
**Information technology — JPEG XS
low-latency lightweight image coding
system —**

**Part 4:
Conformance testing**

*Technologies de l'information — Système de codage d'images léger à
faible latence JPEG XS —
Partie 4: Essais de conformité*

[ISO/IEC 21122-4:2022](https://standards.iso.org/iso-iec/21122-4-2022)

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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.

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 document 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 or www.iec.ch/members_experts/refdocs).

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. 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) or the IEC list of patent declarations received (see <https://patents.iec.ch>).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 21122-4:2020), which has been technically revised.

The main changes are as follows:

- reference test streams have been revised
- reference test streams for testing colour filter array (CFA) image compression have been added;
- reference test streams testing lossless coding have been added;
- reference test streams testing 4:2:0 sampled images has been added;
- a relaxed conformance point based on PSNR bounds was introduced.

A list of all parts in the ISO/IEC 21122 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

Information technology — JPEG XS low-latency lightweight image coding system —

Part 4: Conformance testing

1 Scope

This document specifies the framework, concepts, methodology for testing, and criteria to be achieved to claim conformance to multiple parts of the ISO/IEC 21122 series. It lists the conformance testing procedures.

This document specifies:

- Conformance testing procedures for decoders implementing ISO/IEC 21122-1.
- Tests to check which conformance point an ISO/IEC 21122-1 decoder conforms to, that is, whether a decoder satisfies the error bounds required for strict or relaxed conformance.
- Conformance testing procedures for decoders implementing ISO/IEC 21122-3.
- Tests to check codestreams for conformance to ISO/IEC 21122-1. As such, it provides means to test whether encoder implementations generate syntactically correct codestreams, and whether codestreams generated by such implementations follow the requirements of a particular profile, level and sublevel, and the buffer model implied by them.
- Tests to check files for conformance to ISO/IEC 21122-3.
- Conformance testing procedures that allow testing whether codestreams conform to any of the profiles specified in ISO/IEC 21122-2.
- Conformance testing procedures that allow testing whether codestreams conform to the buffer model specified in ISO/IEC 21122-2 as part of a profile, level and sublevel.
- Codestreams, decoded images, and error metrics to be used within the decoder testing procedures.
- A buffer model test.
- Abstract test suites.

NOTE This document does not specify:

- Testing the reconstruction of a full resolution image from a subsampled image format. In particular, upsampling from 4:2:2 or 4:2:0 to 4:4:4 sampling is a non-normative extension and as such its testing is beyond the scope of this document.
- Testing the conversion of the sample values reconstructed by an ISO/IEC 21122-3 decoder to the target colour space by means of the colour specification box of ISO/IEC 21122-3.
- Testing of the composition of background and foreground for images reconstructed from ISO/IEC 21122-3 files or codestreams that contain auxiliary channels carrying opacity information.
- Testing of the interpolation of a colour filter array image to a full scale colour image; this process is not normatively defined and beyond the scope of this document.
- 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 is able to conceal problems from attempting to reconstruct an image from an ill-formed codestream.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 21122-1, *Information technology — JPEG XS low-latency lightweight image coding system — Part 1: Core coding system*

ISO/IEC 21122-2, *Information technology — JPEG XS low-latency lightweight image coding system — Part 2: Profiles and buffer models*

ISO/IEC 21122-3, *Information technology — JPEG XS low-latency lightweight image coding system — Part 3: Transport and container formats*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 21122-1, ISO/IEC 21122-2, ISO/IEC 21122-3 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 executable test suite

set of executable test cases in the form of codestreams that are input into an implementation under test

3.2 JPEG XS file

sequence of bytes encoding an image in the JXS file format

Note 1 to entry: This format is specified in ISO/IEC 21122-3.

3.3 procedure

set of steps which accomplishes one of the tasks which comprise an encoding or decoding process

3.4 test codestream set

(sub-)set of codestreams that are input to an implementation under test for a particular test purpose

4 Abbreviated terms

ASCII American Standard Code for Information Interchange

ETS executable test suite

IUT	implementation under test
PSNR	peak signal to noise ratio
TCS	test codestream set

5 Overview

The conformance files including codestreams, reference decoded images, descriptive files and auxiliary software to facilitate testing are provided at <https://standards.iso.org/iso-iec/21122/-4/ed-2/en>, in compressed form. File locations given in this document are expressed relative to the top level directory tree within this compressed file. A Unix style file structure and delimiters are assumed.

This document contains instructions for the use of these files.

