Amalfi

ESA–SPPA Landsat

Add-on User Manual

amalfi-esa-sppa-landsat-1.0.19

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Introduction

This document describes the Amalfi Add-on named "ESA–SPPA Landsat" dedicated to the quality control of Landsat TM, ETM+ and MSS products distributed by the European Space Agency (ESA) and formatted in GeoTIFF respectively according to the USGS Data Format Control Books [LS-DFBC-20], [LS-DFCB-04] and [LSDS-286]. The document includes a general description of the add-on composing files, an overview of the actually controlled files and the complete definitions of the inspections applied. The document is structured as follow:

Chapter 1 – Introduction	The present chapter
Chapter 2 – Anatomy of the Add-on	Logical and Physical description of the Add-on files
Chapter 3 – Classes of Items	Description of the Ontology supporting the file types
Chapter 4 – Landsat Products Coverage	Overview of files actually controlled
Chapter 5 – Landsat Quality Control Plans	The Quality Control plans applied for each product type
Appendix – System Requirements	Requirements for installing this add-on
Appendix – Acronyms and Abbreviation	Those abbreviations used in this document
Appendix – Glossary of Terms	Definition of terms used in this document
Appendix – Bibliography	Complete description of referenced books or articles
Appendix – Document Change Log	This document change log

Note: it is expected that readers of this document have some familiarity with Amalfi general concepts and potentially with related technologies as DRB API®, XML, XML Schema, XQuery, etc. This knowledge can be acquired through the Amalfi – Software User Manual [AMALFI-SUM].

Anatomy of the Add-on

Physical View

The add-on is composed of the following files, usually installed under the "`addons`" sub-directory of the main installation folder:

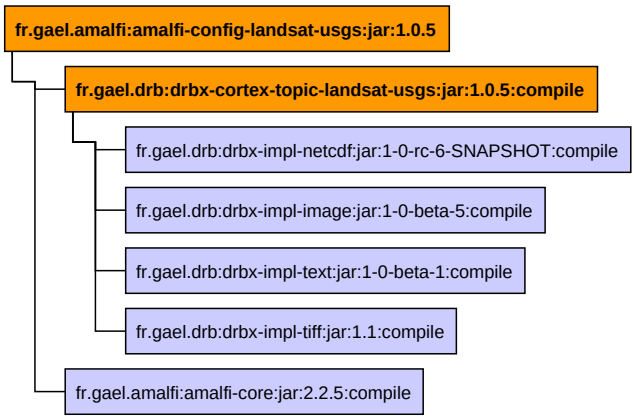
```
├── amalfi-config-landsat-usgs-1.0.19.jar
├── drbx-cortex-topic-landsat-usgs-1.0.17.jar
├── drbx-impl-text-1-0-beta-1.jar
├── drbx-impl-tiff-1.1.jar
└── …
```

The entry point of the add-on is the `amalfi-config-landsat-usgs-<version>.jar` file described in the section “Amalfi configuration for Landsat products” below.

The addon directory also contains a set of other jar libraries used to manage most complex inspections execution.

Dependencies – Logical View

The following tree provides the top level dependency hierarchy of the files listed above. The leaves of this tree have also sub-dependencies but they have been omitted here for clarity. A total of 152 dependencies compose the add-on.



Note – Versions reported in the previous figure are informative. Check previous section for up-to-date numbers.

The entry point of the dependency tree is the `amalfi-config-landsat-usgs:jar` package that includes the Amalfi inspection definitions. The two immediate dependencies are the `drbx-cortex-topic-landsat-usgs:jar` that includes the DRB item support i.e. file formats support, and the `amalfi-core:jar` for reuse of the Amalfi Core inspectors e.g. the Xquery inspector or the XML Schema inspector.

Amalfi configuration for Landsat USGS products

The “Amalfi configuration for Landsat USGS products” package i.e. `amalfi-config-landsat-usgs:jar` is dedicated to the specification of the Amalfi inspections and inspection plans applicable to Landsat products formatted according to the USGS Data Format Control Books [LS-DFBC-04], [LS-DFCB-20] and [LSDS-286] controlling respectively the Landsat ETM+, TM and MSS data formats.

This package includes the following files:

File	Description
`dat/gov/usgs/landsat/WRScornerPoints.xml`	This file is an XML database of the WRS corner coordinates made available by the USGS. This file is used in particular for comparing the product coordinates to the reference scenes.
`Fr/gael/amalfi/config/landsat/*.class`	A series of Java classes that implements two specialized inspectors i.e. the “Geolocation Inspector” applied to the Metadata File and the “Ground Control Points Inspector”.
`META-INF/cortex-index.owl`	The main entry point of the Ontology specifying and gathering all the resources of this package. This file includes, for example, the Xquery scripts that extracts the metadata information, the inspection definition common to all supported product types, etc.
`META-INF/MANIFEST.MF`	The standard JAR archive manifest file.
`META-INF/maven`	A folder of files replicating the Maven build configuration files.
`Owl/gov/usgs/landsat/ls-dfcb-04-v15.0.owl`	The Ontology file defining the Amalfi inspections dedicated to the quality control of the Landsat ETM+ GeoTIFF products formatted according to the [LS-DFCB-04] version 15 i.e. this file the one actually used and connected to the main Ontology of this add-on package i.e. imported from the `cortex-index.owl` file described above.
`Owl/gov/usgs/landsat/ls-dfcb-20-v4.0.owl`	The Ontology file defining the Amalfi inspections dedicated to the quality control of the Landsat TM GeoTIFF products formatted according to the [LS-DFCB-20] version 4 i.e. this file the one actually used and connected to the main Ontology of this add-on package i.e. imported from the `cortex-index.owl` file described above.

File	Description
`Owl/gov/usgs/landsat/lsds-286-v6.0.owl`	**[since amalfi-esa-sppa-landsat-1.0.11]** The Ontology file defining the Amalfi inspections dedicated to the quality control of the Landsat MSS GeoTIFF products formatted according to the [LSDS-286] version 6.0 i.e. this file the one actually used and connected to the main Ontology of this add-on package i.e. imported from the `cortex-index.owl` file described above.

Landsat DRB Cortex Topic for Landsat USGS products

The "DRB Cortex Topic for Landsat USGS products" package i.e. `drbx-cortex-topic-landsat-usgs:jar` is dedicated to support of the Landsat products files formatted according to the USGS data format control books [LS-DFBC-04], [LS-DFCB-20] and [LSDS-286]. This package is delivered separated from the Amalfi configuration `amalfi-config-landsat-usgs:jar` package in order to be reusable in other components e.g. Derby Application® or through direct use of DRB API® without including the Amalfi specific parts. This is useful not only for different contexts but also for quality control activities with the same definition files.

This package includes the following files:

File	Description
`fr/gael/drb/impl/mtl/*.class`	A series of Java classes that provides a DRB implementation for the support of the Landsat MTL file format barely defined in the USGS data format control books. This direct implementation in Java has been preferred to the use of an external descriptor to get the best parsing performance as possible.
`META-INF/cortex-index.owl`	The main entry point of the Ontology specifying and gathering all the resources of this package. This file includes, for example, the Xquery scripts that extracts the metadata information, the inspection definition common to all supported product types, etc.
`META-INF/MANIFEST.MF`	The standard JAR archive manifest file.
`META-INF/maven/*`	A folder of files replicating the Maven build configuration files.

File	Description
`Xsd/gov/usgs/landsat/ls-dfcb-04-v15.0-mtl.xsd`	An XML Schema dedicated to the validation of the Landsat ETM+ Metadata (MTL) File following the USGS data format control book [LS-DFCB-04] version 15. This file is only used for the validation and not for the format definition/decoding as far as the DRB implementation dedicated to the MTL file described above does not require any external definition.
`Xsd/gov/usgs/landsat/ls-dfcb-20-v4.0-mtl.xsd`	An XML Schema dedicated to the validation of the Landsat TM Metadata (MTL) File following the USGS data format control book [LS-DFCB-20] version 4. This file is only used for the validation and not for the format definition/decoding as far as the DRB implementation dedicated to the MTL file described above does not require any external definition.
`Xsd/gov/usgs/landsat/lsds-286-v6.0-mtl.xsd`	**[since amalfi-esa-sppa-landsat-1.0.11]** An XML Schema dedicated to the validation of the Landsat MSS Metadata (MTL) File following the USGS data format control book [LSDS-286] version 6.0. This file is only used for the validation and not for the format definition/decoding as far as the DRB implementation dedicated to the MTL file described above does not require any external definition.

Landsat Products Coverage

This chapter provides an overview of the current quality control coverage of this add-on on a file per file basis and for all supported Landsat TM, ETM+ product types. The file types are extracted from all USGS data format control books [LS-DFCB-04], [LS-DFCB-20] and [LSDS-286] or deduced from actual instances of products in output of the ESA processing chain when the documentation is incomplete.

The cells of the following table may contain a bullet if the quality control is possible or expected, and contain nothing if the file is not applicable for given product type. The bullets may be plain for file type supposed to be always part of the products or may be hollowed when the file is optional. For those applicable files, the cells background may be filled in green if a complete level of quality control can be considered, in orange for a partial level of implementation and a red for an nonexistent quality control coverage. Finally, the cells backgrounds are striped for those mandatory files that are not (yet?) available in ESA products.

File type	TM			ETM+			MSS	
	L1G	L1Gt	L1T	L1G	L1Gt	L1T	L1G	L1T
ESA Specific Files (in the top level directory)								
Metadata Report File (MTR.XML)	○	○	○	○	○	○	○	○
Browse Product File (BP.PNG)	●	●	●	●	●	●	●	●
Browse Report File (BP.XML)	●	●	●	●	●	●	●	●
Amalfi PDF Report File (QR.PDF)[1]	○	○	○	○	○	○	○	○
Amalfi XML Report File (QR.XML)1	○	○	○	○	○	○	○	○
USGS/ESA (in the *.TIFF sub-directory)								
L1 image file (for each requested band)	●	●	●	●	●	●	●	●
L1 BQA file (BQA.TIF file)	●	●	●	●	●	●	●	●
L1 Metadata file (text [.txt] file)	●	●	●	●	●	●	●	●
L1 Metadata file (text [.txt] file)	●	●	●	●	●	●	●	●
QA Band (GCP) file (text [.txt] file)							○	●
Ground Control Points (GCP) file (text [.txt] file)			●			●	○	●
GCP repartition			●			●	○	●
3 Band Verification Browse Image (JPEG [.JPG] file)[2]			●					●
Geometric Verification Statistics file (text [.txt] file)			●					●
Gap mask (.tif.gz file)[3]				○[3]	○[3]	○[3]		

[1] Amalfi Reports cannot be controlled since they are in output of the quality control process

[2] For disambiguation with respect to the DFCB, “3 Band” corresponds to a single JPEG including the three red, green and blue bands.

