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Information technology — Coded representation of immersive media —

Part 15: Conformance testing for versatile video coding

Technologies de l'information — Représentation codée de média immersifs —

Partie 15: Essai de conformité pour le codage vidéo polyvalent

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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 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).

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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. 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*, in collaboration with ITU-T Study Group 16 (as Rec. ITU-T H.266.1).

A list of all parts in the ISO/IEC 23090 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 — Coded representation of immersive media —

Part 15: Conformance testing for versatile video coding

1 Scope

This document specifies a set of tests and procedures designed to indicate whether encoders or decoders meet the requirements specified in Rec. ITU-T H.266 | ISO/IEC 23090-3.

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.

Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021, *Information technology – Coded representation of immersive media– Part 3: Versatile video coding*

Rec. ITU-T H.266.2 | ISO/IEC 23090-16, *Information technology – Coded representation of immersive media – Part 16: Reference software for versatile video coding*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Rec. ITU-T H.266 | ISO/IEC 23090-3 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
bitstream
sequence of bits that conforms to specified syntax requirements or sequence of bits to be tested for conformance to such syntax requirements

3.2
decoder
embodiment of a specified decoding process or process to be tested for conformance to such a decoding process specification

3.3
encoder
embodiment of a process that produces a *bitstream* (3.1)

3.4
reference software decoder
particular *decoder* (3.2) provided as a software package for use as an example available for study, as a potential starting basis for the development of other decoders, as a way of testing *bitstreams* (3.1) for conformance to a decoding process specification, or as a reference for comparison with the behaviour of other decoders

3.5
reference software encoder
particular *encoder* (3.3) provided as a software package for use as an example available for study, as a potential starting basis for the development of other encoders, or as a reference for comparison with the behaviour of other encoders

4 Abbreviated terms

AMVP Adaptive motion vector prediction

CCLM Cross-component linear model

CIIP Combined inter/intra prediction

CST Chroma separate tree

CTC Common test conditions

DCT Discrete cosine transform

DMVR Decoder-side motion vector refinement

DQ Dependent quantization

DST Discrete sine transform

FTP File transfer protocol

ISP Intra subblock partitioning

JCCR Joint coding of chroma residuals

MMVD Merge with MVD

MPM Most probable mode

MRL Multiple reference line

AMVP Adaptive motion vector prediction

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CTC Common test conditions

DCT Discrete cosine transform

DMVR Decoder-side motion vector refinement

DQ Dependent quantization

DST	Discrete sine transform
FTP	File transfer protocol
ISP	Intra subblock partitioning
JCCR	Joint coding of chroma residuals
MMVD	Merge with MVD
MPM	Most probable mode
MRL	Multiple reference line
MVD	Motion vector difference
NUT	NAL unit type
PDPC	Position-dependent (intra) prediction combination
PERP	Padded equirectangular projection
RPR	Reference picture resampling
SAD	Sum of absolute differences
SBT	Subblock transform
SCC	Screen content coding
SbTMVP	Subblock based temporal motion vector prediction.
SMVD	Symmetric MVD
TMVP	Temporal motion vector prediction.

5 Conventions

The conventions in Clause 5 of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021 apply.

6 Conformance testing for ITU-T H.266 | ISO/IEC 23090-3

6.1 General

The conformance testing data for Rec. ITU-T H.266 | ISO/IEC 23090-3 is found in the electronic attachment that can be obtained at the following location:

https://standards.iso.org/iso-iec/23090/-15/ed-1/en/

The following subclauses specify normative tests for verifying conformance of video bitstreams as well as decoders. Those normative tests make use of test data (bitstream test suites) provided as an electronic attachment to this document and the reference software decoder specified in Rec. ITU-T H.266.2 | ISO/IEC 23090-16.

6.2 Bitstream conformance

Bitstream conformance for Rec. ITU-T H.266 | ISO/IEC 23090-3 is specified by clause C.4 of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

6.3 Decoder conformance

Decoder conformance for Rec. ITU-T H.266 | ISO/IEC 23090-3 is specified by clause C.5 of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

6.4 Procedure to test bitstreams

A bitstream that is claimed to conform to Rec. ITU-T H.266 | ISO/IEC 23090-3 shall pass the following normative test. 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 Rec. ITU-T H.266 | ISO/IEC 23090-3.

The bitstream under test shall be decoded by processing it with the reference software decoder specified in Rec. ITU-T H.266.2 | ISO/IEC 23090-16. 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. When the bitstream under test contains decoded picture hash SEI messages, the hash values signalled in the decoded picture hash SEI messages in the bitstream shall match those calculated by the reference software decoder.