6 General description

6.1 Overview

The ISO/IEC 21122 series, also known as JPEG XS, consists of multiple parts of which for ISO/IEC 21122-1 describes the core coding system and the syntax of a codestream, for ISO/IEC 21122-2 describes profiles and buffer models and for ISO/IEC 21122-3 describes transport and container formats. This document defines test suites for decoder conformance tests for ISO/IEC 21122-1, ISO/IEC 21122-2 and ISO/IEC 21122-3.

6.2 Codestream syntax testing

The procedures of [Annex A](#) shall be used for testing codestreams for syntactical correctness. They depend on a codestream syntax parsing tool whose source code is provided at <https://standards.iso.org/iso-iec/21122/-4/ed-2/en>.

6.3 Test procedures to test decoders for conformance to ISO/IEC 21122-1

The procedures defined in [Annex B](#) and the subset of ETS defined in [Annex C, subclauses C.2 to C.10](#) that correspond to the profiles, levels and sublevels supported by the decoder, shall be used for testing decoders for compliance to ISO/IEC 21122-1. These procedures and ETS allow an IUT to evaluate conformance to ISO/IEC 21122-1 only. [Annex B](#) defines two conformance points, a strict conformance point that requires decoders to reconstruct codestreams into image data that is bitwise identical to the reference data, and a relaxed conformance point that offers additional freedom to implementations.

6.4 Test procedures to test decoders for conformance to ISO/IEC 21122-3

The procedures defined in [Annex B](#) and the subset of ETS defined in [Annex C, subclause C.11](#) that correspond to the profiles, levels and sublevels supported by the decoder shall be used for testing decoders for compliance to ISO/IEC 21122-3. These procedures and ETS allow an IUT to evaluate conformance to ISO/IEC 21122-1 and ISO/IEC 21122-3.

6.5 File format syntax testing

The procedures that shall be used for testing JPEG XS files for compliance to the file format specified in ISO/IEC 21122-3 are defined in [Annex D](#). They depend on a codestream syntax parsing tool whose source code is provided at <https://standards.iso.org/iso-iec/21122/-4/ed-2/en>.

6.6 Profile, level and sublevel conformance testing

[Annex A](#) also specifies a test procedure that shall be used for testing whether a codestream is conforming to a particular profile, level and sublevel, and whether, in particular, its coding parameters are within the constraints of the profile, level and sublevel indicated in the codestream. The test in [Annex A](#) depends on a program that is given at <https://standards.iso.org/iso-iec/21122/-4/ed-2/en>.

6.7 Buffer model conformance testing

[Annex E](#) specifies test procedures that shall be used for testing whether a codestream is conforming to a buffer model implied by the profile, level and sublevel indicated in the codestream. The tests in [Annex E](#) depend on a program that is given at <https://standards.iso.org/iso-iec/21122/-4/ed-2/en>.

6.8 Electronic attachments

[Annex F](#) lists the electronic attachments to this document and describes how to compile and use them.

7 Conformance files availability and updates

The conformance test images, streams and conformance test software released with this document are the latest tested versions available at the date at which the text was released.

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<https://standards.iteh.ai/catalog/standards/sist/5b81f6c7-fc43-490d-b96c-6cb383980280/iso-iec-21122-4-2022>

Annex A (normative)

Codestream syntax testing procedures

A.1 General

This annex defines a procedure that shall be followed for determining whether a codestream is syntactically well-formed and follows the syntactical requirements of ISO/IEC 21122-1. The test procedure also checks whether the coding parameters of a given codestream are consistent with the profile, level and sublevel indicators that are part of the picture header (see ISO/IEC 21122-1). A typical use case for this test is to check whether a given encoder generates profile, level and sublevel information correctly. To this end, a Python¹⁾ test script `jxscodestream.py` that performs a syntax analysis of a given codestream is provided at <https://standards.iso.org/iso-iec/21122/-4/ed-2/en>.

A.2 Installation

The test tool requires installation of a Python 2.7 interpreter on the computer system to be used for performing a test. Python is available for multiple operating systems at <https://docs.python.org>.

A.3 Usage of the syntax test tool

For testing a particular codestream for syntactical correctness and correct indication of profile, level and sublevel, the syntax analyser `jxscodestream.py` tool shall be run on a command line as follows:

```
jxscodestream.py codestream.jxs
```

where `codestream.jxs` is the codestream to be tested. A codestream is not conforming in case the above tool reports any error.

The lack of detection of any conformance violation by the syntax test tool should not be considered as a definite proof that the codestream under testing conforms to all constraints required for conformance to ISO/IEC 21122-1 and ISO/IEC 21122-2. ISO/IEC 21122-5 provides additional means for testing a codestream for conformance to the ISO/IEC 21122 series by feeding it into the reference software implementation.

