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**CODING OF MOVING PICTURES AND AUDIO**

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# Abstract

This document is the working draft of the conformance testing specification for G-PCC, containing an annex for information for conformance bitstream submitters.

**ISO/IEC 23090-22:2020(E)**

ISO/IEC JTC 1/SC 29/WG 11

Secretariat: JISC

**Information technology — MPEG-I (Coded Representation of Immersive Media) — Part 22: Conformance Testing for ISO/IEC 23090-9 (G-PCC: Geometry-based Point Cloud Compression)**

WD stage

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Contents

[Foreword 3](#_Toc50554660)

[Introduction 4](#_Toc50554661)

[1 Scope 5](#_Toc50554662)

[2 Normative references 5](#_Toc50554663)

[2.1 General 5](#_Toc50554664)

[2.2 Identical International Standards 5](#_Toc50554665)

[2.3 Paired International Standards equivalent in technical content 6](#_Toc50554666)

[3 Definitions 6](#_Toc50554667)

[4 Abbreviations and acronyms 6](#_Toc50554668)

[5 Conventions 6](#_Toc50554669)

[6 Conformance testing for ISO/IEC 23090-9 6](#_Toc50554670)

[6.1 Introduction 6](#_Toc50554671)

[6.2 Bitstream conformance 6](#_Toc50554672)

[6.3 Decoder conformance 6](#_Toc50554673)

[6.4 Procedure to test bitstreams 6](#_Toc50554674)

[6.5 Procedure to test decoder conformance 7](#_Toc50554675)

[6.5.1 Conformance bitstreams 7](#_Toc50554676)

[6.5.2 Contents of the bitstream file 7](#_Toc50554677)

[6.5.3 Requirements on output of the decoding process 8](#_Toc50554678)

[6.5.4 Recommendations (informative) 8](#_Toc50554679)

[6.5.5 Decoder conformance test of a particular profile and level 8](#_Toc50554680)

[6.6 Specification of the test bitstreams 8](#_Toc50554681)

[6.6.1 General 8](#_Toc50554682)

[6.6.2 Test bitstreams – Geometry Coding 8](#_Toc50554683)

[6.7 Normative test suites for ISO/IEC 23090-9 8](#_Toc50554684)

[Annex A Information for conformance bitstream submitters 10](#_Toc50554685)

[A.1 ftp site 10](#_Toc50554686)

[A.2 Bitstream files 10](#_Toc50554687)

[A.3 Bitstream validation 11](#_Toc50554688)

[A.4 Test Sequences 11](#_Toc50554689)

[A.5 Timeline 11](#_Toc50554690)

[A.6 Recommendations 11](#_Toc50554691)

[A.7 Conformance bitstream list 11](#_Toc50554692)

Foreword

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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](https://www.iso.org/directives-and-policies.html)).

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](https://www.iso.org/iso-standards-and-patents.html)).

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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](https://www.iso.org/foreword-supplementary-information.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](https://www.iso.org/members.html).

Introduction

This document specifies how tests can be designed to verify whether bitstreams and decoders meet the requirements as specified in ISO/IEC 23090-9.

Advance in 3D capturing and rendering technologies is enabling new applications and services in the field of assisted and autonomous driving, maps, cultural heritage, industrial processes, immersive real-time communication, and Virtual/Augmented/Mixed reality (VR/AR/MR) content creation, transmission and communication. Point clouds have arisen as one of the main representations for such applications. A point cloud frame consists of a set of 3D points. Each point, in addition to having a 3D position may also be associated with numerous other attributes such as colour, transparency, reflectance, timestamp, surface normal, and classification. Such representations require a large amount of data, which can be costly in terms of storage and transmission. Therefore, ISO/IEC 23090-9 specifies Geometry-based Point Cloud Compression (G-PCC), which aims at efficiently compressing point cloud representations.

Information technology — MPEG-I (Coded Representation of Immersive Media) — Part 22: Conformance Testing for ISO/IEC 23090-9 (G-PCC: Geometry-based Point Cloud Compression)

# 1 Scope

This International Standard[[1]](#footnote-1) specifies a set of tests and procedures designed to indicate whether encoders or decoders meet the normative requirements specified in ISO/IEC 23090-9.

# 2 Normative references

## 2.1 General

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All Standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

## 2.2 Identical International Standards

– None.

## 2.3 Paired International Standards equivalent in technical content

– ISO/IEC 23090-9: in force, *Information technology – Coded representation of immersive media– Part 9: Geometry-based Point Cloud Compression*.

– ISO/IEC 23090-21: in force, *Information technology – Reference software of immersive media – Part 9: Geometry-based Point Cloud Compression*.

# 3 Terms and definitions

For the purposes of this International Standard, the terms, definitions, abbreviations and symbols specified in ISO/IEC 23090-9 (particularly in clause 3) apply. The following terms are further clarified for purposes herein as follows.

**3.1 bitstream**: An ISO/IEC 23090-9 bitstream.

**3.2 decoder**: An ISO/IEC 23090-9 decoder, i.e., an embodiment of the decoding process specified by ISO/IEC 23090-9. The decoder does not include the point cloud rendering process, which is outside the scope of this International Standard.