[3] The Gap mask is mandatory for SLC-off products

Landsat Quality Control Plans

The following sections describe the inspection plans applicable for:

- Landsat TM GeoTIFF Products (p. 9)
- Landsat ETM+ GeoTIFF Products (p. 19) and
- Landsat MSS GeoTIFF Products (p. 28)

Landsat TM GeoTIFF Products

The following inspection plan is applied to any Landsat TM L1T GeoTIFF Product:

Name	Inspector	Criteria	Description
TM L1 Metadata (MTL) Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Metadata (MTL) file
TM File Name Pattern	Xquery	Fails if the pattern does not match the specifications	Controls that the actual metadata file name conforms to the one specified in the [LS-DFCB-20]
XML Schema Validation	XML Schema	Fails upon any validation error	Applies the Metadata file XML Schema included in the DRB Cortex Topic and applicable to the TM Metadata file i.e. the ls-dfcb-20-v4.0-mtl.xsd file included in the drbx-cortex-topic-landsat-usgs:jar package (introduced in earlier chapters). The quality controlled applied to each element is defined in the table following the present one.
Creation Time	Xquery	Fails if the data structure does not conform to ISO 8601 standard	Extracts and verifies that the METADATA_FILE_INFO/FILE_DATE field conforms to the ISO 8610 standard
Sensor Mode Inspection	Xquery	Fails if the sensor mode does not match the allowed period for the acquiring platform	Extracts and verifies that the PRODUCT_METADATA /SENSOR_MODE field is correct according to the PRODUCT_METADATA/DATE_ACQUIRED. For Landsat 5 TM, the sensor mode is supposed to be SAM up to 2002-03-01T00:00:00 and BUMPER after this date. For Landsat 4 the mode shall always be SAM.
Acquisition Date Inspection	Xquery	Fails if the acquisition date is outside the actual operational period of the acquiring platform	Extracts and verifies that the PRODUCT_METADATA /DATE_ACQUIRED field is correct according to the actual operational period of acquiring platform i.e. PRODUCT_METADATA/SPACECRAFT_ID field. For Landsat 4, the acquisition date shall be after 1982-07-16T00:00:00 and before 1993-12-14T00:00:00. For Landsat 5, the acquisition date shall be after 1984-03-01T00:00:00 and before 2012-05-08T00:00:00.

Name	Inspector	Criteria	Description
Geolocation Inspection	MTLGeolocation	Fails if the overlapping ratio is over 75% (configurable)	Reads the Landsat World Reference System (WRS) path/row and geographic coordinates from the Metadata file, validates all of them and check their consistency with respect to a reference WRS database of corner points made available by USGS. The consistency is estimated by the overlapping percentage between the product footprint and the one of the expected by the reference WRS. Any distance or surface are computed over the WGS84 ellipsoid. The report includes a map of the product image and WRS geographical extents for a better comprehension of the adherence with the reference positions.
L1 GCP Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Ground Control Point (GCP) file
GCP File Name Pattern	Xquery	Fails if the pattern does not match the specifications	Controls that the actual GCP file name conforms to the one specified in the [LS-DFCB-20]
Ground Control Points	GCP	Fails if any residual exceeds 35 m or if less than 15 ground control points have been found.	Extracts all GCPs and verifies that more than 14 have been found and that any of the along and across scan residuals are not greater than 35 metres. The report includes a map of the GCPs over the product image geographical extents for a better comprehension of the GCP distribution. The GCPs are plotted in green if they have correct residuals and in red otherwise.
L1 Image Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Ground Control Point (GCP) file
File Name Pattern Inspection	Xquery	Fails if the pattern does not match the specifications	Controls that the actual BAND file name conforms to the one specified in the [LS-DFCB-20]. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi ESA-SPPA Landsat distribution branch**
Image Saturation	Landsat Image Saturation (defined in the Landsat configuration only)	Fails if the percentage of high saturation of a given image band if greater than a threshold (80%) or if the percentage of non-background pixels is lower than a threshold (5%).	Controls that only a limited number of pixels are saturated. Pixels are image samples with a DN value greater than a configurable threshold. Current configuration considers 255 DN sampling value as a saturation, and the maximum threshold is set to 80%. The inspection also controls that a minimum of non-background pixels are present in the band. The goal of this test is to identify empty images composed only of background pixels (i.e. 0 DN in current configuration) such observed in output of some development versions of the ESA Landsat Instrument Processing Facility (IPF). The current configuration consider empty, a band that contains less than 5% of non-background pixels.

Name	Inspector	Criteria	Description
			Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi configuration for Landsat **Note – since amalfi-esa-sppa-landsat-1.0.9, this inspection was limited to high saturation. Previous versions were including a low saturation tests that was impracticable for Landsat products.**
Image Striping	Image Striping	Fails if the one or more spectral peaks of DFT analysis of performed on several locations of the band are over a threshold (1.8).	Controls that none of the Direct Fourier Transform analyses performed on sub-windows evenly extracted from an image band has a spectral peak over a configurable threshold. The current configuration defines window of 256x256, a minimal period of 16, a density of 16 with a minimal standard deviation of 0.9. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi configuration for Landsat**
BQA extraction	Image Quality	Never fails	This test is informative. It gathers the image quality stored into the BQA band. Quality information is reported into the report and can be retrieved by ID reference within the XML report. **Note – this test has been implemented since amalfi-esa-sppa-landsat-1.0.15.**
GCP repartition	GCP/MTL Location	Fails if Cell is isolated or when most distant valid cells contains no GCP	This inspection controls the spatial distribution of Ground Control Points (GCP) among Landsat L1T and L1G+ single scenes. The purpose is to ensure that in the image data, the spatial distribution of the GCPs is uniformly spread over "valid" portions of the image (defined by cloud-free land pixels, without QC issues). The image is therefore divided into 16 (4 x 4) cells and the presence of GCPs in each of the “valid” cells is tested. A cell is classified as “valid” if it contains a percentage of invalid (cloud, water, saturated, SB) pixels lower than the maximum accepted (30%). **Note – this test has been implemented since amalfi-esa-sppa-landsat-1.0.18.**

The following table details the constraints verified during the XML Schema validation of the Metadata (MTL) file.

Field	Value Type	Occurr.	Constraints
METADATA_FILE_INFO	Complex	1..1	None
ORIGIN	String	1..1	Value shall have an length between 1 and 47 characters
REQUEST_ID	String	1..1	Value shall have an length between 1 and 20 characters
LANDSAT_SCENE_ID	String	1..1	Value shall match the pattern “LT[45]\d{3}\d{3}\d{4}\d{3}…\d{2}”
ORIGINAL_FILENAME	String	0..1	Value shall match the pattern “LM0[1-5]_(L1TP|L1GS)_\d{6}_\d{8}_\d{8}_(KSE|MTI|MPS|FUI|BSK|LBG|ULB|OHG)” **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility. Moved since 1.0.19.**
FILE_DATE	dateTime	1..1	ISO 8610 formatted
STATION_ID	String	1..1	Value shall have a length equal to 3
PROCESSING_SOFTWARE_VERSION	String	1..1	Value shall have an length between 1 and 20 characters and match the pattern “\w+_\d+\.\d+(\.\d+)*”
DATA_CATEGORY	String	1..1	Value shall be either NOMINAL, VALIDATION, EXCHANGE, TEST or ENGINEERING
PRODUCT_METADATA	Complex	1..1	None
DATA_TYPE	String	1..1	Value shall be either L1G, L1GT or L1T
DATA_TYPE_L0R	String	0..1	Value shall be either TMA_L0RP or TMR_L0RP
ELEVATION_SOURCE	String	0..1	Value shall be either NED, SRTM1, SRTM3, GTOPO30, GLS2000 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
OUTPUT_FORMAT	String	1..1	Value shall be equal to GEOTIFF
EPHEMERIS_TYPE	String	1..1	Value shall be either DEFINITIVE, PREDICTIVE or RESTITUTED **Note – the RESTITUTED value has been added since amalfi-esa-sppa-landsat-1.0.8**
SPACECRAFT_ID	String	1..1	Value shall be either LANDSAT_4 or LANDSAT_5
SENSOR_ID	String	1..1	Value shall be equal to TM
SENSOR_MODE	String	1..1	Value shall be either SAM or BUMPER
WRS_PATH	Integer	1..1	Value shall be included between 1 and 251
WRS_ROW	Integer	1..1	Value shall be included between 1 and 248
DATE_ACQUIRED	String	1..1	Value shall match the pattern "\d{4}-\d{2}-\d{2}"
SCENE_CENTER_TIME	String	1..1	Value shall match the pattern "\d{2}:\d{2}:\d{2}\.\d{7}Z"
CORNER_UL_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0

Field	Value Type	Occurr.	Constraints
CORNER_UL_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_UR_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_UR_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_LL_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_LL_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_LR_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_LR_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_UL_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UL_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UR_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UR_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LR_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LR_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LL_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LL_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
REFLECTIVE_LINES	Integer	1..1	Value shall be greater or equal to 1
REFLECTIVE_SAMPLES	Integer	1..1	Value shall be greater or equal to 1
THERMAL_LINES	Integer	1..1	Value shall be greater or equal to 1
THERMAL_SAMPLES	Integer	1..1	Value shall be greater or equal to 1
FILE_NAME_BAND_1	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B1\.TIF"
FILE_NAME_BAND_2	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B2\.TIF"
FILE_NAME_BAND_3	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B3\.TIF"
FILE_NAME_BAND_4	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B4\.TIF"
FILE_NAME_BAND_5	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B5\.TIF"
FILE_NAME_BAND_6	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B6\.TIF"
FILE_NAME_BAND_7	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B7\.TIF"