1) Python is a trademark of the Python Software Foundation. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO/IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Annex B (normative)

Decoder testing procedures

B.1 General

This annex defines procedures that shall be followed for determining whether a JPEG XS decoder implementation is conforming to a particular profile, level and sublevel. It defines two conformance points; strict conformance and relaxed conformance.

B.2 Decoder test procedure

The following steps shall be performed for the purpose of testing a decoder implementation:

- Select to test for ISO/IEC 21122-1 only or ISO/IEC 21122-1 and ISO/IEC 21122-3.
- Select a profile, level and sublevel to test against.
- The profile, level and sublevel define a TCS (test codestream set), which consists of codestreams or files within the test suite that conform to
 - the codestream syntax specified in ISO/IEC 21122-1 or the file format specified in ISO/IEC 21122-3,
 - the selected profile,
 - a level whose sample count and sample rate is smaller than or equal to the sample count and sample rate of the selected level, and
 - to a sublevel whose bitrate is smaller or equal than the bitrate of the selected sublevel.
- Decode each codestream or file using the implementation under test.
- The decoded outputs are format converted if necessary.
- The difference between the decoded outputs and reference outputs is measured.
- If the decoded and reference are identical, the test proceeds to the next codestream in the TCS.
- The decoded image shall be compared to the reference image. Depending on the outcome of this test, the decoder is conforming to the strict conformance point, or only to the relaxed conformance point, or is non-conforming as follows:
 - **Strict Conformance Point:** If the decoded images are identical (i.e. the PSNR difference is infinity) to the reference images for all codestreams in the TCS, the decoder conforms to the strict conformance point in the given profile, level and sublevel.
 - **Relaxed Conformance Point:** If the PSNR difference between all decoded image and the reference image is above or equal to the PSNR bounds listed in [Annex C](#) for all codestreams in the TCS, the decoder conforms to the relaxed conformance point in the given profile, level and sublevel.
 - If for at least one codestream in the TCS the PSNR difference between the decoded image and the reference image is below the PSNR bounds listed in [Annex C](#) for this codestream, the decoder is non-conforming to the given profile, level and sublevel.

The entire set of test codestreams along with PSNR bounds is defined in more detail in [Annex C](#). Instructions how to measure PSNR are specified in [subclause B.8](#).

B.3 Files for testing

A particular ETS defines the input codestreams and PSNR bounds. These are specified in [Annex C](#) for all profiles.

B.4 Decoder settings

Decoders may have mechanisms for supporting various decompression settings. These may be set in the most advantageous way to achieve strict or relaxed conformance. For example, a decoder with a "fast mode" and an "accurate mode" may be set to the "accurate mode" to determine the level of conformance. These settings should be noted in any statement of conformance. Settings that allow the output resolution or spatial region of the reference decoded images to be matched may be changed for each decoded image. The same user-controlled settings for accuracy shall be used for all test codestreams of a TCS.

B.5 Output file format conversion

The reference decoded images are provided in a specific file format defined in [subclause B.7](#). In order to compare decoded images from the decoder under test with these images, several conversions may be necessary. These conversions may be done as post-processing steps outside of the decoder solely for determining conformance. There is no requirement for a conforming decoder to perform these processes as part of its normal operation. These conversions shall not introduce a quality change (either loss or gain) except as required by the specific conversions described in [subclauses B.6](#) and [B.7](#).

B.6 Sample format conversion

Image sample values are always unsigned integers. For the purpose of testing, it is of advantage to represent the integer output of the IUT in the ppx format defined in [subclause B.7](#) as ISO/IEC provides tools to measure on such files directly. Any up-sampling or colour space format conversions shall be disabled for the purpose of testing should a decoder offer these as optional features.

There is no requirement that a conforming decoder has to generate output to the specified format, and the representation of the output of the IUT in this format only facilitates the testing process. That is, it is acceptable to include additional lossless format conversions in the testing procedure provided the comparison between reconstructed and reference images is performed in the normative way.

Conversion from YC_bC_r to RGB, colour space conversions, up-sampling or interpolation of components to populate the entire sample grid may be provided as optional features of a decoder implementation and need to be disabled for testing purposes. This conversion between colour spaces is not related to the RCT or Star-Tetrix transformations that are normatively defined in ISO/IEC 21122-1, both of which shall be executed for the purpose of reference testing if enabled in the codestream. Conformance testing applies to the reconstructed sample values only, bare any interpretation relative to a colour space, and no colour space conversions are made for the purpose of testing. In particular, colour filter array images are understood as four-component images consisting of one red, two green and one blue component, consistent with their interpretation in ISO/IEC 21122-1. The width of their sampling grid is half the width of the sensor array, and the height of their sensor grid is half the height of the sensor array used to create these images.