)
PRODUCT_LL_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are meters	Projection X coordinate for lower left corner of product (L1 systems calculated, 1G only)
PRODUCT_LL_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are meters	Projection Y coordinate for lower left corner of product (L1 systems calculated, 1G only)
PRODUCT_LR_CORNER_MAPX	14	= -132000000.000 through 132000000.000 Units are meters	Projection X coordinate for lower right corner of product (L1 systems calculated, 1G only)
PRODUCT_LR_CORNER_MAPY	14	= -132000000.000 through 132000000.000 Units are meters	Projection Y coordinate for lower right corner of product (L1 systems calculated, 1G only)
PRODUCT_SAMPLES	6		Product samples
PRODUCT_LINES	6		Product lines
HDF_DIR_FILE_NAME	32	"EO1spprrrYYYYDDDXXXXML_HDF.TTT" (TTT = L1G or L1T)	L1G-generated file name for HDF directory file (HDF products only)
BAND#_FILE_NAME	36	"EO1spprrrYYYYDDDXXXXML_B###.TTT" Or "EO1spprrrYYYYDDDXXXXML_B###_TTT.TIF" (TTT = L1G or L1T) (### = 001-242)	L1G-generated external element file name for band 1-242. Value will have band number padded with zeros if needed, parameter name will not.
METADATA_L1_FILE_NAME	32	"EO1spprrrYYYYDDDXXXXML_MTL.TTT" (TTT = L1G) or (TTT= L1T)	L1G-generated external element file name for L1G metadata
CPF_FILE_NAME	27	"EO1ACPFYYYYMMDD_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 Calibration Parameter File.
END_GROUP	16	= PRODUCT_METADATA	End of product metadata group

Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
GROUP	16	= RADIANCE_SCALING	Beginning of the radiance scaling group
SCALING_FACTOR_VNIR	2	= NN	Scaling factor used to convert calibrated DN to Radiance units for bands 1-70. (W/(m <sup>2</sup> sr um).
SCALING_FACTOR_SWIR	2	= NN	Scaling factor used to convert calibrated DN to Radiance units for bands 71-242. (W/(m <sup>2</sup> sr um).
END_GROUP	16	= RADIANCE_SCALING	End of radiance scaling group.
GROUP	18	= PRODUCT_PARAMETERS	Beginning of product parameters group
CORRECTION_METHOD_GAIN	4	= "CPF" (for CPF gains) = "NONE" (for no gains used)	Correction method used by L1G in creating the image.
CORRECTION_METHOD_BIAS	4	= "CPF" (for CPF bias) = "NONE" (for no bias used)	Correction method used by L1G in creating image
SENSOR_LOOK_ANGLE	11	= -90.0000 through 90.0000 degrees (with 4-digit precision) A positive value indicates sensor pointing east. A negative value ( - ) indicates sensor pointing west. Leading zeros not required = "UNAVAILABLE" (not calculated)	The look angle is the angle between nadir and the center of the collected image. It is zero when the collected data are centered at the nadir point. The angle when descending is positive when the sensor is pointing east, negative when the sensor is pointing west of nadir.
SUN_AZIMUTH	12	= -180.000000 through 180.000000 degrees (with 6-digit precision) A positive value indicates angles to the east or clockwise from north. A negative value (-) indicates angles to the west or counterclockwise from north. Leading zeros are not required. = "UNAVAILABLE" (not calculated)	Sun azimuth angle in degrees for image center location at image center acquisition time
SUN_ELEVATION	11	= -90.000000 through 90.000000 degrees (with 6-digit precision) A positive value indicates a daytime scene. A negative value (-) indicates a nighttime scene. Leading zeros are not required. = "UNAVAILABLE" (not calculated)	Sun elevation angle in degrees for image center location at image center acquisition time
OUTPUT_FORMAT	10	= "FORMAT_VERSION" where FORMAT = HDF, GEOTIFF VERSION = output format version	Output format and output format version of image. Examples: HDF_4.1r5 GEOTIFF Note: No version included for GEOTIFF
END_GROUP	18	= PRODUCT_PARAMETERS	End of product parameters group
GROUP	19	= CORRECTIONS_APPLIED	Beginning of corrections applied group
ABNORMAL_PIXELS	1	= "Y" or "N"	Indicator of whether image was corrected for abnormal pixels
INOPERABLE_DETECTORS	1	= "Y" or "N"	Indicator of whether image was corrected for inoperable or out of spec detectors
STRIPING	1	= "Y" or "N"	Indicator of whether image was corrected for striping
ELEVATION_SOURCE	7	= "N" (no correction applied) = "SRTM-2" (1 Arc Sec) = "SRTM-1" (3 Arc Sec) = "NED" = "DTED" = "GTOPO30"	Indicates the primary source (if any) of Digital Elevation Model (DEM) used in the correction process.
END_GROUP	19	= CORRECTIONS_APPLIED	End of corrections applied group
GROUP	21	= PROJECTION_PARAMETERS	Beginning of projection parameters group (1G product only)
REFERENCE_DATUM	8	= "WGS84"	Datum used in creating image
REFERENCE_ELLIPSOID	8	= "WGS84"	Ellipsoid used in creating image



