FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/IEC
FDIS
15444-4**

ISO/IEC JTC **1**/SC **29**

Secretariat: JISC

Voting begins on:
2021-03-11

Voting terminates on:
2021-05-06

Information technology — JPEG 2000 image coding system —

Part 4:
Conformance Testing

Technologies de l'information — Système de codage d'images JPEG 2000 —

Partie 4: Tests de conformité

Reference number
ISO/IEC FDIS 15444-4:2021(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IEC JTC 1, Information technology, Subcommittee SC 29, Coding of audio, picture, multimedia and hypermedia information, in collaboration with ITU-T. The technically identical text is published as Recommendation ITU-T T.803.

This third edition cancels and replaces the second edition (ISO/IEC 15444-4:2004) which has been technically revised.

The main changes compared to the previous edition are as follows:

— the criteria to be achieved to claim compliance with Rec. ITU-T 814 | ISO/IEC 15444-15 have been added.

A list of all parts in the ISO/IEC 15444 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Rec. ITU-T T.800 | ISO/IEC 15444-1 describes an image compression system that allows great flexibility, not only for the compression of images but also for access into the codestream. The codestream provides a number of mechanisms for locating and extracting portions of the compressed image data for the purpose of retransmission, storage, display, or editing. This access allows storage and retrieval of compressed image data appropriate for a given application without decoding.

This Recommendation | International Standard provides the framework, concepts, and methodology for testing and the criteria to be achieved to claim compliance to Rec. ITU-T T.800 | ISO/IEC 15444-1 or Rec. ITU-T T.814 | ISO/IEC 15444-15. The objective of standardization in this field is to promote interoperability between JPEG 2000 encoders and decoders and to test these systems for compliance to this Recommendation | International Standard. Compliance testing is the testing of a candidate product for the existence of specific characteristics required by a standard. It involves testing the capabilities of an implementation against both the compliance requirements in the relevant standard and the statement of the implementation's capability.

The purpose of this Recommendation | International Standard is to define a common test methodology, to provide a framework for specifying abstract test suites (ATS), and to define the procedures to be followed during compliance testing.

Any organization contemplating the use of test methods defined in this Recommendation | International Standard should carefully consider the constraints on their applicability. Compliance testing does not include robustness testing, acceptance testing, and performance testing.

Information technology – JPEG 2000 image coding system —

Part 4: Conformance testing

1 Scope

This Recommendation | International Standard specifies the framework, concepts, methodology for testing, and criteria to be achieved to claim compliance to Rec. ITU-T T.800 | ISO/IEC 15444-1 or Rec. ITU-T T.814 | ISO/IEC 15444-15. It provides a framework for specifying abstract test suites and for defining the procedures to be followed during compliance testing.

This Recommendation | International Standard:

— specifies compliance testing procedures for encoding and decoding using Rec. ITU-T T.800 | ISO/IEC 15444-1 and Rec. ITU-T T.814 | ISO/IEC 15444-15;

— specifies codestreams, decoded images, and error metrics to be used with the testing procedures;

— specifies abstract test suites;

— provides guidance for creating an encoder compliance test

This Recommendation | International Standard does not include the following tests:

Acceptance testing: the process of determining whether an implementation satisfies acceptance criteria and enables the user to determine whether or not to accept the implementation. This includes the planning and execution of several kinds of tests (e.g., functionality, quality, and speed performance testing) that demonstrate that the implementation satisfies the user requirements.

Performance testing: measures the performance characteristics of an Implementation Under Test (IUT) such as its throughput, responsiveness, etc., under various conditions.

Robustness testing: the process of determining how well an implementation processes data which contains errors.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. At the time of publication, the editions indicated in dated references were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the

possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

Recommendation ITU-T T.800 | ISO/IEC 15444-1:2019, Information technology – JPEG 2000 image coding system: Core coding system.

Recommendation ITU-T T.814 | ISO/IEC 15444-15:2019, Information technology – JPEG 2000 image coding system: High-throughput JPEG 2000.

3 Definitions

For the purposes of this Recommendation | International Standard, the terms and definitions given in Rec. ITU-T T.800 | ISO/IEC 15444-1, Rec. ITU-T T.814 | ISO/IEC 15444-15 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
abstract test suite
Generic compliance testing concepts and procedures for a given requirement.

3.2
arithmetic coder
An entropy coder that converts variable length strings to variable length codes (encoding) and vice versa (decoding).

3.3
big endian
An order of bytes with the most significant byte first.

3.4
bit
A contraction of the term "binary digit"; a unit of information represented by a zero or a one.