Successfully passing this test provides only a strong presumption that the bitstream under test does indeed meet all the requirements specified in Rec. ITU-T H.266 | ISO/IEC 23090-3 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 Rec. ITU-T H.266 | ISO/IEC 23090-3, including hypothetical reference decoder (HRD) conformance (based on Annexes C and D). Such complementary tests may be performed using other video bitstream verifiers that perform more complete tests than those implemented by the reference software decoder.

Rec. ITU-T H.266 | ISO/IEC 23090-3 contains several informative recommendations that are not an integral part of that Recommendation | 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 the 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 Rec. ITU-T H.266 | ISO/IEC 23090-3.

A bitstream verifier may not necessarily perform all stages of the decoding process specified in Rec. ITU-T H.266 | ISO/IEC 23090-3 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 that conforms to Rec. ITU-T H.266 | ISO/IEC 23090-3 has values of general_profile_idc, general_tier_flag, and general_level_idc corresponding to a set of specified constraints on a bitstream for which a decoder conforming to a corresponding specified profile, tier, and level is required in Annex A of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021 to properly perform the decoding process.

6.5.2 Contents of the bitstream file

The associated conformance testing bitstreams are included with this document as an electronic attachment. The following information is included in a single zipped file for each such bitstream.

— *.bit – bitstream (provided for all bitstreams)

— *.txt – description (provided for all bitstreams)

— *.yuv.md5 – MD5 checksum of the complete decoded yuv file (provided for all bitstreams)

— *.md5 – MD5 checksum of the bitstream file (provided for all bitstreams)

— *.opl – output picture log (provided for all bitstreams)

— *.cfg – config file used to generate bitstream with VTM encoder software (not provided for all bitstreams, not applicable if a VTM encoder release version was not used)

6.5.3 Requirements on output of the decoding process and timing

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 and Annex C of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

For output order conformance, it is a requirement that all of the cropped decoded pictures specified for output in Annex C of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021 shall be output by a conforming decoder in the specified order and that the values of the decoded samples of the cropped decoded pictures that are output shall be (exactly equal to) the values specified in clause 8 of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

For output timing conformance, it is a requirement that a conforming decoder shall also output the cropped decoded pictures at the picture rates and times specified in Annex C of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

The display process, which ordinarily follows the output of the decoding process, is outside the scope of this document.

6.5.4 Static tests for output order conformance

Static tests of a video decoder require testing of the samples of the cropped decoded pictures that are output from the decoder, and can be accomplished when the decoded samples at the output of the decoding process are available. It may not be possible to perform this type of test with a production decoder (due to the lack of an appropriate accessible interface in the design at which to perform the test). In such a case this test should be performed by the manufacturer during the design and development phase. Static tests are used for testing the decoding process.

The pictures that are output by the decoder under test are checked to ensure that the following requirements are fulfilled:

— The cropped decoded pictures that are output by the decoder under test shall correspond to those that are output by the reference software decoder.

— The cropped decoded pictures that are output by the decoder under test shall be output in the same order as those that are output by the reference software decoder.

— The values of the samples of the cropped decoded pictures that are output by the decoder under test shall be identical to those that are output by the reference software decoder.

To assist with the checking of the decoding process and the cropped decoded pictures, hash values for the cropped decoded pictures that are output by conforming decoders are provided in a corresponding output picture log file for each test bitstream that is used in the specified conformance tests, and most of these test bitstreams also contain decoded picture hash SEI messages that may be used for checking the results of the decoding process of the decoder under test.

6.5.5 Dynamic tests for output timing conformance

Dynamic tests are applied to check that all the decoded samples of the cropped decoded pictures are output and that the timing of the output of the decoder's decoded samples conforms to the specifications of Clause 8 and Annex C of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021, and to verify that the decoder under test can operate according to bitstream flow characteristics prescribed by the specified HRD models (as specified by the CPB and DPB specification in Annex C of Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021) when the bits of the bitstream are delivered at the proper rate.

The dynamic test is often easier to perform on a complete decoding system, which may include a systems decoder, a video decoder and a display process. It may be possible to record the output of the display process and to check that display order and timing of the cropped decoded pictures are correct at the output of the display process. However, since the display process is not within the normative scope of Rec. ITU-T H.266 | ISO/IEC 23090-3, there may be cases where the output of the display process differs in timing or value even though the video decoder is conforming. In this case, the output of the video decoder itself (before the display process) would need to be captured in order to perform the dynamic tests on the video decoder. In particular the output order and timing of the output of the cropped decoded pictures shall be correct.