Parameter Name	Size*	Value, Format, Range, and Units	Parameter Description/Remarks
GRID_CELL_SIZE	5	=15.00 through 30.00 meters, in increments of 0.01 meters	Grid cell size used in creating image for Visible and Near Infrared (VNIR)/ Short-Wave Infrared (SWIR) bands, if part of product
ORIENTATION	3	= "NUP" North Up	Orientation used in creating image
RESAMPLING_OPTION	3	= "NN" Nearest Neighbor = "CC" Cubic Convolution	Resampling option used in creating image
MAP_PROJECTION	3	= "UTM" Universal Transverse Mercator	Map projection used in creating image
END_GROUP	21	= PROJECTION_PARAMETERS	End of projection parameters group
<b>Projection parameters data (not a Level 1 metadata parameter)</b>			<b>The following parameters are included only with products that select a map projection of UTM</b>
GROUP	14	UTM_PARAMETERS	Beginning of UTM parameters group
ZONE_NUMBER	3	= 1 to 60 or -1 to -60	Value used to indicate zone number. "-" signifies zones south of the equator.
END_GROUP	14	UTM_PARAMETERS	End of UTM parameters group
END_GROUP	16	L1_METADATA_FILE	End of Level 1 metadata file level group
END			Required standalone parameter signifying file end
*ASCII bytes			

**Table 3-3. Level 1 Metadata File**

### 3.3.2 FGDC Metadata File

The FGDC Metadata file contains metadata information about the Hyperion scene in a standard format as described in *Content Standard for Digital Geospatial Metadata* (See References Section). The FGDC Metadata file does not contain information specific to the processing of the L1G image; this specific information is included in the L1G Metadata file.

## Section 4 Product Packaging

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L1G products are available on Digital Versatile Disk - Recordable (DVD-R) and via electronic transfer. The following sections provide information on each of the distribution methods for the available L1G product formats.

### 4.1 DVD-R

Data products on DVD-R are mastered using International Standards Organization (ISO) 9660 Interchange Level 2, the International standard for file formatting a DVD-R. File unpacking is required. DVD-R products are mastered using single sided, single layered technology providing a capacity of 4.2 gigabytes. This configuration will be compatible with most DVD-ROM readers.

The root directory contains a readme file, which describes product content. Hyperion products will be compressed (tarred and gzipped) on DVD with the exception of the readme file.

The DVD-R label will include the following information: processing level (e.g., Level 1R, L1Gst); product format (e.g., HDF or GeoTIFF); order number; unit number; DVD-R volume number; scene ID; mission indicator (which is EO-1 Hyperion); and the USGS logo. Corner coordinates may be included if space permits. The target path, row, and acquisition date information is supplied through the format of the naming convention of the base part of file names and the subdirectory (as defined in Section 2 as part of the scene ID).