**3.3 encoder**: An embodiment of a process, not specified in this International Standard (except in regard to identification of the reference software encoder), that produces a bitstream.

**3.4 reference software decoder**: The software decoder provided in ISO/IEC 23090-21.

**3.5 reference software encoder**: The software encoder provided in | ISO/IEC 23090-21.

# 4 Abbreviations and acronyms

For the purposes of this International Standard, relevant abbreviations and acronyms are specified in clause 4 of ISO/IEC 23090-9.

# 5 Conventions

For the purposes of this International Standard, relevant conventions are specified in clause 5 of ISO/IEC 23090-9.

# 6 Conformance testing for ISO/IEC 23090-9

## 6.1 Introduction

The following clauses specify normative tests for verifying conformance of bitstreams as well as decoders. Those normative tests make use of test data (bitstream test suites) provided as an electronic annex to this International Standard and the reference software decoder specified in Rec. ISO/IEC 23090-21.

## 6.2 Bitstream conformance

Bitstream conformance for ISO/IEC 23090-9 is specified by clause x1.y1 of ISO/IEC 23090-9.

## 6.3 Decoder conformance

Decoder conformance for ISO/IEC 23090-9 is specified by clause x2.y2 of ISO/IEC 23090-9.

## 6.4 Procedure to test bitstreams

A bitstream that claims conformance with ISO/IEC 23090-9 shall pass the following normative test.

The bitstream shall be decoded by processing it with the reference software decoder. When processed by the reference software decoder, the bitstream shall not cause any error or non-conformance messages to be reported by the reference software decoder. This test should not be applied to bitstreams that are known to contain errors introduced by transmission, as such errors are highly likely to result in bitstreams that lack conformance to ISO/IEC 23090-9.

Successfully passing the reference software decoder test provides only a strong presumption that the bitstream under test does indeed meet all the requirements (except Annexes xx, yy and zz) specified in ISO/IEC 23090-9 that are tested by the reference software decoder.

Additional tests may be necessary to more thoroughly check that the bitstream properly meets all the requirements specified in ISO/IEC 23090-9 including the hypothetical reference decoder (HRD??) conformance (based on Annexes xx, yy and zz. These complementary tests may be performed using other video bitstream verifiers that perform more complete tests than those implemented by the reference software decoder.

ISO/IEC 23090-9 contains several informative recommendations that are not an integral part of International Standard. When testing a bitstream for conformance, it may also be useful to test whether or not the bitstream follows those recommendations.

To check correctness of a bitstream, it is necessary to parse the entire bitstream and to extract all the syntax elements and other values derived from those syntactic elements and used by the decoding process specified in ISO/IEC 23090-9.

A verifier may not necessarily perform all stages of the decoding process specified in ISO/IEC 23090-9 in order to verify bitstream correctness. Many tests can be performed on syntax elements in a state prior to their use in some processing stages.

## 6.5 Procedure to test decoder conformance

### 6.5.1 Conformance bitstreams

A bitstream has values of main\_profile\_compatibility\_flag and level\_idc corresponding to a set of specified constraints on a bitstream for which a decoder conforming to a specified profile, and level is required in Annex A of ISO/IEC 23090-9 to properly perform the decoding process.

### 6.5.2 Contents of the bitstream file

The conformance bitstreams are included in this International Standard as an electronic attachment. The following information is included in a single zipped file for each such bitstream.

* \*.bit – bitstream as described in section 2.2 (mandatory)
* \*.txt – description (mandatory)
* \*.cfg – config file used to generate bitstream with TMC13 encoder SW (optional, not applicable if TMC13 encoder release version not used)
* \*.md5 – MD5sum of the bitstream file (mandatory)
* \*\_dec.ply – sorted decoded point cloud frames (soft/optional, using a generalized Morton based order sorting).
* \*\_dec.ply.md5 – MD5 checksum for decoded point cloud frame (mandatory)

### 6.5.3 Requirements on output of the decoding process

Two classes of decoder conformance are specified:

* output order conformance; and
* output timing conformance

The output of the decoding process is specified in clause 8 of ISO/IEC 23090-9.

For output order conformance, it is a requirement that … (Ed. To be added)

For output timing conformance, it is a requirement that … (Ed. To be added)

The rendering process, which ordinarily follows the output of the decoding process, is outside the scope of this International Standard.

### 6.5.4 Recommendations (informative)

In addition to the requirements, it is desirable that conforming decoders implement various informative recommendations specified in ISO/IEC 23090-9 that are not an integral part of that International Standard. This clause discusses some of these recommendations.

It is recommended that a conforming decoder be able to resume the decoding process as soon as possible after the loss or corruption of part of a bitstream. In most cases it is possible to resume decoding at the next slice header.

### 6.5.5 Decoder conformance test of a particular profile and level

[Ed: To be added]

## 6.6 Specification of the test bitstreams

### 6.6.1 General

Some characteristics of each bitstream listed in Table 1 are specified in this clause.

