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**Email of convenor:** [leonardo@chiariglione.org](mailto:leonardo@chiariglione.org)

**Committee URL:** [mpeg.chiariglione.org](http://mpeg.chiariglione.org)

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ORGANISATION INTERNATIONALE DE NORMALISATION  
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CODING OF MOVING PICTURES AND AUDIO**

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**Abstract**

This is a draft of the reference software implementing the G-PCC specification. Source code is provided in the attached zip archive.

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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](http://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](http://www.iso.org/patents)).

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](http://www.iso.org/iso/foreword.html).

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

A list of all parts in the ISO/IEC 23090 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](http://www.iso.org/members.html).

## Introduction

- <sup>1</sup> This International Standard accompanies reference software for ISO/IEC 23090-9 Geometry-based Point Cloud Compression. The reference software includes both encoder and decoder functionality.

- 2 Reference software is useful in aiding users of a compression standard to establish and test conformance and interoperability, and to educate users and demonstrate the capabilities of the standard. For these purposes, the accompanying software is provided as an aid for the study and implementation of ISO/IEC 23090-9 Geometry-based Point Cloud Compression.
- 3 The software has been developed by the ISO/IEC Moving Picture Experts Group (MPEG, Working Group 11 of Subcommittee 29 of ISO/IEC Joint Technical Committee 1).

### **Purpose**

- 4 The purpose of this International Standard is to provide the following:
  - (4.1) — Reference decoder software capable of decoding bitstreams that conform to ISO/IEC 23090-9 in a manner that conforms to the decoding process specified in ISO/IEC 23090-9.
  - (4.2) — Reference encoder software capable of producing bitstreams that conform to ISO/IEC 23090-9.

### **Examples of use**

- 5 Some examples of uses that may be appropriate for the reference decoder software are as follows:
  - (5.1) — As an illustration of how to perform the decoding process specified in ISO/IEC 23090-9.
  - (5.2) — As the starting basis for the implementation of a decoder that conforms to ISO/IEC 23090-9.
  - (5.3) — For testing the conformance of a decoder implementation with the decoding process specified in ISO/IEC 23090-9 (as the values of the samples in all decoded pictures and the relative ordering of those pictures will be identical from all conforming decoder implementations that support the profile and level used in a bitstream that conforms to ISO/IEC 23090-9).
  - (5.4) — For testing the conformance of a bitstream to the constraints specified for bitstream conformance in ISO/IEC 23090-9, as the software can detect and report many bitstream conformance violations.

NOTE — However, the lack of the detection of any conformance violation by the reference decoder software should not be considered as definitive proof that the bitstream conforms to all constraints specified for bitstream conformance in ISO/IEC 23090-9.

- 6 Some examples of uses that may be appropriate for the reference encoder software are as follows:
  - (6.1) — As an illustration of how to perform an encoding process that produces bitstreams that conform to the constraints specified for bitstream conformance in ISO/IEC 23090-9.
  - (6.2) — As the starting basis for the implementation of an encoder that conforms to ISO/IEC 23090-9.
  - (6.3) — As a means of generating bitstreams for testing the conformance of a decoder implementation with the decoding process specified in ISO/IEC 23090-9.
  - (6.4) — As a means of evaluating and demonstrating examples of the quality that can be achieved by an encoding process that conforms to ISO/IEC 23090-9.

NOTE — However, no guarantee of the quality that will be achieved by an encoder is provided by its conformance to ISO/IEC 23090-9, as the conformance of an encoder to ISO/IEC 23090-9 is defined only in terms of format constraints imposed on the bitstream syntax. Thus, while the reference encoder software may suffice to provide some illustrative examples of what quality can be achieved in conformance to ISO/IEC 23090-9, it provides neither an assurance of minimum guaranteed encoding quality nor maximum achievable encoding quality.

### **Warranty disclaimer**

- 7 Regardless of any and all statements made herein or elsewhere regarding the possible uses of the reference software, the following disclaimers of warranty apply to the provided reference software.
  - (7.1) — ISO/IEC disclaim any and all warranties, whether express, implied, or statutory, including any implied warranties of merchantability or of fitness for a particular purpose.

- (7.2) — In no event shall the contributor(s), ISO/IEC be liable for any incidental, punitive, or consequential damages of any kind whatsoever arising from the use of these programs.
- (7.3) — This disclaimer of warranty extends to the user of these programs and user's customers, employees, agents, transferees, successors, and assignees.
- (7.4) — ITU does not represent or warrant that the programs furnished hereunder are free of infringement of any third-party patents.?
- (7.5) — Commercial implementations of ISO/IEC International Standards, including shareware, may be subject to royalty fees to patent holders.
- (7.6) — Information regarding the common patent policy for ITU-T/ITU-R/ISO/IEC is available from the ITU website at <http://itu.int/ITU-T/dbase/patent/patent-policy.html>.

Information technology — MPEG-I (Coded Representation of Immersive Media) — Part XXX: Reference software for ISO/IEC 23090-XXX Geometry-based Point Cloud Compression

## 1 Scope

- <sup>1</sup> This document provides accompanying reference software for ISO/IEC 23090-9 as an electronic attachment. The software is an integral part of this International Standard.
- <sup>2</sup> The use of this reference software is not required for making an implementation of an encoder or decoder in conformance to ISO/IEC 23090-9. Requirements established in ISO/IEC 23090-9 take precedence over the behaviour of the reference software.

## 2 Normative references

- <sup>1</sup> 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.
- <sup>2</sup> ISO/IEC 23090-9:XXXX, Information technology — MPEG-I (Coded Representation of Immersive Media) — Part 9: Geometry-based Point Cloud Compression

## 3 Terms and definitions

- <sup>1</sup> For the purposes of this document, the terms and definitions given in ISO/IEC 23090-9 and the following apply.
- <sup>2</sup> ISO and IEC maintain terminological databases for use in standardization at the following addresses:
  - (2.1) — ISO Online browsing platform: available at <https://www.iso.org/obp>
  - (2.2) — IEC Electropedia: available at <http://www.electropedia.org/>
- <sup>3</sup> Definitions 3.1, 3.2, and 3.3 below replace the corresponding definitions in ISO/IEC 23090-9. Definitions 3.4 and 3.5 are additional definitions.

### 3.1

[defns.bitstream]

#### Bitstream

A sequence of bits that may conform to ISO/IEC 23090-9. A bitstream that conforms to ISO/IEC 23090-9 will contain one or more slices.

### 3.2

[defns.decoder]

#### Decoder

An embodiment of a process that operates on a bitstream and may conform to the decoding process requirements specified for conformance to ISO/IEC 23090-9. The scope of decoder, as considered herein, does not include a display process, which is outside the scope of this International Standard.

### 3.3

[defns.encoder]

#### Encoder

An embodiment of a process, not specified in this International Standard, that produces a bitstream.

### 3.4

[defns.refswdec]

#### Reference software decoder

The decoding software accompanying this International Standard.

**3.5****[defns.refswenc]****Reference software encoder**

The encoding software accompanying this International Standard.

**4 Abbreviations**

- <sup>1</sup> For the purposes of this document, relevant abbreviations are specified in clause 4 of ISO/IEC 23090-9.

**5 Conventions****[convention]**

- <sup>1</sup> For the purposes of this document, relevant conventions are specified in clause 5 of ISO/IEC 23090-9.

**6 Reference software for ISO/IEC 23090-9****[refsw]**

- <sup>1</sup> The reference software for ISO/IEC 23090-9 is found in the electronic attachment to this International Standard.
- <sup>2</sup> The attached software package contains one part:
- (2.1) — TMC13 software: Support for the **TBD** profiles.