3.5
bit-depth
The number of bits required to represent an original component of an image.

3.6
bit-plane
A two-dimensional array of bits. In this Recommendation | International Standard, a bit-plane refers to all the bits of the same magnitude in all coefficients or samples. This could refer to a bit-plane in a component, tile- component, code-block, region of interest, or other.

3.7
bitstream
The actual sequence of bits resulting from the coding of a sequence of symbols. It does not include the markers or marker segments in the main and tile-part headers or the EOC marker. It does include any packet headers and in stream markers and marker segments not found within the main or tile-part headers.

3.8
box
A portion of the file format defined by a length and unique box type. Boxes of some types may contain other boxes.

3.9
byte
Eight bits.

3.10
Cclass
Defines a level of performance for a decoder. Also provides guidance for encoders to produce codestreams that are easily decodable by compliant decoders.

3.11
code-block
A rectangular grouping of coefficients from the same sub-band of a tile-component.

3.12
coder
An embodiment of either an encoding or decoding process.

3.13
codestream
A collection of one or more bitstreams and the main header, tile-part headers, and the EOC required for their decoding and expansion into image data. This is the image data in a compressed form with all of the signalling needed to decode. This does not include the file format.

3.14
coding pass
A procedure accessing coefficients in a code-block where the context and bit are determined. Typically there are three different coding passes for each bitplane, each coefficient will be represented in exactly one of the three passes. For an encoder a coding pass examines coefficients and augments a bitstream. For a decoder a coding pass reads a bitstream and updates coefficients.

3.15
coefficient
The values that are the result of a transformation.

3.16
component
A two-dimensional array of samples. An image typically consists of several components (e.g., red, green, and blue).

3.17
compressed image data
Part or all of a codestream. Can also refer to a collection of bitstreams in part or all of a codestream.

3.18
compliance
Fulfilment of the specified requirements, as defined in this Recommendation | International Standard, for a given Profile and Cclass.

3.19
compliance test procedure
The process of assessing compliance.

3.20
context
Function of coefficients previously decoded and used to condition the decoding of the present coefficient.

3.21
decoder
An embodiment of a decoding process, and optionally a colour transformation process.

3.22
decoding process
A process that takes as its input all or part of a codestream and outputs all or part of a reconstructed image.

3.23
decomposition level

A collection of wavelet sub-bands where each coefficient has the same spatial impact or span with respect to the source component samples. These include all sub-bands of the same two-dimensional sub-band decomposition. For the last decomposition level, the LL sub-band is also included.

3.24
Discrete Wavelet Transformation (DWT)
A transformation that iteratively transforms one signal into two or more filtered and decimated signals corresponding to different frequency bands. This transformation operates on spatially discrete samples.

3.25
encoder
An embodiment of an encoding process, and optionally a colour transformation process.

3.26
encoding process
A process that takes as its input all or part of a source image data and outputs a codestream.

3.27
executable test suite
Set of executable test cases that support the abstract test cases.

3.28
file format
A codestream and additional support data and information not explicitly required for the decoding of the codestream. Examples of such support data include text fields providing titling, security and historical information, data to support placement of multiple codestreams within a given data file, and data to support exchange between platforms or conversion to other file formats.

3.29
fully decode
Applying Rec. ITU-T T.800 | ISO/IEC 15444-1 to produce an image from a codestream where all coded data in the codestream has been used to produce the image.

3.30
guard bits
Additional most significant bits that have been added to sample data.

3.31
header
Either a part of the codestream that contains only markers and marker segments (main header and tile part header) or the signalling part of a packet (packet header).

3.32
image
The set of all components.

3.33
image data
The component samples making up an image. Image data can refer to either the source image data or the reconstructed image data.

3.34
implementation
A realization of a specification.

3.35
Implementation Compliance Statement (ICS)
Statement of specification options and the extent to which they have been implemented by an implementation under test.

3.36
Implementation Under Test (IUT)
An implementation that is being evaluated for compliance.

3.37
irreversible
A transformation, progression, system, quantization, or other process that, due to systemic or quantization error, prevents lossless recovery.

3.38
JP2 file
The name of a file in the file format described in this Recommendation | International Standard. Structurally, a JP2 file is a contiguous sequence of boxes.

3.39
JPEG
Joint Photographic Experts Group – The joint ISO/ITU committee responsible for developing standards for continuous-tone still picture coding. It also refers to the standards produced by this committee: Rec. ITU-T T.81 | ISO/IEC 10918-1, Rec. ITU-T T.83 | ISO/IEC 10918-2, Rec. ITU-T T.84 | ISO/IEC 10918-3 and Rec. ITU-T T.87 | ISO/IEC 14495-1.