### 4.2 Electronic Transfer

Products available via electronic transfer will include the L1G volume descriptor (readme file) with the same filenames as listed above. Electronic data transfer products use UNIX File Transfer Protocol (FTP). FTP, as described in Request for Comments (RFC) 959, is an Internet standard for file transfer that supports 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 will be stored using the following standard. The home or initial login directory contains a set of files. All files for an order will be in a home directory. Hyperion products available via FTP will be compressed (tarred and zipped). The FTP instructions are e-mailed to the customer at the time the data are posted to the FTP site will contain directions for uncompressing the data.

## Appendix A Hyperion Spectral Coverage and Band Designator (Sorted by Wavelength)

HYPERION Spectral Coverage						
ALI Band Comparison		Hyperion Band	Average Wavelength (nm)	Full Width at Half the Maximum FWHM (nm)	Spatial Resolution (m)	Not Calibrated (X)
MS	Pan (nm) 480 - 690 (X)					
		B001	355.5900	11.3871	30	X
		B002	365.7600	11.3871	30	X
		B003	375.9400	11.3871	30	X
		B004	386.1100	11.3871	30	X
		B005	396.2900	11.3871	30	X
		B006	406.4600	11.3871	30	X
		B007	416.6400	11.3871	30	X
		B008	426.8200	11.3871	30	
MS-1		B009	436.9900	11.3871	30	
MS-1		B010	447.1700	11.3871	30	
MS-1'		B011	457.3400	11.3871	30	
MS-1'		B012	467.5200	11.3871	30	
MS-1'		B013	477.6900	11.3871	30	
MS-1'	X	B014	487.8700	11.3784	30	
MS-1'	X	B015	498.0400	11.3538	30	
MS-1'	X	B016	508.2200	11.3133	30	
	X	B017	518.3900	11.2580	30	
MS-2	X	B018	528.5700	11.1907	30	
MS-2	X	B019	538.7400	11.1119	30	
MS-2	X	B020	548.9200	11.0245	30	
MS-2	X	B021	559.0900	10.9321	30	
MS-2	X	B022	569.2700	10.8368	30	
MS-2	X	B023	579.4500	10.7407	30	
MS-2	X	B024	589.6200	10.6482	30	
MS-2	X	B025	599.8000	10.5607	30	
	X	B026	609.9700	10.4823	30	
	X	B027	620.1500	10.4147	30	

MS-3	X	B028	630.3200	10.3595	30	
MS-3	X	B029	640.5000	10.3188	30	
MS-3	X	B030	650.6700	10.2942	30	
MS-3	X	B031	660.8500	10.2856	30	
MS-3	X	B032	671.0200	10.2980	30	
MS-3	X	B033	681.2000	10.3349	30	
		B034	691.3700	10.3909	30	
		B035	701.5500	10.4592	30	
		B036	711.7200	10.5322	30	
		B037	721.9000	10.6004	30	
		B038	732.0700	10.6562	30	
		B039	742.2500	10.6933	30	
		B040	752.4300	10.7058	30	
		B041	762.6000	10.7276	30	
MS-4		B042	772.7800	10.7907	30	
MS-4		B043	782.9500	10.8833	30	
MS-4		B044	793.1300	10.9938	30	
MS-4		B045	803.3000	11.1044	30	
		B046	813.4800	11.1980	30	
		B047	823.6500	11.2600	30	
		B048	833.8300	11.2824	30	
MS-4'		B049	844.0000	11.2822	30	
MS-4'		B071	851.9200	11.0457	30	X
MS-4'		B050	854.1800	11.2816	30	
MS-4'		B072	862.0100	11.0457	30	X
MS-4'		B051	864.3500	11.2809	30	
MS-4'		B073	872.1000	11.0457	30	X
MS-4'		B052	874.5300	11.2797	30	
MS-4'		B074	882.1900	11.0457	30	X
MS-4'		B053	884.7000	11.2782	30	
		B075	892.2800	11.0457	30	X
		B054	894.8800	11.2771	30	
		B076	902.3600	11.0457	30	X
		B055	905.0500	11.2765	30	
		B077	912.4500	11.0457	30	
		B056	915.2300	11.2756	30	
		B078	922.5400	11.0457	30	
		B057	925.4100	11.2754	30	
		B079	932.6400	11.0457	30	
		B058	935.5800	11.2754	30	X