Field	Value Type	Occurr.	Constraints
REPORT_VERIFY_FILE_NAME	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_VER\.txt"
BROWSE_VERIFY_FILE_NAME	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_VER\.jpg"
METADATA_FILE_NAME	String	1..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_MTL\.txt"
CPF_NAME	String	1..1	Value shall match "L[45]CPF\d{4}\d{2}\d{2}_\d{4}\d{2}\d{2}\.\d{2}"
ESA_CPF_NAME	String	0..1	Value shall match "NOT_APPLICABLE|LM[1-5]CPF\d{8}_\d{8}\.\d{2}" **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility. Pattern since 1.0.18**
CALIBRATION_COEFFICIENTS	String	0..1	Value shall be either ESA or USGS **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility.**
IMAGE_ATTRIBUTES	Complex	1..1	None
CLOUD_COVER	Double	1..1	Value shall be greater or equal to -1.0 and lower or equal to 100.0
IMAGE_QUALITY_BAND_X	String	7	Value shall match pattern "[0-9]_[0-9]"
STICKY_BIT_CORRECTION_APPLIED	String	0..1	Expected value {YES,NO,NOT_APPLICABLE}
SB_PIXELS_BAND_X	Integer	0..7	Expected positive integer value
SUN_AZIMUTH	Double	1..1	Value shall be greater than -180.0 and lower or equal to 180.0 **Note – since amalfi-esa-sppa-landsat-1.0.7, this fields extents have been restored to DFCB values. Previous versions were following the ESA IPF that up to this release was wrongly considering -90, 90 range.**
SUN_ELEVATION	Double	1..1	Value shall be greater or equal to -90.0 and lower or equal to 90.0
GROUND_CONTROL_POINTS_MODEL	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
GEOMETRIC_RMSE_MODEL	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
GEOMETRIC_RMSE_MODEL_Y	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**

Field	Value Type	Occurr.	Constraints
GEOMETRIC_RMSE_MODEL_X	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
GROUND_CONTROL_POINTS_VERIFY	Double	0..1	Value shall be greater or equal to 1 and lower or equal to 9999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
GEOMETRIC_RMSE_VERIFY	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
GEOMETRIC_RMSE_VERIFY	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
MIN_MAX_RADIANCE	Complex	1..1	None
RADIANCE_MAXIMUM_BAND_1	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_1	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_2	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_2	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_3	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_3	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_4	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_4	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_5	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_5	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_6	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999

Field	Value Type	Occurr.	Constraints
RADIANCE_MINIMUM_BAND_6	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_7	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_7	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
MIN_MAX_PIXEL_VALUE	Complex	1..1	None
QUANTIZE_CAL_MAX_BAND_1	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_1	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_2	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_2	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_3	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_3	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_4	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_4	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_5	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_5	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_6	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_6	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_7	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_7	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
PRODUCT_PARAMETERS	Complex	1..1	None
CORRECTION_GAIN_BAND_1	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_2	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_3	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_4	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_5	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_6	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_7	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_1	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_2	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION

Field	Value Type	Occurr.	Constraints
CORRECTION_BIAS_BAND_3	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_4	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_5	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_6	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_7	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
RADIOMETRIC_RESCALING	Complex	1..1	None
RADIANCE_MULT_BAND_1	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_2	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_3	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_4	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_5	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_6	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_7	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_ADD_BAND_1	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_2	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_3	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_4	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_5	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_6	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_7	Double	1..1	Value shall be between -9999.999 and 9999.999 included
PROJECTION_PARAMETERS	Complex	1..1	None
MAP_PROJECTION	String	1..1	Value shall be equal to PS or UTM
DATUM	String	1..1	Value shall be equal to WGS84
ELLIPSOID	String	1..1	Value shall be equal to WGS84
UTM_ZONE	Integer	1..1	Value shall be between -60 and 60 included
VERTICAL_LON_FROM_POLE	Double	0..1	Value shall be between -180.0 and 180.0 included

Field	Value Type	Occurr.	Constraints
TRUE_SCALE_LAT	Double	0..1	Value shall be between -90.0 and 90.0 included
FALSE_EASTING	Double	0..1	Value shall be between -200000000.0 and 200000000 included
FALSE_NORTHING	Double	0..1	Value shall be between -200000000.0 and 200000000 included
GRID_CELL_SIZE_REFLECTIVE	Double	1..1	Value shall be between 0.0 and 120.0 included
GRID_CELL_SIZE_THERMAL	Double	1..1	Value shall be between 0.0 and 120.0 included
ORIENTATION	String	1..1	Value shall be equal to NORTH_UP
RESAMPLING_OPTION	String	1..1	Value shall be equal to CUBIC_CONVOLUTION
MAP_PROJECTION_L0RA	String	0..1	Value shall either be equal to PS, UTM, HOM, SOM or NA

Landsat ETM+ GeoTIFF Products

The following inspection plan is applied to any Landsat ETM+ L1T GeoTIFF Product.

Note – First complete version since amalfi-esa-sppa-landsat-1.0.8.

Note – since amalfi-esa-sppa-landsat-1.0.10, output reports of products acquired in SLC-OFF mode (i.e. acquired after 2003-05-31T21:30:00 excluded) include the following disclaimer in a headline section:

"*On May the 31st, 2003, the Scan Line Corrector (SLC) on board the Landsat 7 instrument suffered a total failure, which impacted the quality of the acquired images, with areas in the centre of the image being acquired twice and those at the edge of the image not being acquired at all. More information on the behaviour of the SLC can be found on the USGS site here: http://landsat.usgs.gov/products_slcoffbackground.php.*

As a result of this failure, and its impact on products, routine acquisition of Landsat ETM+ data by ESA was halted in May 2003. This product is not part of a routine acquisition, therefore should be used with caution.

Additional information on methods to overcome the gaps within products resulting from the failure in the SLC can be found here: http://landsat.usgs.gov/using_Landsat_7_data.php."

Name	Inspector	Criteria	Description
TM L1 Metadata (MTL) Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Metadata (MTL) file
TM File Name Pattern	XQuery	Fails if the pattern does not match the specifications	Controls that the actual metadata file name conforms to the one specified in the [LS-DFCB-04]
XML Schema Validation	XML Schema	Fails upon any validation error	Applies the Metadata file XML Schema included in the DRB Cortex Topic and applicable to the ETM+ Metadata file i.e. the ls-dfcb-04-v15.0-mtl.xsd file included in the DRBx-cortex-topic-landsat-usgs:jar package (introduced in earlier chapters). The quality controlled applied to each element is defined in the table following the present one.
Creation Time	XQuery	Fails if the data structure does not conform to ISO 8601 standard	Extracts and verifies that the METADATA_FILE_INFO/FILE_DATE field conforms to the ISO 8610 standard
Sensor Mode Inspection	XQuery	Fails if the sensor mode does not match the allowed period for the acquiring platform	Extracts and verifies that the PRODUCT_METADATA /SENSOR_MODE field is correct according to the PRODUCT_METADATA/DATE_ACQUIRED. For Landsat 5 TM, the sensor mode is supposed to be SAM up to 2002-03-01T00:00:00 and BUMPER after this date. For Landsat 4 the mode shall always be SAM.
Acquisition Date Inspection	XQuery	Fails if the acquisition date is outside the actual operational	Extracts and verifies that the PRODUCT_METADATA /DATE_ACQUIRED field is correct according to the actual operational period

Name	Inspector	Criteria	Description
		period of the acquiring platform	of acquiring platform i.e. PRODUCT_METADATA/SPACECRAFT_ID field. For Landsat 4, the acquisition date shall be after 1982-07-16T00:00:00 and before 1993-12-14T00:00:00. For Landsat 5, the acquisition date shall be after 1984-03-01T00:00:00 and before 2012-05-08T00:00:00.
Geolocation Inspection	MTLGeolocation	Fails if the overlapping ratio is over 75% (configurable)	Reads the Landsat World Reference System (WRS) path/row and geographic coordinates from the Metadata file, validates all of them and check their consistency with respect to a reference WRS database of corner points made available by USGS. The consistency is estimated by the overlapping percentage between the product footprint and the one of the expected by the reference WRS. Any distance or surface are computed over the WGS84 ellipsoid. The report includes a map of the product image and WRS geographical extents for a better comprehension of the adherence with the reference positions.
L1 GCP Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Ground Control Point (GCP) file
GCP File Name Pattern	XQuery	Fails if the pattern does not match the specifications	Controls that the actual GCP file name conforms to the one specified in the [LS-DFCB-04]
Ground Control Points	GCP	Fails if any residual exceeds 35 m or if less than 15 ground control points have been found.	Extracts all GCPs and verifies that more than 14 have been found and that any of the along and across scan residuals are not greater than 35 metres. The report includes a map of the GCPs over the product image geographical extents for a better comprehension of the GCP distribution. The GCPs are plotted in green if they have correct residuals and in red otherwise.
L1 Image Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Ground Control Point (GCP) file
File Name Pattern Inspection	XQuery	Fails if the pattern does not match the specifications	Controls that the actual BAND file name conforms to the one specified in the [LS-DFCB-04]. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi ESA-SPPA Landsat distribution branch**
Image Saturation	Landsat Image Saturation (defined in the Landsat configuration only)	Fails if the percentage of high saturation of a given image band if greater than a threshold (80%) or if the percentage of non-	Controls that only a limited number of pixels are saturated. Pixels are image samples with a DN value greater than a configurable threshold. Current configuration considers 255 DN sampling value as a saturation, and the maximum threshold is set to 80%.