If buffering period and picture timing SEI messages are included in the test bitstream, HRD conformance shall be verified using the values of nal_initial_cpb_removal_delay, nal_initial_cpb_removal_offset, au_cpb_removal_delay_minus1 and pic_dpb_output_delay that are included in the bitstream.

If buffering period and picture timing SEI messages are not included in the bitstream, the following inferences shall be made to generate the missing parameters:

— fixed_pic_rate_general_flag[i] shall be inferred to be equal to 1.

— low_delay_hrd_flag[i] shall be inferred to be equal to 0.

— cbr_flag[subLayerId][j] shall be inferred to be equal to 0.

— The frame rate of the bitstream shall be inferred to be equal to the frame rate value specified in the .txt file for the bitstream. If this is missing, then a frame rate of either 25 or 30000 ÷ 1001 can be inferred.

— The bit rate of the bitstream shall be inferred to be equal to the maximum value for the level specified in Table 136 in Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

— CPB and DPB sizes shall be inferred to be equal to the maximum value for the level specified in Table 135 in Rec. ITU-T H.266:2020 | ISO/IEC 23090-3:2021.

With the above inferences, the HRD shall be operated as follows:

— The CPB is filled starting at time t = 0, until it is full, before removal of the first access unit. This means that the bp_nal_initial_cpb_removal_delay[i][j] shall be inferred to be equal to the total CPB buffer size divided by the bit rate divided by 90000 (rounded downwards) and bp_vcl_initial_cpb_removal_offset[i][j] shall be inferred to be equal to zero.

— The first access unit is removed at time t = bp_nal_initial_cpb_removal_delay[i][j] ÷ 90000 and subsequent access units are removed at intervals based on the picture distance.

— Using these inferences with the accompanying bitstreams, the CPB will not overflow or underflow and the DPB will not overflow.

6.5.6 Decoder conformance test for a particular profile, tier, and level

In order for a decoder for a particular profile, tier, and level to claim output order conformance to Rec. ITU-T H.266 | ISO/IEC 23090-3, the decoder shall successfully pass the static test specified in Clause 6.5.4 with all the bitstreams of the normative test suite specified for testing decoders of this particular profile, tier, and level combination.

In order for a decoder of a particular profile, tier, and level to claim output timing conformance to Rec. ITU-T H.266 | ISO/IEC 23090-3, the decoder shall successfully pass both the static test specified in clause 6.5.4 and the dynamic test specified in Clause 6.5.5 with all the bitstreams of the normative test suite specified for testing decoders of this particular profile, tier, and level.

Tables 1 through 10 specify the normative test suites. The profile, tier, and level combinations are described in the tables or in the .txt file associated with the bitstream.

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 – Coding tools for Main 10 profile with 4:2:0 chroma format and 10 bit depth

6.6.2.1 Chroma separate tree (CST)

6.6.2.1.1 Test bitstream CST_A

Specification: All pictures are coded in I slices with CST enabled. CST is tested with all possible luma and chroma block sizes, and luma-chroma block size combinations (e.g., luma block size is larger than, equal to, or smaller than the corresponding chroma block size).

Functional stage: Reconstruction process.

Purpose: Check that the decoder can properly decode slices with CST enabled.

6.6.2.2 Dependent quantization (DQ)

6.6.2.2.1 Test bitstream DQ_A

Specification: The bitstream consists of three CVSs, with the following properties:

— The first CVS uses dependent quantization for all pictures, all non-related features (inter tools, ALF, ...) are disabled, and MTS and LFNST are disabled.

— The second CVS uses dependent quantization for all pictures, all non-related features (inter tools, ALF, ...) are disabled, and MTS (for intra) and LFNST are enabled.

— The third CVS exercises a picture-level selection between dependent quantization, sign data hiding, and standard quantization, all non-related features (inter tools, ALF, ...) are disabled, and MTS (for intra) and LFNST are enabled.

Functional stage: Dependent quantization.

Purpose: Check that the decoder can properly decode slices with DQ enabled.

6.6.2.2.2 Test bitstream DQ_B

Specification: The bitstream consists of three CVSs of resolution 1920 x 1080, with the following properties:

— The first CVS uses dependent quantization for all pictures, all non-related features (inter tools, ALF, ...) are disabled, and MTS and LFNST are disabled.

— The second CVS uses dependent quantization for all pictures, all non-related features (inter tools, ALF, ...) are disabled, and MTS (for intra) and LFNST are enabled.