		B080	942.7300	11.0457	30	
		B059	945.7600	11.2754	30	X
		B081	952.8200	11.0457	30	
		B060	955.9300	11.2754	30	X
		B082	962.9100	11.0457	30	
		B061	966.1100	11.2754	30	X
		B083	972.9900	11.0457	30	
		B062	976.2800	11.2754	30	X
		B084	983.0800	11.0457	30	
		B063	986.4600	11.2754	30	X
		B085	993.1700	11.0457	30	
		B064	996.6300	11.2754	30	X
		B086	1003.3000	11.0457	30	
		B065	1006.8100	11.2754	30	X
		B087	1013.3000	11.0457	30	
		B066	1016.9800	11.2754	30	X
		B088	1023.4000	11.0451	30	
		B067	1027.1600	11.2754	30	X
		B089	1033.4900	11.0423	30	
		B068	1037.3300	11.2754	30	X
		B090	1043.5900	11.0372	30	
		B069	1047.5100	11.2754	30	X
		B091	1053.6900	11.0302	30	
		B070	1057.6800	11.2754	30	X
		B092	1063.7900	11.0218	30	
		B093	1073.8900	11.0122	30	
		B094	1083.9900	11.0013	30	
		B095	1094.0900	10.9871	30	
		B096	1104.1900	10.9732	30	
		B097	1114.1900	10.9572	30	
		B098	1124.2800	10.9418	30	
		B099	1134.3800	10.9248	30	
		B100	1144.4800	10.9065	30	
		B101	1154.5800	10.8884	30	
		B102	1164.6800	10.8696	30	
		B103	1174.7700	10.8513	30	
		B104	1184.8700	10.8335	30	
		B105	1194.9700	10.8154	30	
MS-5'		B106	1205.0700	10.7979	30	
MS-5'		B107	1215.1700	10.7822	30	

MS-5'		B108	1225.1700	10.7663	30	
MS-5'		B109	1235.2700	10.7520	30	
MS-5'		B110	1245.3600	10.7385	30	
MS-5'		B111	1255.4600	10.7270	30	
MS-5'		B112	1265.5600	10.7174	30	
MS-5'		B113	1275.6600	10.7091	30	
MS-5'		B114	1285.7600	10.7022	30	
MS-5'		B115	1295.8600	10.6970	30	
		B116	1305.9600	10.6946	30	
		B117	1316.0500	10.6937	30	
		B118	1326.0500	10.6949	30	
		B119	1336.1500	10.6996	30	
		B120	1346.2500	10.7058	30	
		B121	1356.3500	10.7163	30	
		B122	1366.4500	10.7283	30	
		B123	1376.5500	10.7437	30	
		B124	1386.6500	10.7612	30	
		B125	1396.7400	10.7807	30	
		B126	1406.8400	10.8034	30	
		B127	1416.9400	10.8267	30	
		B128	1426.9400	10.8534	30	
		B129	1437.0400	10.8818	30	
		B130	1447.1400	10.9110	30	
		B131	1457.2300	10.9422	30	
		B132	1467.3300	10.9743	30	
		B133	1477.4300	11.0074	30	
		B134	1487.5300	11.0414	30	
		B135	1497.6300	11.0759	30	
		B136	1507.7300	11.1108	30	
		B137	1517.8300	11.1461	30	
		B138	1527.9200	11.1811	30	
		B139	1537.9200	11.2156	30	
		B140	1548.0200	11.2496	30	
MS-5		B141	1558.1200	11.2826	30	
MS-5		B142	1568.2200	11.3146	30	
MS-5		B143	1578.3200	11.3460	30	
MS-5		B144	1588.4200	11.3753	30	
MS-5		B145	1598.5100	11.4037	30	
MS-5		B146	1608.6100	11.4302	30	
MS-5		B147	1618.7100	11.4538	30	