3.40
LL sub-band
The sub-band obtained by forward horizontal low-pass filtering and vertical low-pass filtering. This sub-band contributes to reconstruction with inverse vertical low-pass filtering and horizontal low-pass filtering.

3.41
layer
A collection of compressed image data from coding passes of one, or more, code-blocks of a tile-component. Layers have an order for encoding and decoding that has to be preserved.

3.42
lossless
A descriptive term for the effect of the overall encoding and decoding processes in which the output of the decoding process is identical to the input to the encoding process. Distortion-free restoration can be assured. All of the coding processes or steps used for encoding and decoding are reversible.

3.43
lossy
A descriptive term for the effect of the overall encoding and decoding processes in which the output of the decoding process is not identical to the input to the encoding process. There is distortion (measured mathematically). At least one of the coding processes or steps used for encoding and decoding is irreversible.

3.44
main header
A group of markers and marker segments at the beginning of the codestream that describe the image parameters and coding parameters that can apply to every tile and tile-component.

3.45
marker
A two-byte code in which the first byte is hexadecimal FF (0xFF) and the second byte is a value between 1 (0x01) and hexadecimal FE (0xFE).

3.46
marker segment
A marker and associated (not empty) set of parameters.

3.47
packet
A part of the codestream comprising a packet header and the compressed image data from one layer of one precinct of one resolution level of one tile-component.

3.48
packet header
Portion of the packet that contains signalling necessary for decoding that packet.

3.49
parser
Reads and identifies components of the codestream down to the code-block level.

3.50
partial decoding
Producing an image from a subset of an entire codestream.

3.51
precinct
A rectangular region of a transformed tile-component, within each resolution level, used for limiting the size of packets.

3.52
precision
Number of bits allocated to a particular sample, coefficient, or other binary numerical representation.

3.53
progression
The order of a codestream where the decoding of each successive bit contributes to a "better" reconstruction of the image. What metrics make the reconstruction "better" is a function of the application. Some examples of progression are increasing resolution or improved sample fidelity.

3.54
profile
A subset of technology, from Rec. ITU-T T.800 | ISO/IEC 15444-1, that meets the needs of a given application with limits on parameters within a selected technology. This is a codestream limitation.

3.55
quantization
A method of reducing the precision of the individual coefficients to reduce the number of bits used to represent them. This is equivalent to division while compressing and multiplying while decompressing. Quantization can be achieved by an explicit operation with a given quantization value (scalar quantization) or by dropping (truncating) coding passes from the codestream.

3.56
reconstructed image
An image that is the output of a decoder.

3.57
reference grid
A regular rectangular array of points used to define other rectangular arrays of data. The reference grid is used to determine the number of samples in tile-components for example.

3.58
Region Of Interest (ROI)
A collection of coefficients that are considered of particular relevance by some user-defined measure.

3.59
reversible
A transformation, progression, system, or other process that does not suffer systemic or quantization error and therefore allows for lossless signal recovery.

3.60
reversible filter
A particular filter pair used in the wavelet transformation which allows lossless compression.

3.61
sample
One element in the two-dimensional array that comprises a component.

3.62
selective arithmetic coding bypass
A coding style where some of the code-block passes are not coded by the arithmetic coder. Instead, the bits to be coded are appended directly to the bitstream without coding.

3.63
shift
Multiplication or division of a number by powers of two. Division of an integer via shift implies truncation toward minus infinity of the non-integer portion.

3.64
sign bit
A bit that indicates whether a number is positive (zero value) or negative (one value).

3.65
sign-magnitude notation
A binary representation of an integer where the distance from the origin is expressed with a positive number and the direction from the origin (positive or negative) is expressed with a separate single sign bit.

3.66
source image
An image used as input to an encoder.

3.67
sub-band
A group of transform coefficients resulting from the same sequence of low-pass and high-pass filtering operations, both vertically and horizontally.

3.68
testing
The process of evaluating compliance.

3.69
tile
A rectangular array of points on the reference grid, registered with an offset from the reference grid origin and defined by a width and height.

3.70
tile-component
All the samples of a given component in a tile.

3.71
tile-part
A portion of the codestream with compressed image data for some, or all, of a tile. The tile-part may include one or more packets that make up the coded tile.

3.72
tile-part header
A group of markers and marker segments at the beginning of each tile-part in the codestream that describe the tile-part coding parameters.

3.73
transformation
A mathematical mapping from one signal space to another.