### 6.6.2 Test bitstreams – Geometry Coding

#### 6.6.2.1 Test bitstream xx

**Specification**: …

**Functional stage**: Test the reconstruction process of …

**Purpose**:…

#### 6.6.2.2 Test bitstream yy

**Specification**: …

**Functional stage**: Test the reconstruction process of ...

**Purpose**: ...

6.7 Normative test suites for ISO/IEC 23090-9

**Annex A**  
  
Information for conformance bitstream submitters

This annex provides preliminary description of a conformance testing bitstream set and testing process for G-PCC. Refer to Section 3 for a preliminary list of planned bitstreams and volunteered contributors. It is encouraged for participants to contribute additional bitstreams that test other features and combinations.

* 1. ftp site

Establish an ftp site for bitstream exchanges and keep a summary record on the status of bitstream exchange. All the generated conformance bitstreams need to be made available at this site.

The information about the ftp site will be provided once it is available

* 1. Bitstream files

Volunteer organizations need to upload the bitstream together with:

* short description of the bitstream. A “textual” description could for example be “Trisoup with **log2\_trisoup\_node\_size=4** is used to encode geometry. Test the reconstruction process of trisoup geometry coding”.
* MD5 checksum MD5 for decoded point cloud frame provided.

Candidate list of the files is shown below:

1. \*.bit – bitstream (mandatory)
2. \*.txt – a short description of the bitstream (mandatory)
3. \*.cfg – config file used to generate bitstream using TMC13 reference encoder SW (mandatory)
4. \*.md5 – MD5 check sum of the bitstream file (mandatory)
5. \*\_dec.ply – unordered decoded point cloud frames (soft/optional). The decoded point cloud does not necessarily need to be ordered. However, for performing conformance test voxels in the point cloud need to be sorted in certain order (e.g. using a generalized Morton based order sorting).
6. \*\_dec.ply.md5 – MD5 checksum for decoded point cloud frame (mandatory)

All files in the zip archive should be in the top level, without a subfolder.

The .md5 file should contain only the MD5sum value and no additional characters.

A naming convention for zip file needs also to be established. One possible example of a naming convention is indicated below:

The following naming convention is to be used.

*Feature\_BistreamID\_Source\_Version*

* *Feature* is summarized in A.7.
* *BitstreamID* is a single capital letter, to distinguish among multiple bitstreams provided for a particular feature.
* *Source* is the name of the company who provided the bitstream.
* *Version* is the version number of the file (starting from 1), in case a bitstream is replaced because of an identified problem or updated for compatibility with a new version of the TMC13.

For example, for the feature “feature”, bitstream “A”, from source “company”, in its version “1”, the archive is named "feature\_A\_company\_1.zip", and the files would be named

feature\_A\_company\_1.bit

feature\_A\_company\_1.txt

feature\_A\_company\_1.cfg

feature\_A\_company\_1.md5

feature\_A\_company\_1\_dec.ply.md5

feature\_A\_company\_1\_dec.ply

* 1. Bitstream validation

The uploaded bitstreams should be validated and verified by at least two organizations and following aspects should be verified.

* Confirm if bitstream is decoded with perfect match
* Confirm if all intended features are included in the bitstream
  1. Test Sequences

Identify the test sequences that are used to generate conformance bitstreams. Practically, this should include all the CTC test sequences with some possible exception:

* Cat3-Fuse Sequences can only be used to generate lossy bitstream based on request from the content owner.
  1. Timeline

Establish schedule to prepare conformance bitstreams.

* 1. Recommendations

Test bitstreams should exercise the full range of parameters of modes of the tool tested in the category, including corner cases. Multiple bitstreams should be provided for each feature.

As new releases of the TMC13 software are made available, it is recommended to provide updated versions of the bitstreams compatible with the latest release.

The test bitstreams shall not violate the profile, level indicated in the bitstream. The minimum level that the bitstream conforms to should be used.

A TMC13 config file should be included in the .zip file if an unmodified TMC13 version is used, and the command line used should be included in the .txt file. If a modified version of the TMC13 is used, the TMC13 config file should not be included.

* 1. Conformance bitstream list

The conformance bitstreams are listed in the following categories, described below.

Table 1: Coding tools for G-PCC Main Profile

* Streams which exercise the range of capabilities of individual coding tools for Main profile

Table 1: Coding tools for Main Profile

|  |  |  |  |
| --- | --- | --- | --- |
| **Categories** | **Tool description** | **Bitstream features** | **Submitter** |
| Geometry coding | **neighbour\_avail\_boundary** | Test various neighbor boundary size |  |
| Geometry coding | **geometry\_planar\_mode** | Test planar\_mode on and off |  |
| Geometry coding | **geometry\_angular\_mode** | Test angular\_mode on and off |  |
| … | **…** | … |  |

1. This International Standard includes an electronic attachment containing the conformance bitstreams identified within the text. The conformance bitstreams needed for this International Standard are available at the following link: [TBD] [↑](#footnote-ref-1)