MS-5		B148	1628.8100	11.4760	30	
MS-5		B149	1638.8100	11.4958	30	
MS-5		B150	1648.9000	11.5133	30	
MS-5		B151	1659.0000	11.5286	30	
MS-5		B152	1669.1000	11.5404	30	
MS-5		B153	1679.2000	11.5505	30	
MS-5		B154	1689.3000	11.5580	30	
MS-5		B155	1699.4000	11.5621	30	
MS-5		B156	1709.5000	11.5634	30	
MS-5		B157	1719.6000	11.5617	30	
MS-5		B158	1729.7000	11.5563	30	
MS-5		B159	1739.7000	11.5477	30	
MS-5		B160	1749.7900	11.5346	30	
		B161	1759.8900	11.5193	30	
		B162	1769.9900	11.5002	30	
		B163	1780.0900	11.4789	30	
		B164	1790.1900	11.4548	30	
		B165	1800.2900	11.4279	30	
		B166	1810.3800	11.3994	30	
		B167	1820.4800	11.3688	30	
		B168	1830.5800	11.3366	30	
		B169	1840.5800	11.3036	30	
		B170	1850.6800	11.2696	30	
		B171	1860.7800	11.2363	30	
		B172	1870.8700	11.2007	30	
		B173	1880.9800	11.1666	30	
		B174	1891.0700	11.1333	30	
		B175	1901.1700	11.1018	30	
		B176	1911.2700	11.0714	30	
		B177	1921.3700	11.0424	30	
		B178	1931.4700	11.0155	30	
		B179	1941.5700	10.9912	30	
		B180	1951.5700	10.9698	30	
		B181	1961.6600	10.9508	30	
		B182	1971.7600	10.9355	30	
		B183	1981.8600	10.9230	30	
		B184	1991.9600	10.9139	30	
		B185	2002.0600	10.9083	30	
		B186	2012.1500	10.9069	30	
		B187	2022.2500	10.9057	30	

		B188	2032.3500	10.9013	30	
		B189	2042.4500	10.8951	30	
		B190	2052.4500	10.8854	30	
		B191	2062.5500	10.8740	30	
		B192	2072.6500	10.8591	30	
MS-7		B193	2082.7500	10.8429	30	
MS-7		B194	2092.8400	10.8242	30	
MS-7		B195	2102.9400	10.8039	30	
MS-7		B196	2113.0400	10.7820	30	
MS-7		B197	2123.1400	10.7592	30	
MS-7		B198	2133.2400	10.7342	30	
MS-7		B199	2143.3400	10.7092	30	
MS-7		B200	2153.3400	10.6834	30	
MS-7		B201	2163.4300	10.6572	30	
MS-7		B202	2173.5300	10.6312	30	
MS-7		B203	2183.6300	10.6052	30	
MS-7		B204	2193.7300	10.5803	30	
MS-7		B205	2203.8300	10.5560	30	
MS-7		B206	2213.9300	10.5328	30	
MS-7		B207	2224.0300	10.5101	30	
MS-7		B208	2234.1200	10.4904	30	
MS-7		B209	2244.2200	10.4722	30	
MS-7		B210	2254.2200	10.4552	30	
MS-7		B211	2264.3200	10.4408	30	
MS-7		B212	2274.4200	10.4285	30	
MS-7		B213	2284.5200	10.4197	30	
MS-7		B214	2294.6100	10.4129	30	
MS-7		B215	2304.7100	10.4088	30	
MS-7		B216	2314.8100	10.4077	30	
MS-7		B217	2324.9100	10.4077	30	
MS-7		B218	2335.0100	10.4077	30	
MS-7		B219	2345.1100	10.4077	30	
		B220	2355.2100	10.4077	30	
		B221	2365.2000	10.4077	30	
		B222	2375.3000	10.4077	30	
		B223	2385.4000	10.4077	30	
		B224	2395.5000	10.4077	30	
		B225	2405.6000	10.4077	30	X
		B226	2415.7000	10.4077	30	X
		B227	2425.8000	10.4077	30	X