— The third CVS exercises a picture-level selection between dependent quantization, sign data hiding, and standard quantization, all non-related features (inter tools, ALF, ...) are disabled, and MTS (for intra) and LFNST are enabled.

Functional stage: Dependent quantization.

Purpose: Check that the decoder can properly decode slices with DQ enabled.

6.6.2.3 Cross-component linear model (CCLM)

6.6.2.3.1 Test bitstream CCLM_A

Specification: The bitstream exercises corner cases for coding structures using CCLM with the following properties:

— POC0: Chroma CU size is 64x64.

— POC1: First split of CU is horizontal, i.e. CU size is 64x32.

— POC2: First split of CU is quad, i.e. CU size is 32x32.

— POC3: First and second split of CU are horizontal and vertical, respectively.

— POC4: First split of CU is vertical or ternary, i.e. none of condition is satisfied for CCLM.

— POC5: CU size is 64x64 and ISP is enabled.

— POC6: First luma split is something else than quad.

Functional stage: Intra prediction.

Purpose: Check that the decoder can properly decode slices with CCLM enabled.

6.6.2.4 Multiple transform set (MTS)

6.6.2.4.1 Test bitstream MTS_A

Specification: The bitstream exercises the following transform features:

— 1st part

  — Explicit intra MTS on and explicit inter MTS off with low frequency non-separable transform (LFNST) disabled.

  — Include all test cases for ISP, MIP, luma tree, and CST.

  — Include all candidates of explicit MTS, i.e. DCT2-DCT2, DST7-DST7, DCT8-DST7, DST7-DCT8, and DCT8-DCT8.

  — Include all possible block sizes and partitions where all MTS combinations can happen.

— 2nd part

  — Implicit MTS on and explicit inter MTS off with LFNST disabled.

  — Include all test cases for ISP, MIP, luma tree, and CST.

  — Include all possible block sizes and partitions (especially for ISP) for all allowable MTS combinations.

Functional stage: Transform.

Purpose: Check that the decoder can properly decode slices with MTS enabled.

6.6.2.4.2 Test bitstream MTS_B

Specification: The bitstream exercises the following transform features:

- 1st part
  - Explicit intra MTS on and explicit inter MTS off with LFNST disabled.
  - Include all test cases for SBT, single tree and TU-tiling based on maximum transform size (64).
  - Include all candidates of explicit MTS, i.e., DCT2-DCT2, DST7-DST7, DCT8-DST7, DST7-DCT8, and DCT8-DCT8.
  - Include all possible block sizes and partitions (especially for SBT) where all MTS combinations can happen.
- 2nd part
  - Implicit intra MTS on and explicit inter MTS off with LFNST disabled.
  - Include all test cases for SBT, single tree, and TU-tiling based on maximum transform size (64).
  - Include all possible block sizes and partitions (especially for SBT) where all MTS combinations can happen.
- 3rd part
  - Implicit MTS on and explicit inter MTS off with LFNST disabled.
  - Include all test cases for SBT and single tree.
  - Include all possible block sizes and partitions (especially for SBT) where all MTS combinations can happen.
- 4th part
  - Explicit intra MTS on and explicit inter MTS on with LFNST disabled.
  - Include all test cases for SBT and single tree.
  - Include all possible block sizes and partitions (especially for SBT) where all MTS combinations can happen.

Functional stage: Transform.

Purpose: Check that the decoder can properly decode slices with MTS enabled.

6.6.2.5 Adaptive loop filter (ALF)

6.6.2.5.1 Test bitstream ALF_A

Specification: This bitstream uses both ALF and virtual boundary, as follows:

- Applies ALF virtual boundary (VB) at non-CTC CTU sizes (CTU size of 64 is used).
- Positions luma VB at 4 lines (Pos : 60) and chroma VB at 2 lines (Pos : 62) above the CTU height.

Functional stage: Adaptive loop filter.

Purpose: Check that the decoder can properly decode slices with ALF enabled.

6.6.2.5.2 Test bitstream ALF_B

Specification: This bitstream uses both ALF and virtual boundary, as follows:

— Applies ALF virtual boundary (VB) to sequences whose picture height is 1 CTU (CTU size of 128 is used as per CTC).

— Positions luma VB at 4 lines (Pos : 124) and chroma VB at 2 lines (Pos : 62) above the CTU height.

Functional stage: Adaptive loop filter.

Purpose: Check that the decoder can properly decode slices with ALF enabled.

6.6.2.5.3 Test bitstream ALF_C

Specification: Bitstream exercises clipping values of non-linear ALF.

Functional stage: Adaptive loop filter.

