

---

---

**Information technology — JPEG 2000  
image coding system: An entry level  
JPEG 2000 encoder**

*Technologies de l'information — Système de codage d'images  
JPEG 2000: Un encodeur JPEG 2000 de niveau d'entrée*

**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



**COPYRIGHT PROTECTED DOCUMENT**

© ISO/IEC 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## CONTENTS

	<i>Page</i>
1 Scope .....	1
1.1 Context .....	1
1.2 Requirements .....	1
2 References .....	1
2.1 Identical Recommendations   International Standards .....	1
3 Definitions .....	2
4 Abbreviations and symbols .....	5
4.1 Abbreviations .....	5
4.2 Symbols .....	5
5 General description .....	6
5.1 Codestream .....	6
5.2 Coding principles .....	6
6 Encoder requirements .....	8
6.1 General .....	8
6.2 Encoder function definition .....	8
6.3 Implementation .....	12
6.4 Codestream description .....	13
7 Optional file format requirements .....	13
Annex A – Codestream syntax .....	14
Annex B – Image and compressed image data ordering .....	15
Annex C – Arithmetic entropy coding .....	16
C.1 Binary encoding .....	16
C.2 Description of the arithmetic encoder .....	17
Annex D – Coefficient bit modelling .....	25
D.1 Code-block scan pattern within code-blocks .....	25
D.2 Coefficient bits and significance .....	25
D.3 Encoding passes over the bit-planes .....	26
D.4 Initializing and terminating .....	29
D.5 Error resilience segmentation symbol .....	31
D.6 Selective arithmetic coding bypass .....	31
D.7 Vertically causal context formation .....	32
D.8 Flow diagram of the code-block coding .....	32
Annex E – Quantization .....	35
E.1 Inverse quantization procedure (Informative) .....	35
E.2 Scalar coefficient quantization .....	36
Annex F – Discrete wavelet transformation of tile-components .....	37
F.1 Tile-component parameters .....	37
F.2 Discrete wavelet transformations .....	37
F.3 Forward transformation .....	37
F.4 Sub-sampling of components .....	45
F.5 Visual frequency weighting .....	45
Annex G – DC level shifting and multiple component transformations .....	48
G.1 DC level shifting of tile-components .....	48
G.2 Forward reversible multiple component transformation (RCT) .....	48
G.3 Forward irreversible multiple component transformation (ICT) .....	49
G.4 Chrominance component sub-sampling and the reference grid .....	49
Annex H – Coding of images with regions of interest .....	50
H.1 Description of the Maxshift method .....	50
H.2 Remarks on region of interest coding .....	51
Annex I – JP2 file format syntax .....	53

## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 15444-13 was prepared by Joint 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 identical text is published as ITU-T Rec. T.812.

ISO/IEC 15444 consists of the following parts, under the general title *Information technology — JPEG 2000 image coding system*:

- *Part 1: Core coding system*
- *Part 2: Extensions*
- *Part 3: Motion JPEG 2000*
- *Part 4: Conformance testing*
- *Part 5: Reference software*
- *Part 6: Compound image file format*
- *Part 8: Secure JPEG 2000*
- *Part 9: Interactivity tools, APIs and protocols*
- *Part 10: Extensions for three-dimensional data*
- *Part 11: Wireless*
- *Part 12: ISO base media file format*
- *Part 13: An entry level JPEG 2000 encoder*

**INTERNATIONAL STANDARD  
ITU-T RECOMMENDATION**

**Information technology – JPEG 2000 image coding system:  
An entry level JPEG 2000 encoder**

## **1 Scope**

This Recommendation | International Standard was developed by the Joint Photographic Experts Group (JPEG), the joint ISO/I–TU committee responsible for developing standards for continuous-tone still picture coding. It also refers to the Recommendations | International Standards produced by this committee: ITU-T Rec. T.81 | ISO/IEC 10918-1, ITU-T Rec. T.83 | ISO/IEC 10918-2, ITU-T Rec. T.84 | ISO/IEC 10918-3 and ITU-T Rec. T.87 | ISO/IEC 14495-1.

### **1.1 Context**

This Recommendation | International Standard defines a set of lossless (bit-preserving) and lossy compression methods for coding bi-level, continuous-tone greyscale, palletized colour, or continuous-tone colour digital still images. This Recommendation | International Standard:

- specifies normative but optional encoding processes for converting source image data to JPEG 2000 compressed image data;
- specifies a complete encoding path to produce a conforming codestream as defined in Part 1 Annex A (ITU-T Rec. T.800 | ISO/IEC 15444-1);
- provides guidance on encoding processes for converting source image data to compressed image data;
- provides guidance on how to implement these processes in practice.

### **1.2 Requirements**

This subclause contains a list of requirements for the definitions of an entry-level encoder.

An entry-level JPEG 2000 encoder implementation (this Recommendation | International Standard):

- shall be normative but optional; implementers shall be allowed to select necessary technologies/paths that would suite their application needs;
- shall define a JPEG 2000 Part 1 codestream encoder implementation; should define a JP2 file format encoder implementation;
- shall define a complete encoding path to produce a conforming codestream as defined in Annex A of ITU-T Rec. T.800 | ISO/IEC 15444-1:2004;
- shall consist of technology with clear IP status being royalty fee-free.

## **2 References**

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated 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.

### **2.1 Identical Recommendations | International Standards**

- ITU-T Recommendation T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines*.
- ITU-T Recommendation T.84 (1996) | ISO/IEC 10918-3:1997, *Information technology – Digital compression and coding of continuous-tone still images: Extensions*.

- ITU-T Recommendation T.86 (1998) | ISO/IEC 10918-4:1999, *Information technology – Digital compression and coding of continuous-tone still images: Registration of JPEG profiles, SPIFF profiles, SPIFF tags, SPIFF colour spaces, APPn markers, SPIFF compression types and Registration Authorities (REGAUT).*
- ITU-T Recommendation T.87 (1998) | ISO/IEC 14495-1:2000, *Information technology – Lossless and near-lossless compression of continuous-tone still images: Baseline.*
- ITU-T Recommendation T.88 (2000) | ISO/IEC 14492:2001, *Information technology – Lossy/lossless coding of bi-level images.*
- ITU-T Recommendation T.800 (2002) | ISO/IEC 15444-1:2004, *Information technology – JPEG 2000 image coding system: Core coding system.*
- ITU-T Recommendation T.801 (2002) | ISO/IEC 15444-2:2004, *Information technology – JPEG 2000 image coding system: Extensions.*
- ITU-T Recommendation T.803 (2002) | ISO/IEC 15444-4:2004, *Information technology – JPEG 2000 image coding system: Conformance testing.*
- ITU-T Recommendation T.804 (2002) | ISO/IEC 15444-5:2003, *Information technology – JPEG 2000 image coding system: Reference software.*