		<b>B228</b>	<b>2435.8900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B229</b>	<b>2445.9900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B230</b>	<b>2456.0900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B231</b>	<b>2466.0900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B232</b>	<b>2476.1900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B233</b>	<b>2486.2900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B234</b>	<b>2496.3900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B235</b>	<b>2506.4800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B236</b>	<b>2516.5900</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B237</b>	<b>2526.6800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B238</b>	<b>2536.7800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B239</b>	<b>2546.8800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B240</b>	<b>2556.9800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B241</b>	<b>2566.9800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>
		<b>B242</b>	<b>2577.0800</b>	<b>10.4077</b>	<b>30</b>	<b>X</b>

## Appendix B Projection Parameters

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Projection Name Mnemonic	Array Element							
	1	2	3	4	5	6	7	8
UTM	Lon/Z	Lat/Z						

**Table B-1. USGS Projection Parameters – Projection Transformation Package  
Projection Parameters**

Projection Name Mnemonic	Array Element						
	9	10	11	12	13	14	15
UTM							

**Table B-2. 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

**Table B-3. USGS Projection Parameters Key**

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

## Appendix C Abbreviations and Acronyms

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AC	(Linear Etalon Imaging Spectrometer Array) Atmospheric Corrector
ACS	Attitude Control System
AEA	Albers Equal Area
ALI	Advanced Land Imager
ASCII	American Standard Code for Information Interchange
CCB	Configuration Control Board
CCR	Configuration Change Request
CD-ROM	Compact Disc Read-Only Memory
CPF	Calibration Parameter File
DCPF	Data Capture and Processing Facility
DEM	Digital Elevation Model
DFCB	Data Format Control Book
DORRAN	Distributed Ordering Research Reporting and Accounting Network
DPS	Data Processing System
DPSRT	Data Processing System Real Time
DVD-R	Digital Versatile Disk - Recordable
EO-1	Earth Observing-1
EPG	EO-1 Product Generation
EPSG	European Petroleum Survey Group
EROS	Earth Resources Observation and Science
ESDIS	Earth Science Data and Information System
ETM+	Enhanced Thematic Mapper Plus
FGDC	Federal Geographic Data Committee
FTP	File Transfer Protocol
F&PRS	Functional and Performance Requirements Specification
GCP	Ground Control Point
GeoTIFF	Geographic Tagged Image File Format
GMT	Greenwich Mean Time
GPS	Global Positioning System

GSFC	Goddard Space Flight Center
HDF	Hierarchical Data Format
IC	Internal Calibrator
ICD	Interface Control Document
I/O	Input/Output
ISO	International Standards Organization
JPL	Jet Propulsion Laboratory
L0	Level 0
L0Ra	Level 0 Reformatted Archive
L0Rp	Level 0 Reformatted Product
L1	Level 1
L1G	Level 1 Geometrically Corrected
L1Gs	Level 1 Geometric Systematically Corrected
L1Gst	Level 1 Geometric Systematic Terrain Corrected
L1R	Level 1 Radiometrically Corrected
L1Gt	Level 1 Terrain Corrected
LASP	Laboratory for Atmospheric and Space Physics
LGS	Landsat Ground System
m	Meter
mm	Millimeter
Mbps	Megabits Per Second
MTL	Metadata Level 1
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
ODL	Object Description Language
RFC	Request For Comments
SCA	Sensor Chip Assembly
SOM	Space Oblique Mercator
SWIR	Short-Wave Infrared
TIFF	Tagged Image File Format
USGS	United States Geological Survey

UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
VNIR	Visible and Near Infrared
WRS	Worldwide Reference System

## References

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The following documents provide additional detail and reference information regarding the format of the Level 1 output files.

U.S. Geological Survey (USGS)/EROS Data Center (EDC), LPS-112-1, Landsat 7 System Zero-R Distribution Product Data Format Control Book, Volume 5, Book 1, Revision 6, October 1999.

U.S. Geological Survey (USGS)/EROS Data Center (EDC), L7-DFCB-04.6, Landsat 7 ETM+ Level 1 Product Output Files Data Format Control Book (DFCB), Version 6, April 2004.

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 (<http://pds.jpl.nasa.gov/stdref/chap12.htm>)

Federal Geographic Data Committee (FGDC), Content Standard for Digital Geospatial Metadata, (<http://www.fgdc.gov/metadata/contstan.html>).