Purpose: Check that the decoder can properly decode slices with ALF enabled.

6.6.2.5.4 Test bitstream ALF_D

Specification: Bitstream uses multiple ALF APSs with LMCS enabled.

Functional stage: Adaptive loop filter.

Purpose: Check that the decoder can properly decode slices with ALF enabled.

6.6.2.6 Affine motion model (AFF)

6.6.2.6.1 Test bitstream AFF_A

Specification: The bitstream enables 6-parameter affine mode by SPS flag. All allowed blocks sizes of Affine merge mode are exercised multiple times. All allowed blocks sizes of Affine AMVP mode, including 4-parameter and 6-parameter Affine mode, are exercised multiple times. All allowed candidates for Affine merge mode, including two inherited candidates, four 6-parameter constructed candidates, two 4-parameter constructed candidates, and zero padding candidate are exercised multiple times. Inheritance of affine model from top CTU are exercised multiple times. Fallback mode for affine memory bandwidth restriction is triggered multiple times.

Functional stage: Affine mode inter prediction.

Purpose: Check that the decoder can properly decode slices with affine mode enabled.

6.6.2.6.2 Test bitstream AFF_B

Specification: The bitstream uses affine mode, with 6-parameter affine mode disabled by SPS flag. All allowed blocks sizes of Affine merge mode are exercised multiple times. All allowed blocks sizes of 4-parameter Affine AMVP mode are exercised multiple times. All allowed candidates for Affine merge mode, including two inherited candidates, two 4-parameter constructed candidates, and zero padding candidate are exercised multiple times. Inheritance of affine model from top CTU are exercised multiple times. Fallback mode for affine memory bandwidth restriction is triggered multiple times. All allowed blocks sizes of Affine merge mode are exercised multiple times. All allowed blocks sizes of 4-parameter Affine AMVP mode are exercised multiple times. All allowed candidates for Affine merge mode, including two inherited candidates, two 4-parameter constructed candidates, and zero padding candidate are exercised multiple times. Inheritance of affine model from top CTU are exercised multiple times. Fallback mode for affine memory bandwidth restriction is triggered multiple times.

Functional stage: Affine mode inter prediction.

Purpose: Check that the decoder can properly decode slices with affine mode enabled.

6.6.2.7 Subblock-based temporal merging candidates (SbTMVP)

6.6.2.7.1 Test bitstream SbTMVP_A

Specification: The bitstream uses SbTMVP when affine is disabled.

Functional stage: Inter prediction process.

Purpose: Check that the decoder can properly decode PUs with SbTMVP on and affine off.

6.6.2.7.2 Test bitstream SbTMVP_B

Specification: This bitstream disables SbTMVP.

Functional stage: Inter prediction process.

Purpose: Check that the decoder can properly decode PUs with SbTMVP off.

6.6.2.8 Adaptive motion vector resolution (AMVR)

6.6.2.8.1 Test bitstream AMVR_A

Specification: The bitstream exercises translational and affine AMVR with different settings. It represents a concatenation of 5 CVSs with the following properties:

— The first CVS exercises translational AMVR with amvr_precision_idx equal to 1 (i.e., 1 luma sample motion vector resolution).

— The second CVS exercises translational AMVR with amvr_precision_idx equal to 2 (i.e., 4 luma samples motion vector resolution).

— The third CVS exercises translational AMVR with amvr_precision_idx equal to 0 (i.e., 1/2 luma sample motion vector resolution). This implies application of the Switchable Interpolation Filter (SIF).

— The fourth CVS exercises affine AMVR with amvr_precision_idx equal to 0 (i.e., 1/16 luma sample motion vector resolution).

— The fifth CVS exercises affine AMVR with amvr_precision_idx equal to 1 (i.e., 1 luma sample motion vector resolution).

Functional stage: Inter prediction.

Purpose: Check that the decoder can properly decode bitstreams with AMVR enabled.

6.6.2.8.2 Test bitstream AMVR_B

Specification: The bitstream exercises AMVR. It cycles frame-by-frame between the following variants:

— Translational AMVR with amvr_precision_idx equal to 1 (i.e., 1 luma sample motion vector resolution).

— Translational AMVR with amvr_precision_idx equal to 2 (i.e., 4 luma samples motion vector resolution).

— Translational AMVR with amvr_precision_idx equal to 0 (i.e., 1/2 luma sample motion vector resolution), this implies application of the Switchable Interpolation Filter (SIF).

— Affine AMVR with amvr_precision_idx equal to 0 (i.e., 1/16 luma sample motion vector resolution).