Name	Inspector	Criteria	Description
		background pixels is lower than a threshold (5%).	The inspection also controls that a minimum of non-background pixels are present in the band. The goal of this test is to identify empty images composed only of background pixels (i.e. 0 DN in current configuration) such observed in output of some development versions of the ESA Landsat Instrument Processing Facility (IPF). The current configuration consider empty, a band that contains less than 5% of non-background pixels. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi configuration for Landsat** **Note – since amalfi-esa-sppa-landsat-1.0.9, this inspection was limited to high saturation. Previous versions were including a low saturation tests that was impracticable for Landsat products.**
Image Striping	Image Striping	Fails if the one or more spectral peaks of DFT analysis of performed on several locations of the band are over a threshold (1.8).	Controls that none of the Direct Fourier Transform analyses performed on sub-windows evenly extracted from an image band has a spectral peak over a configurable threshold. The current configuration defines window of 256x256, a minimal period of 16, a density of 16 with a minimal standard deviation of 0.9. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi configuration for Landsat** **Note – since amalfi-esa-sppa-landsat-1.0.10, this inspection is applied only for products acquired in SLC-ON mode i.e. acquired before 2003-05-31T21:30:00 included.**
BQA extraction	Image Quality	Never fails	This test is informative. It gathers the image quality stored into the BQA band. Quality information is reported into the report and can be retrieved by ID reference within the XML report. **Note – this test has been implemented since amalfi-esa-sppa-landsat-1.0.15.**
GCP repartition	GCP/MTL Location	Fails if Cell is isolated or when most distant valid cells contains no GCP	This inspection controls the spatial distribution of Ground Control Points (GCP) among Landsat L1T and L1G+ single scenes. The purpose is to ensure that in the image data, the spatial distribution of the GCPs is uniformly spread over "valid" portions of the image (defined by cloud-free land pixels, without QC issues). The image is therefore divided into 16 (4 x 4) cells and the presence of GCPs in each of the “valid” cells is tested. A cell is classified as “valid” if it contains a percentage of invalid (cloud, water, saturated, SB) pixels lower than the maximum accepted (30%).

Name	Inspector	Criteria	Description
			Note – this test has been implemented since amalfi-esa-sppa-landsat-1.0.18.

The following table details the constraints verified during the XML Schema validation of the Metadata (MTL) file.

Field	Value Type	Occurr.	Constraints
METADATA_FILE_INFO	Complex	1..1	None
ORIGIN	String	1..1	Value shall have an length between 1 and 47 characters
REQUEST_ID	String	1..1	Value shall have an length between 1 and 20 characters
LANDSAT_SCENE_ID	String	1..1	Value shall match the pattern "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}"
ORIGINAL_FILENAME	String	0..1	Value shall match the pattern "LE07_(L1TP|L1GT)_\d{6}_\d{8}_\d{8}_(KSE|MTI|MPS|FUI|BSK|LBG|ULB|OHG)" **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility. Moved since 1.0.19.**
FILE_DATE	dateTime	1..1	ISO 8610 formatted
STATION_ID	String	1..1	Value shall have a length equal to 3
PROCESSING_SOFTWARE_VERSION	String	1..1	Value shall have an length between 1 and 20 characters and match the pattern "\w+_\d+\.\d+(\.\d+)*"
DATA_CATEGORY	String	1..1	Value shall be either NOMINAL, VALIDATION, EXCHANGE, TEST or ENGINEERING
PRODUCT_METADATA	Complex	1..1	None
DATA_TYPE	String	1..1	Value shall be either L1G, L1GT or L1T
ELEVATION_SOURCE	String	0..1	Value shall be either NED, SRTM1, SRTM3, GTOPO30, GLS2000 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
OUTPUT_FORMAT	String	1..1	Value shall be equal to GEOTIFF
EPHEMERIS_TYPE	String	1..1	Value shall be either DEFINITIVE, PREDICTIVE or RESTITUTED **Note – the RESTITUTED value has been added since amalfi-esa-sppa-landsat-1.0.8**
SPACECRAFT_ID	String	1..1	Value shall be either LANDSAT_4 or LANDSAT_5
SENSOR_ID	String	1..1	Value shall be equal to TM

Field	Value Type	Occurr.	Constraints
SENSOR_MODE	String	1..1	Value shall be either SAM or BUMPER
WRS_PATH	Integer	1..1	Value shall be included between 1 and 251
WRS_ROW	Integer	1..1	Value shall be included between 1 and 248
DATE_ACQUIRED	String	1..1	Value shall match the pattern "\d{4}-\d{2}-\d{2}"
SCENE_CENTER_TIME	String	1..1	Value shall match the pattern "\d{2}:\d{2}:\d{2}\.\d{7}Z"
CORNER_UL_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_UL_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_UR_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_UR_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_LL_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_LL_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_LR_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_LR_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_UL_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UL_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UR_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UR_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LR_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LR_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LL_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LL_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
REFLECTIVE_LINES	Integer	1..1	Value shall be greater or equal to 1
REFLECTIVE_SAMPLES	Integer	1..1	Value shall be greater or equal to 1
THERMAL_LINES	Integer	1..1	Value shall be greater or equal to 1
THERMAL_SAMPLES	Integer	1..1	Value shall be greater or equal to 1
FILE_NAME_BAND_1	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B1\.TIF"

Field	Value Type	Occurr.	Constraints
FILE_NAME_BAND_2	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B2\.TIF"
FILE_NAME_BAND_3	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B3\.TIF"
FILE_NAME_BAND_4	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B4\.TIF"
FILE_NAME_BAND_5	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B5\.TIF"
FILE_NAME_BAND_6	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B6\.TIF"
FILE_NAME_BAND_7	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_B7\.TIF"
REPORT_VERIFY_FILE_NAME	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_VER\.txt"
BROWSE_VERIFY_FILE_NAME	String	0..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_VER\.jpg"
METADATA_FILE_NAME	String	1..1	Value shall match "LT[45]\d{3}\d{3}\d{4}\d{3}...\d{2}_MTL\.txt"
CPF_NAME	String	1..1	Value shall match "L[45]CPF\d{4}\d{2}\d{2}_\d{4}\d{2}\d{2}\.\d{2}"
ESA_CPF_NAME	String	1..1	Shall contain "Not Applicable" string **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility. Pattern updated since 1.0.18**
CALIBRATION_COEFFICIENTS	String	0..1	Value shall be either ESA or USGS **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility.**
IMAGE_ATTRIBUTES	Complex	1..1	None
CLOUD_COVER	Double	1..1	Value shall be greater or equal to -1.0 and lower or equal to 100.0
IMAGE_QUALITY_BAND_X	String	9	Value shall match pattern “[0-9]_[0-9]”
STICKY_BIT_CORRECTION_APPLIED	String	0..1	Expected value {YES,NO,NOT_APPLICABLE}
SUN_AZIMUTH	Double	1..1	Value shall be greater than -180.0 and lower or equal to 180.0 **Note – since amalfi-esa-sppa-landsat-1.0.7, this fields extents have been restored to DFCB values. Previous versions were following the ESA IPF that up to this release was wrongly considering -90, 90 range.**
SUN_ELEVATION	Double	1..1	Value shall be greater or equal to -90.0 and lower or equal to 90.0
GROUND_CONTROL_POINTS_MODEL	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 999 **Note – since amalfi-esa-sppa-landsat-1.0.7, this field is not mandatory for levels different from L1T**
GEOMETRIC_RMSE_MODEL	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999
GEOMETRIC_RMSE_MODEL_Y	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999

Field	Value Type	Occurr.	Constraints
GEOMETRIC_RMSE_MODEL_X	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999
MIN_MAX_RADIANCE	Complex	1..1	None
RADIANCE_MAXIMUM_BAND_1	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_1	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_2	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_2	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_3	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_3	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_4	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_4	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_5	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_5	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_6	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_6	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_7	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_7	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
MIN_MAX_PIXEL_VALUE	Complex	1..1	None
QUANTIZE_CAL_MAX_BAND_1	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_1	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_2	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_2	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_3	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255

Field	Value Type	Occurr.	Constraints
QUANTIZE_CAL_MIN_BAND_3	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_4	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_4	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_5	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_5	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_6	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_6	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_7	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_7	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
PRODUCT_PARAMETERS	Complex	1..1	None
CORRECTION_GAIN_BAND_1	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_2	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_3	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_4	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_5	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_6	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_7	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_1	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_2	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_3	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_4	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_5	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_6	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_BIAS_BAND_7	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
RADIOMETRIC_RESCALING	Complex	1..1	None
RADIANCE_MULT_BAND_1	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_2	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_3	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included

Field	Value Type	Occurr.	Constraints
RADIANCE_MULT_BAND_4	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_5	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_6	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_7	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_ADD_BAND_1	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_2	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_3	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_4	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_5	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_6	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_7	Double	1..1	Value shall be between -9999.999 and 9999.999 included
PROJECTION_PARAMETERS	Complex	1..1	None
MAP_PROJECTION	String	1..1	Value shall be equal to PS or UTM
DATUM	String	1..1	Value shall be equal to WGS84
ELLIPSOID	String	1..1	Value shall be equal to WGS84
UTM_ZONE	Integer	1..1	Value shall be between -60 and 60 included
VERTICAL_LON_FROM_POLE	Double	0..1	Value shall be between -180.0 and 180.0 included
TRUE_SCALE_LAT	Double	0..1	Value shall be between -90.0 and 90.0 included
FALSE_EASTING	Double	0..1	Value shall be between -200000000.0 and 200000000 included
FALSE_NORTHING	Double	0..1	Value shall be between -200000000.0 and 200000000 included
GRID_CELL_SIZE_REFLECTIVE	Double	1..1	Value shall be between 0.0 and 120.0 included
GRID_CELL_SIZE_THERMAL	Double	1..1	Value shall be between 0.0 and 120.0 included
ORIENTATION	String	1..1	Value shall be equal to NORTH_UP
RESAMPLING_OPTION	String	1..1	Value shall be equal to CUBIC_CONVOLUTION
MAP_PROJECTION_L0RA	String	0..1	Value shall either be equal to PS, UTM, HOM, SOM or NA

Landsat MSS GeoTIFF Products

[since amalfi-esa-sppa-landsat-1.0.7]

The following inspection plan is applied to any Landsat MSS GeoTIFF Product:

Name	Inspector	Criteria	Description
TM L1 Metadata (MTL) Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Metadata (MTL) file
TM File Name Pattern	XQuery	Fails if the pattern does not match the specifications	Controls that the actual metadata file name conforms to the one specified in the [LS-DFCB-22]
XML Schema Validation	XML Schema	Fails upon any validation error	Applies the Metadata file XML Schema included in the DRB Cortex Topic and applicable to the TM Metadata file i.e. the ls-dfcb-22-v3.0-mtl.xsd file included in the drbx-cortex-topic-landsat-usgs:jar package (introduced in earlier chapters). The quality controlled applied to each element is defined in the table following the present one.
Creation Time	XQuery	Fails if the data structure does not conform to ISO 8601 standard	Extracts and verifies that the METADATA_FILE_INFO/FILE_DATE field conforms to the ISO 8610 standard
Cloud Cover Type	XQuery	Fails if the both cloud coverage and cloud cover automated fields are positives or null.	Extracts and verifies that the CLOUD_COVER and CLOUD_COVER_AUTOMATED_L1 fields of IMAGE_ATTRIBUTES group are mutually exclusive i.e. both not positive or null simultaneously. **Note – Since amalfi-esa-sppa-landsat-1.0.11.**
L1 GCP Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for MSS L1 Ground Control Point (GCP) file **Note – applies only for L1T level**
GCP File Name Pattern	XQuery	Fails if the pattern does not match the specifications	Controls that the actual GCP file name conforms to the one specified in the [LS-DFCB-22]
Ground Control Points	GCP	Fails if any residual exceeds **140 m** or if less than 15 ground control points have been found.	Extracts all GCPs and verifies that more than 14 have been found and that any of the along and across scan residuals are not greater than **140 metres**. The report includes a map of the GCPs over the product image geographical extents for a better comprehension of the GCP distribution. The GCPs are plotted in green if they have correct residuals and in red otherwise. **Note – the maximum allowed residual has been doubled with respect to TM and ETM+ in order at least to reflect the processing pixel size for MSS L1T that is twice the one of the other sensors.**

Name	Inspector	Criteria	Description
L1 Image Inspection Plan	Plan	Fails upon any sub-inspection failure	The top level inspection plan for TM L1 Ground Control Point (GCP) file
File Name Pattern Inspection	XQuery	Fails if the pattern does not match the specifications	Controls that the actual BAND file name conforms to the one specified in the [LS-DFCB-22]. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi ESA-SPPA Landsat distribution branch**
Image Saturation	Landsat Image Saturation (defined in the Landsat configuration only)	Fails if the percentage of high saturation of a given image band if greater than a threshold (80%) or if the percentage of non-background pixels is lower than a threshold (5%).	Controls that only a limited number of pixels are saturated. Pixels are image samples with a DN value greater than a configurable threshold. Current configuration considers 255 DN sampling value as a saturation, and the maximum threshold is set to 80%. The inspection also controls that a minimum of non-background pixels are present in the band. The goal of this test is to identify empty images composed only of background pixels (i.e. 0 DN in current configuration) such observed in output of some development versions of the ESA Landsat Instrument Processing Facility (IPF). The current configuration consider empty, a band that contains less than 5% of non-background pixels. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi configuration for Landsat** **Note – since amalfi-esa-sppa-landsat-1.0.9, this inspection was limited to high saturation. Previous versions were including a low saturation tests that was impracticable for Landsat products.**
Image Striping	Image Striping	Fails if the one or more spectral peaks of DFT analysis of performed on several locations of the band are over a threshold (1.8).	Controls that none of the Direct Fourier Transform analyses performed on sub-windows evenly extracted from an image band has a spectral peak over a configurable threshold. The current configuration defines window of 256x256, a minimal period of 16, a density of 16 with a minimal standard deviation of 0.9. **Note – this test is described since this document version 1.3, although the inspection was available from the early version of the Amalfi configuration for Landsat**
BQA extraction	Image Quality	Never fails	This test is informative. It gathers the image quality stored into the BQA band. Quality information is reported into the report and can be retrieved by ID reference within the XML report. **Note – this test has been implemented since amalfi-esa-sppa-landsat-1.0.15.**

Name	Inspector	Criteria	Description
GCP repartition	GCP/MTL Location	Fails if Cell is isolated or when most distant valid cells contains no GCP	This inspection controls the spatial distribution of Ground Control Points (GCP) among Landsat L1T and L1G+ single scenes. The purpose is to ensure that in the image data, the spatial distribution of the GCPs is uniformly spread over "valid" portions of the image (defined by cloud-free land pixels, without QC issues). The image is therefore divided into 16 (4 x 4) cells and the presence of GCPs in each of the “valid” cells is tested. A cell is classified as “valid” if it contains a percentage of invalid (cloud, water, saturated, SB) pixels lower than the maximum accepted (30%). **Note – this test has been implemented since amalfi-esa-sppa-landsat-1.0.18.**

The following table details the constraints verified during the XML Schema validation of the Metadata (MTL) file.

Field	Value Type	Occurr.	Constaints
METADATA_FILE_INFO	Complex	1..1	None
ORIGIN	String	1..1	Value shall have an length between 1 and 47 characters
REQUEST_ID	String	1..1	Value shall have an length between 1 and 20 characters **Note – DFCB limits the length of this field to 19. The maximum length has however been set to 20, as for TM, on request of ESA**
LANDSAT_SCENE_ID	String	1..1	Value shall match the pattern "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}"
ORIGINAL_FILENAME	String	0..1	Value shall match the pattern “LM0[1-5]_(L1TP|L1GS)_\d{6}_\d{8}_\d{8}_(KSE|MTI|MPS|FUI|BSK|LBG|ULB|OHG)” **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility. Moved since 1.0.19.**
FILE_DATE	dateTime	1..1	ISO 8610 formatted
STATION_ID	String	1..1	Value shall have a length equal to 3
PROCESSING_SOFTWARE_VERSION	String	1..1	Value shall have an length between 1 and 20 characters and match the pattern "\w+_\d+\.\d+(\.\d+)*"
DATA_CATEGORY	String	1..1	Value shall be either NOMINAL, VALIDATION, EXCHANGE, TEST or ENGINEERING
PRODUCT_METADATA	Complex	1..1	None
DATA_TYPE	String	1..1	Value shall be either L1G, L1GT or L1T **Note – DFCB allows L1GT pattern also MS products are not supposed to be generated at this level**

Field	Value Type	Occurr.	Constaints
DATA_TYPE_L0R	String	0..1	Value shall be either MSSA_L0RP, MSSX_L0RP, MSSP_L0RP or MSSR_L0RP **Note – MSSR_L0RP value accepted since amalfi-esa-sppa-landsat-1.0.11**
ELEVATION_SOURCE	String	0..1	Value shall be either GLS2000 or RAMP
OUTPUT_FORMAT	String	1..1	Value shall be equal to GEOTIFF
EPHEMERIS_TYPE	String	1..1	Value shall be either DEFINITIVE, PREDICTIVE or RESTITUTED **Note – the RESTITUTED value has been added since amalfi-esa-sppa-landsat-1.0.8**
SPACECRAFT_ID	String	1..1	Value shall be either LANDSAT_1, LANDSAT_2, LANDSAT_3, LANDSAT_4 or LANDSAT_5
SENSOR_ID	String	1..1	Value shall be equal to MSS
WRS_PATH	Integer	1..1	Value shall be included between 1 and 251
WRS_ROW	Integer	1..1	Value shall be included between 1 and 248
DATE_ACQUIRED	String	1..1	Value shall match the pattern "\d{4}-\d{2}-\d{2}"
SCENE_CENTER_TIME	String	1..1	Value shall match the pattern "\d{2}:\d{2}:\d{2}\.\d{7}Z"
CORNER_UL_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_UL_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_UR_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_UR_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_LL_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_LL_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_LR_LAT_PRODUCT	Double	1..1	Value shall be included between -90.0 and 90.0
CORNER_LR_LON_PRODUCT	Double	1..1	Value shall be included between -180.0 and 180.0
CORNER_UL_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UL_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UR_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_UR_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LR_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000

Field	Value Type	Occurr.	Constaints
CORNER_LR_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LL_PROJECTION_X_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
CORNER_LL_PROJECTION_Y_PRODUCT	Double	1..1	Value shall be included between -132000000.000 and 132000000.000
REFLECTIVE_LINES	Integer	1..1	Value shall be greater or equal to 1
REFLECTIVE_SAMPLES	Integer	1..1	Value shall be greater or equal to 1
THERMAL_LINES	Integer	1..1	Value shall be greater or equal to 1
FILE_NAME_BAND_1	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B1\.TIF"
FILE_NAME_BAND_2	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B2\.TIF"
FILE_NAME_BAND_3	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B3\.TIF"
FILE_NAME_BAND_4	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B4\.TIF"
FILE_NAME_BAND_5	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B5\.TIF"
FILE_NAME_BAND_6	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B6\.TIF"
FILE_NAME_BAND_7	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_B7\.TIF"
FILE_NAME_BAND_QA	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_BQA\.TIF" **Note –Since amalfi-esa-sppa-landsat-1.0.13**
PRESENT_BAND_1	String	0..1	Value shall be equal to Y, N, M or U **Note – Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**
PRESENT_BAND_2	String	0..1	Value shall be equal to Y, N, M or U **Note – Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**
PRESENT_BAND_3	String	0..1	Value shall be equal to Y, N, M or U **Note –Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**
PRESENT_BAND_4	String	0..1	Value shall be equal to Y, N, M or U **Note –Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**

Field	Value Type	Occurr.	Constaints
PRESENT_BAND_5	String	0..1	Value shall be equal to Y, N, M or U **Note – Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**
PRESENT_BAND_6	String	0..1	Value shall be equal to Y, N, M or U **Note –Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**
PRESENT_BAND_7	String	0..1	Value shall be equal to Y, N, M or U **Note – Since amalfi-esa-sppa-landsat-1.0.11. Field not mandatory for backward compatibility purpose and because the ESA products does not seem to implement it.**
GROUND_CONTROL_FILE_NAME	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_GCP\.txt"
REPORT_VERIFY_FILE_NAME	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_VER\.txt"
BROWSE_VERIFY_FILE_NAME	String	0..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_VER\.jpg"
METADATA_FILE_NAME	String	1..1	Value shall match "LM[1-5]\d{3}\d{3}\d{4}\d{3}...\d{2}_MTL\.txt"
CPF_NAME	String	1..1	Value shall match "LM[1-5]CPF\d{4}\d{2}\d{2}_\d{4}\d{2}\d{2}\.\d{2}"
ESA_CPF_NAME	String	0..1	Value shall match “NOT_APPLICABLE|LM[1-5]CPF\d{8}_\d{8}\.\d{2}" **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility. Pattern since 1.0.18**
CALIBRATION_COEFFICIENTS	String	0..1	Value shall be either ESA or USGS **Note – since amalfi-esa-sppa-landsat-1.0.15, this field is not mandatory for backward compatibility.**
IMAGE_ATTRIBUTES	Complex	1..1	None
CLOUD_COVER	Double	1..1	Value shall be greater or equal to -1.0 and lower or equal to 100.0
CLOUD_COVER_AUTOMATED_L1	Double	1..1	Value shall be greater or equal to -1.0 and lower or equal to 100.0 **Note – Since amalfi-esa-sppa-landsat-1.0.11**
IMAGE_QUALITY	Integer	0..1	Value shall be greater or equal to -1 and lower or equal to 9. This field has been kept for backward compatibility with products generated by SLAP versions prior to v3.05. It is now implemented as a choice between this single field and the set of IMAGE_QUALITY_BAND_<n> fields defined below. **Note – Changed since amalfi-esa-sppa-landsat-1.0.14**

Field	Value Type	Occurr.	Constaints
IMAGE_QUALITY_BAND_<n> **Note – <n> from 1 to 7**	String	0..1	Value shall match "[0-9]_[0-9]". Field presence not verified according to product level (always optional). It is implemented as a choice between this set of four fields and the single IMAGE_QUALITY field defined above. **Note – Since amalfi-esa-sppa-landsat-1.0.14**
STICKY_BIT_CORRECTION_APPLIED	String	0..1	Value shall be equal to YES, NO or NOT_APPLICABLE. Field presence not verified according to product level (always optional) **Note – Since amalfi-esa-sppa-landsat-1.0.14**
SB_PIXELS_BAND_<n> **Note – <n> from 1 to 7**	Double	0..4	Value shall be greater or equal to 0.0. **Note – Moved here since amalfi-esa-sppa-landsat-1.0.14, SLA renamed to SLA_PIXELS_BAND_X renamed to SB_PIXELS_BAND since 1.0.18**
SUN_AZIMUTH	Double	1..1	Value shall be greater than -180.0 and lower or equal to 180.0
SUN_ELEVATION	Double	1..1	Value shall be greater or equal to -90.0 and lower or equal to 90.0
GROUND_CONTROL_POINTS_MODEL	Integer	0..1	Value shall be greater or equal to -1.0 and lower or equal to 100.0 **Note – Optional since amalfi-esa-sppa-landsat-1.0.13**
GEOMETRIC_RMSE_MODEL	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999
GEOMETRIC_RMSE_MODEL_Y	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999
GEOMETRIC_RMSE_MODEL_X	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999
GROUND_CONTROL_POINTS_VERIFY	Double	0..1	Value shall be greater or equal to 1 and lower or equal to 9999
GEOMETRIC_RMSE_VERIFY	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999
GEOMETRIC_RMSE_VERIFY_QUAD_UL	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – Introduced since amalfi-esa-sppa-landsat-1.0.11 for conformity with [LSDS-286] specifications but apparently not used for ESA products.**
GEOMETRIC_RMSE_VERIFY_QUAD_UR	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – Introduced since amalfi-esa-sppa-landsat-1.0.11 for conformity with [LSDS-286] specifications but apparently not used for ESA products.**

Field	Value Type	Occurr.	Constaints
GEOMETRIC_RMSE_VERIFY_QUAD_LL	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – Introduced since amalfi-esa-sppa-landsat-1.0.11 for conformity with [LSDS-286] specifications but apparently not used for ESA products.**
GEOMETRIC_RMSE_VERIFY_QUAD_LR	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 9999.999 **Note – Introduced since amalfi-esa-sppa-landsat-1.0.11 for conformity with [LSDS-286] specifications but apparently not used for ESA products.**
~~**MODEL_FIT_TYPE**~~	~~String~~	~~0..1~~	~~Value shall match the pattern: "(L1G|L1G\+|L1GT|L1T)_(MULTISCENE|SINGLESCENE)_(SUBOPTIMAL|OPTIMAL)" which corresponds to three parameters which will be separated by an underscore '_':~~ ~~1. Product Level among L1G / L1G+ / L1GT / L1T. Note that it is not controlled that L1GT is valid for ETM+ products only. Same for L1G+ that should apply only for non ETM+ products;~~ ~~2. Indicates if multi-scene modeling has been used;~~ ~~3. Indicates if expected geometric accuracy is below expected threshold.~~ ~~**Note – Moved down to the last position of the group since amalfi-esa-sppa-landsat-1.0.14**~~
GEOMETRIC_MAX_ERR	Double	0..1	Value shall be greater or equal to 0.0. Field presence not verified according to product level (always optional) **Note – Since amalfi-esa-sppa-landsat-1.0.13. Optional for backward compatibility with products prior to SLAP v3.05**
GROUND_CONTROL_POINTS_DISCARDED	Integer	0..1	Value shall be greater or equal to 0. Field presence not verified according to product level (always optional) **Note – Since amalfi-esa-sppa-landsat-1.0.13. Optional for backward compatibility with products prior to SLAP v3.05**
NUMBER_EMPTY_GROUND_CONTROL_POINT~~S~~_WINDOWS	Integer	0..1	Value shall be greater or equal to 0 and low or equal to 9. Field presence not verified according to product level (always optional) **Note – Renamed since amalfi-esa-sppa-landsat-1.0.14**
GROUND_CONTROL_POINTS_WINDOW <n> **Note – <n> from 0 to 8**	Integer	0..1	Value shall be greater or equal to 0. Field presence not verified according to product level (always optional) **Note – Now ranging from 0 to 8 instead of 1 to 9 as specified. Since amalfi-esa-sppa-landsat-1.0.14**
GROUND_CONTROL_POINT~~S~~_RESIDUALS_SKEW_X	Double	0..1	Unrestricted value. Field presence not verified according to product level (always optional) **Note – Since amalfi-esa-sppa-landsat-1.0.13 and renamed since amalfi-esa-sppa-landsat-1.0.14 (no 's' at POINT component)**

Field	Value Type	Occurr.	Constaints
GROUND_CONTROL_POINT~~S~~_RESIDUALS_KURTOSIS_X	Double	0..1	Unrestricted value. Field presence not verified according to product level (always optional) **Note – Moved here and renamed (no 's' at POINT component) since amalfi-esa-sppa-landsat-1.0.14**
GROUND_CONTROL_POINT~~S~~_RESIDUALS_SKEW_Y	Double	0..1	Unrestricted value. Field presence not verified according to product level (always optional) **Note – Since amalfi-esa-sppa-landsat-1.0.13 and renamed since amalfi-esa-sppa-landsat-1.0.14 (no 's' at POINT component)**
~~**GROUND_CONTROL_POINTS_RESIDUALS_KURTOSIS_X**~~	~~Double~~	~~0..1~~	~~Unrestricted value. Field presence not verified according to product level (always optional)~~ ~~**Note – Moved up since amalfi-esa-sppa-landsat-1.0.14**~~
GROUND_CONTROL_POINTS_RESIDUALS_KURTOSIS_Y	Double	0..1	Unrestricted value. Field presence not verified according to product level (always optional) **Note – Since amalfi-esa-sppa-landsat-1.0.13 and renamed since amalfi-esa-sppa-landsat-1.0.14 (no 's' at POINT component)**
~~**STICKY_BIT_CORRECTION_APPLIED**~~	~~String~~	~~0..1~~	~~Value shall be equal to YES, NO or NOT_APPLICABLE. Field presence not verified according to product level (always optional)~~ ~~**Note – Moved up since amalfi-esa-sppa-landsat-1.0.14**~~
~~**IMAGE_QUALITY_BAND_<n>**~~ ~~**Note – <n> from 1 to 7**~~	~~String~~	~~0..1~~	~~Value shall match "[0-9]_[0-9]". Field presence not verified according to product level (always optional)~~ ~~**Note – Moved up since amalfi-esa-sppa-landsat-1.0.14**~~
~~**SLA_PIXELS_BAND_<n>**~~ ~~**Note – <n> from 1 to 7**~~	~~Double~~	~~0..1~~	~~Value shall be greater or equal to 0.0. Field presence not verified according to product level (always optional)~~ ~~**Note – Moved up since amalfi-esa-sppa-landsat-1.0.14**~~
MODEL_FIT_TYPE	String	0..1	Value shall match the pattern: "(L1G|L1G\+|L1GT|L1T)_(MULTISCENE|SINGLESCENE)_(SUBOPTIMAL|OPTIMAL)" which corresponds to three parameters which will be separated by an underscore '_': 4. Product Level among L1G / L1G+ / L1GT / L1T. Note that it is not controlled that L1GT is valid for ETM+ products only. Same for L1G+ that should apply only for non ETM+ products; 5. Indicates if multi-scene modeling has been used; 6. Indicates if expected geometric accuracy is below expected threshold. **Note – Moved here since amalfi-esa-sppa-landsat-1.0.14**

Field	Value Type	Occurr.	Constaints
MIN_MAX_RADIANCE	Complex	1..1	None **Note – According to the different numbering of bands between Landsat 1, 2, 3 (C series) and Landsat 4, 5 (D series), only the band 4 is mandatory. Bands 1, 2 3 are required for Landsat C, and 5,6,7 for Landsat D.**
RADIANCE_MAXIMUM_BAND_1	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999 **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MINIMUM_BAND_1	Double	0..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999 **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MAXIMUM_BAND_2	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999 **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MINIMUM_BAND_2	Double	0..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999 **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MAXIMUM_BAND_3	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999 **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MINIMUM_BAND_3	Double	0..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999 **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MAXIMUM_BAND_4	Double	1..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_4	Double	1..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999
RADIANCE_MAXIMUM_BAND_5	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999
RADIANCE_MINIMUM_BAND_5	Double	0..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999 **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_MAXIMUM_BAND_6	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999 **Note – Mandatory only for Landsat 4 and 5**

Field	Value Type	Occurr.	Constaints
RADIANCE_MINIMUM_BAND_6	Double	0..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999 **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_MAXIMUM_BAND_7	Double	0..1	Value shall be greater or equal to 0.0 and lower or equal to 999.999 **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_MINIMUM_BAND_7	Double	0..1	Value shall be greater or equal to -999.99 and lower or equal to 999.999 **Note – Mandatory only for Landsat 4 and 5**
MIN_MAX_PIXEL_VALUE	Complex	1..1	None **Note – According to the different numbering of bands between Landsat 1, 2, 3 (C series) and Landsat 4, 5 (D series), only the band 4 is mandatory. Bands 1, 2 3 are required for Landsat C, and 5,6,7 for Landsat D.**
QUANTIZE_CAL_MAX_BAND_1	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 255 **Note – Mandatory only for Landsat 1, 2, 3**
QUANTIZE_CAL_MIN_BAND_1	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 1 **Note – Mandatory only for Landsat 1, 2, 3**
QUANTIZE_CAL_MAX_BAND_2	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 255 **Note – Mandatory only for Landsat 1, 2, 3**
QUANTIZE_CAL_MIN_BAND_2	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 1 **Note – Mandatory only for Landsat 1, 2, 3**
QUANTIZE_CAL_MAX_BAND_3	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 255 **Note – Mandatory only for Landsat 1, 2, 3**
QUANTIZE_CAL_MIN_BAND_3	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 1 **Note – Mandatory only for Landsat 1, 2, 3**
QUANTIZE_CAL_MAX_BAND_4	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 255
QUANTIZE_CAL_MIN_BAND_4	Integer	1..1	Value shall be greater or equal to 0 and lower or equal to 1
QUANTIZE_CAL_MAX_BAND_5	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 255 **Note – Mandatory only for Landsat 4 and 5**
QUANTIZE_CAL_MIN_BAND_5	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 1 **Note – Mandatory only for Landsat 4 and 5**

Field	Value Type	Occurr.	Constaints
QUANTIZE_CAL_MAX_BAND_6	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 255 **Note – Mandatory only for Landsat 4 and 5**
QUANTIZE_CAL_MIN_BAND_6	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 1 **Note – Mandatory only for Landsat 4 and 5**
QUANTIZE_CAL_MAX_BAND_7	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 255 **Note – Mandatory only for Landsat 4 and 5**
QUANTIZE_CAL_MIN_BAND_7	Integer	0..1	Value shall be greater or equal to 0 and lower or equal to 1 **Note – Mandatory only for Landsat 4 and 5**
PRODUCT_PARAMETERS	Complex	1..1	None **Note – According to the different numbering of bands between Landsat 1, 2, 3 (C series) and Landsat 4, 5 (D series), only the band 4 is mandatory. Bands 1, 2 3 are required for Landsat C, and 5,6,7 for Landsat D.**
CORRECTION_GAIN_BAND_1	String	0..1	Value shall be equal to CPF or INTERNAL_CALIBRATION **Note – Mandatory only for Landsat 1, 2, 3**
CORRECTION_GAIN_BAND_2	String	0..1	Value shall be equal to CPF or INTERNAL_CALIBRATION **Note – Mandatory only for Landsat 1, 2, 3**
CORRECTION_GAIN_BAND_3	String	0..1	Value shall be equal to CPF or INTERNAL_CALIBRATION **Note – Mandatory only for Landsat 1, 2, 3**
CORRECTION_GAIN_BAND_4	String	1..1	Value shall be equal to CPF or INTERNAL_CALIBRATION
CORRECTION_GAIN_BAND_5	String	0..1	Value shall be equal to CPF or INTERNAL_CALIBRATION **Note – Mandatory only for Landsat 4 and 5**
CORRECTION_GAIN_BAND_6	String	0..1	Value shall be equal to CPF or INTERNAL_CALIBRATION **Note – Mandatory only for Landsat 4 and 5**
CORRECTION_GAIN_BAND_7	String	0..1	Value shall be equal to CPF or INTERNAL_CALIBRATION **Note – Mandatory only for Landsat 4 and 5**
GAIN_BAND_1	String	0..1	Value shall be equal to H, L or U **Note – Mandatory only for Landsat 1, 2, 3**
GAIN_BAND_2	String	0..1	Value shall be equal to H, L or U **Note – Mandatory only for Landsat 1, 2, 3**
GAIN_BAND_3	String	0..1	Value shall be equal to H, L or U **Note – Mandatory only for Landsat 1, 2, 3**

Field	Value Type	Occurr.	Constaints
GAIN_BAND_4	String	1..1	Value shall be equal to H, L or U
GAIN_BAND_5	String	0..1	Value shall be equal to H, L or U **Note – Mandatory only for Landsat 4 and 5**
GAIN_BAND_6	String	0..1	Value shall be equal to H, L or U **Note – Mandatory only for Landsat 4 and 5**
GAIN_BAND_7	String	0..1	Value shall be equal to H, L or U **Note – Mandatory only for Landsat 4 and 5**
RADIOMETRIC_RESCALING	Complex	1..1	None **Note – According to the different numbering of bands between Landsat 1, 2, 3 (C series) and Landsat 4, 5 (D series), only the band 4 is mandatory. Bands 1, 2 3 are required for Landsat C, and 5,6,7 for Landsat D.**
RADIANCE_MULT_BAND_1	Double	0..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MULT_BAND_2	Double	0..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MULT_BAND_3	Double	0..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_MULT_BAND_4	Double	1..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included
RADIANCE_MULT_BAND_5	Double	0..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_MULT_BAND_6	Double	0..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_MULT_BAND_7	Double	0..1	Value shall be between -9999999999999999999.999 and 9999999999999999999.999 included **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_ADD_BAND_1	Double	0..1	Value shall be between -9999.999 and 9999.999 included **Note – Mandatory only for Landsat 1, 2, 3**

Field	Value Type	Occurr.	Constaints
RADIANCE_ADD_BAND_2	Double	0..1	Value shall be between -9999.999 and 9999.999 included **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_ADD_BAND_3	Double	0..1	Value shall be between -9999.999 and 9999.999 included **Note – Mandatory only for Landsat 1, 2, 3**
RADIANCE_ADD_BAND_4	Double	1..1	Value shall be between -9999.999 and 9999.999 included
RADIANCE_ADD_BAND_5	Double	0..1	Value shall be between -9999.999 and 9999.999 included **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_ADD_BAND_6	Double	0..1	Value shall be between -9999.999 and 9999.999 included **Note – Mandatory only for Landsat 4 and 5**
RADIANCE_ADD_BAND_7	Double	0..1	Value shall be between -9999.999 and 9999.999 included **Note – Mandatory only for Landsat 4 and 5**
PROJECTION_PARAMETERS	Complex	1..1	None
MAP_PROJECTION	String	1..1	Value shall be equal to PS or UTM
DATUM	String	1..1	Value shall be equal to WGS84
ELLIPSOID	String	1..1	Value shall be equal to WGS84
UTM_ZONE	Integer	1..1	Value shall be between -60 and 60 included
VERTICAL_LON_FROM_POLE	Double	0..1	Value shall be between -180.0 and 180.0 included
TRUE_SCALE_LAT	Double	0..1	Value shall be between -90.0 and 90.0 included
FALSE_EASTING	Double	0..1	Value shall be between -200000000.0 and 200000000 included
FALSE_NORTHING	Double	0..1	Value shall be between -200000000.0 and 200000000 included
GRID_CELL_SIZE_REFLECTIVE	Double	1..1	Value shall be between 0.0 and 120.0 included
ORIENTATION	String	1..1	Value shall be equal to NORTH_UP
RESAMPLING_OPTION	String	1..1	Value shall be equal to CUBIC_CONVOLUTION
MAP_PROJECTION_L0RA	String	0..1	Value shall either be equal to PS, UTM, HOM, SOM or NA

Appendix – System Requirements

This add-on requires an Amalfi instance and therefore inherit from the system requirements of this latter.

System Requirements

- **Operating Systems**: all supporting Java 6
- **CPU**: equivalent to 500 MHz Pentium 3 or higher speed
- **System Memory (RAM)**: 512 Mb free minimum, 1024 Mb or greater free RAM recommended for extensive use
- **Screen**: 1024x768, "16 bit High Color" screen
- **Network**: required only for deployed installations, 128 Kbits/s recommended

Because all components of the Amalfi software are based on Java™, the supported Operating Systems are those required for installing a Java™ Virtual Machine. For up to date information, report to the following Web page: http://www.oracle.com/technetwork/java/javase/system-configurations-135212.html

Software Requirements

This add-on requires an installed Amalfi v2.0.5 already installed on the target system.

Acronyms and Abbreviations

ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee for Space Data Systems
DOM	Document Object Model
DRB	Data Request Broker
EBV	Effective Boolean Value
FTP	File Transfer Protocol
ISO	International Organization for Standardization
JAR	Java ARchive
OWL	Web Ontology Language
POM	Project Object Model
RDF	Resource Description Framework
RPM	RedHat Package Manager
SDF	Structured Data File
TAR	Tape ARchive
W3C	World Wide Web Consortium
XML	eXtensible Markup Language
XSD	XML Schema Description
ZIP	Compression format

Glossary of Terms

add-on	Amalfi package containing the entire configuration to perform dataset inspection.
Data	A reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing. Examples of data include a sequence of bits, a table of numbers, the characters on a page, the recording of sounds made by a person speaking, or a moon rock specimen – [CCSDS-OAIS].
DRB Cortex Extension	DRB Cortex is an extension to DRB able to provide semantic information inside DRB items.
Format	Format is a way of encoding data in a file.
Inspection	Conformity evaluation by observation and judgment accompanied as appropriate by measurement, testing or gauging – [ISO 9000:2000].
Item (DRB scope)	Item in DRB is the most abstract element managed by DRB. Existing implementations of items is Node, Value or Attribute.
Ontology	Ontology is usually shown as a graph defining relationship between simple element, and given semantic to.
Ontology Model	The model above an ontology. DRB Cortex API uses RDF/OWL model to provides semantics to DRB items.
Quality Control	Part of quality management focused on fulfilling quality requirements – [ISO 9000:2000]
Physical Object	An object (such as a moon rock, bio-specimen, microscope slide) with physically observable properties that represent information that is considered suitable for being adequately documented for preservation, distribution, and independent usage – [CCSDS-OAIS]
Reporting	Returning a formatted set of results.
Representation Information	The information that maps a Data Object into more meaningful concepts. An example is the ASCII definition that describes how a sequence of bits (i.e., a Data Object) is mapped into a symbol - [CCSDS-OAIS]
Result Persistency	A way of keeping result. (database, mail ...)
Structure Information	The information that imparts meaning about how other information is organized. For example, it maps bit streams to common computer types such as characters, numbers, and pixels and aggregations of those types such as character strings and arrays – [CCSDS-OAIS]
Topic	DRB package containing configuration able to decode dataset.

Bibliography

[AMALFI-SUM]	Amalfi 2.1 – User Manual. GAEL-P255-SUM-001. Version 3.4. March 1, 2013. GAEL Systems.
[LS-DFCB-04]	Landsat 7 (L7) – Enhanced Thematic Mapper Plus (ETM+) – Level 1 (L1). Data format Control Book (DFCB). Version 15.0. September 2012. Department of the Interior. U.S. Geological Survey (USGS).
[LS-DFCB-20]	Landsat Thematic Mapper (TM) – Level 1 (L1). Data format Control Book (DFCB). Version 4.0. August 2012. Department of the Interior. U.S. Geological Survey (USGS).
[LSDS-286]	Landsat Multispectral Scanner (MSS) – Level 1 (L1). Data format Control Book (DFCB). Version 6.0. August 2012. Department of the Interior. U.S. Geological Survey (USGS). **Note – Applicable since amalfi-esa-sppa-landsat-1.0.11.**
[LS-DFCB-22]	Landsat Multispectral Scanner (MSS) – Level 1 (L1). Data format Control Book (DFCB). Version 3.0. August 2012. Department of the Interior. U.S. Geological Survey (USGS). **Note – Superseded by [LSDS-286] since amalfi-esa-sppa-landsat-1.0.11.**
[ISO 9000:2000]	Quality management systems. Fundamentals and vocabulary. ISO Standard. September 20, 2005. Revision 2. Copyright © 2005 International Organization for Standardization (ISO).
[OWL]	OWL Web Ontology Language: Reference. W3C Recommendation. February 10, 2004. Version 1.0. Copyright © 2004 World Wide Web Consortium (W3C).
[RDF]	RDF/XML Syntax Specification (Revised). W3C Recommendation. February 10, 2004. Version 1.0. Copyright © 2004 World Wide Web Consortium (W3C).
[XML]	eXtensible Markup Language (XML) 1.0 (Second Edition). W3C Recommendation. October 6, 2000. Version 1.0. Copyright © 2000 World Wide Web Consortium (W3C).
[XML-SCHEMA]	XML Schema: Primer. W3C Recommendation. May 2, 2001. Version 1.0. Copyright © 2001 World Wide Web Consortium (W3C).
[XML-SCHEMA-STRUCT]	XML Schema: Structures. W3C Recommendation. May 2, 2001. Version 1.0. Copyright © 2001 World Wide Web Consortium (W3C).
[XML-SCHEMA-TYPES]	XML Schema: Data Types. W3C Recommendation. May 2, 2001. Version 1.0. Copyright © 2001 World Wide Web Consortium (W3C).

[XQUERY] XQuery 1.0: An XML Query Language. W3C Recommendation. January 23, 2007. Version 1.0. Copyright © 2007 World Wide Web Consortium (W3C).

Document Change Log

Issue	Date	Description of the change
draft	2012-05-31	Creation of the document.
1.0	2013-06-17	First distributed version of the document
1.1	2013-10-28	Updated for Amalfi – ESA SPPA Landsat v1.0.7 introducing MSS products levels L1G and L1Gt for all sensors
1.2	2013-12-03	Updated for Amalfi – ESA SPPA Landsat v1.0.8 introducing the RESTITUTED enumerated values for EPHEMERIS_TYPE field of all MTL files and reviewing the EMT+ product type. IDEAS PR Corrected: [IDEAS-PR-13-05731]: Amalfi Distribution version added to the report [IDEAS-PR-13-05732]: EPHEMERIS_TYPE field accepts the RESTITUTED value [IDEAS-PR-13-05735]: Installation issue not reproduced with 1.0.8 [IDEAS-PR-13-05736]: Image Saturation Test temporarily removed
1.3	2013-12-11	Updated for Amalfi – ESA SPPA Landsat v1.0.9 describing the Image Inspection plan that was missing even if the inspection were already implemented and distributed. IDEAS PR Updated – [IDEAS-PR-13-05736]: the Image Saturation Test was wrongly removed from the distribution. This has been resolved in the v1.0.9 by restoring the inspection but removing only the aspects related to the low saturation tests i.e. actual tests and any corresponding results in the output XML and PDF reports.
1.4	2014-02-14	Updated for Amalfi – ESA SPPA Landsat v1.0.10 distinguishing ETM+ SLC-ON products from SLC-OFF ones. The SLC-OFF products are those strictly acquired after the 2003-05-31T21:30:00, when Landsat 7 ETM+ sensor Scan Line Corrector (SLC) suffered a total failure. A disclaimer has been specially implemented for those products and the Image Striping inspection is toggled off cf. § " Landsat ETM+ GeoTIFF Products" p. 19. IDEAS PR Fixed – [IDEAS-PR-13-05742] AMALFI 1.0.9 fails to recognize the SLC off instrument anomaly.
1.5	2014-10-01	Updated for Amalfi – ESA SPPA Landsat v1.0.11 adopting the new Landsat MSS specifications LSDS-286 v6.0 of August 2013. The changes are:

		– MTL/DATA_TYPE_L0RP now also accepts MSSR_L0RP value; – MTL/PRESENT_BAND_# 1 to 7 fields introduced; – MTL/CLOUD_COVER_AUTOMATED_L1 field introduced; – MTL/GEOMETRIC_RMSE_VERIFY_QUAD_UL/UR/LL/LR introduced; – Introduction of “Cloud Cover Type” inspection. Note – Changes are highlighted by notes in red in the present version of the document. All notes report the amalfi-esa-sppa-landsat-1.0.11 version.
1.7	2017-02-16	Updated for Amalfi – ESA SPPA Landsat v1.0.13 adopting the new Landsat MSS specifications including an additional QA band. The changes are: – MTL/FILE_NAME_BAND_QA field introduced; – MTL/GROUND_CONTROL_POINTS_MODEL field becomes optional; – MTL/MODEL_FIT_TYPE field introduced; – MTL/GEOMETRIC_MAX_ERR field introduced; – MTL/GROUND_CONTROL_POINTS_DISCARDED field introduced; – MTL/NUMBER_EMPTY_GROUND_CONTROL_POINTS_WINDOWS field introduced; – MTL/GROUND_CONTROL_POINTS_WINDOW<n> fields introduced; – MTL/GROUND_CONTROL_POINTS_RESIDUALS_SKEW_X/Y fields introduced; – MTL/GROUND_CONTROL_POINTS_RESIDUALS_KURTOSIS_X/Y field introduced; – MTL/STICKY_BIT_CORRECTION_APPLIED field introduced; – MTL/IMAGE_QUALITY_BAND_<n> fields introduced; – MTL/SLA_PIXELS_BAND_<n> field introduced; – Generalization of GCP file and associated inspection plan; – Introduction and support of BQA band;
1.8	2017-02-19	Updated for Amalfi – ESA SPPA Landsat v1.0.14 mainly fixing the wrong ordering of the new Landsat MSS specifications for SLAP v3.05 introduced in the previous version of the Amalfi. The changes are: - MTL/IMAGE_QUALITY made optional and exclusive with the set of four IMAGE_QUALITY_BAND_<n> fields; - MTL/IMAGE_QUALITY_BAND_<n> moved to replace the IMAGE_QUALITY field; - MTL/STICKY_BIT_CORRECTION_APPLIED moved up - MTL/SLA_PIXELS_BAND_<n> moved up; – NUMBER_EMPTY_GROUND_CONTROL_POINT_WINDOWS renamed (no ‘S’ at POINT component how defined in the original specifications);

		– MTL/MODEL_FIT_TYPE moved down to the last position of the IMAGE_ATTRIBUTES group; – MTL/GROUND_CONTROL_POINTS_WINDOW<n> updated with <n> ranging from 0 to 8 instead of 1 to 9 has defined in the original specifications; – MTL/GROUND_CONTROL_POINTS_RESIDUALS_KURTOSIS_X moved up; – All MTL GROUND_CONTROL_POINT_RESIDUALS_SKEW_X, GROUND_CONTROL_POINT_RESIDUALS_KURTOSIS_X, GROUND_CONTROL_POINT_RESIDUALS_SKEW_Y and GROUND_CONTROL_POINT_RESIDUALS_KURTOSIS_Y renamed with no 'S' for POINT component although initially defined in the original specifications.
	2017-10-19	Updated for Amalfi – ESA SPPA Landsat v1.0.15 adopting the new Landsat MSS/TM/ETM specifications. The changes are: – MTL/METADATA_FILE_INFO/ORIGINAL_FILENAME field introduced; – MTL/ESA_CPF_NAME field introduced; – MTL/CALIBRATION_COEFFICIENTS field introduced; A new inspection has been introduced to extract and expose BQA band quality information. **Note –** Changes are highlighted by notes in red in the present version of the document. All notes are related to the amalfi-esa-sppa-landsat-1.0.14 and amalfi-esa-sppa-landsat-1.0.15 version of the software.
1.9	2018-11-16	Upgrade to Amalfi 1.0.19 includes: - SB_PIXEL_BAND_X modified for MSS and TM datasets (modification from score 0-9 to effective number of pixels corrected for SB) - GCP Residual for MSS products threshold is changed from 70m to 140m - Add of GCP Distribution inspection inspection.