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**Information technology — High  
efficiency coding and media delivery  
in heterogeneous environments —**

**Part 9:  
3D Audio conformance testing**

*Technologies de l'information — Codage à haut rendement et  
fourniture de supports dans les environnements hétérogènes —*

*Partie 9: Essais de conformité 3D Audio*



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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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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

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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

This document specifies how tests can be designed to verify whether bitstreams and decoders meet the requirements as specified in ISO/IEC 23008-3 and allow interoperability with remote terminals in interactive, broadcast, streaming and local (with stored contents) sessions. These tests can be used for various purposes, such as:

- manufacturers of encoders, and their customers, can use the tests to verify whether the encoder produces bitstreams compliant with ISO/IEC 23008-3,
- manufacturers of decoders and their customers can use the tests to verify whether the decoder meets the requirements specified in ISO/IEC 23008-3 for the claimed decoder capabilities,
- manufacturers and customers of terminals supporting interactive, broadcast, streaming, and local sessions over a multitude of transport protocols and networks, can use the tests to verify whether the claimed functionalities are compliant with ISO/IEC 23008-3,
- manufacturers of test equipment, and their customers can use the tests to verify compliance with ISO/IEC 23008-3.

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# Information technology — High efficiency coding and media delivery in heterogeneous environments —

## Part 9: 3D Audio conformance testing

### 1 Scope

This document specifies conformance criteria for both bitstreams and decoders compliant with the MPEG-H 3D audio standard as defined in ISO/IEC 23008-3. This is done to assist implementers and to ensure interoperability.

### 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 23003-1:2007/Amd.1:2008, *Information technology — MPEG audio technologies — Part 1: MPEG Surround — Amendment 1: Conformance testing*

ISO/IEC 23003-2:2010/Amd.4:2016, *Information technology — MPEG audio technologies — Part 2: Spatial Audio Object Coding (SAOC) — Amendment 4: SAOC Conformance*

ISO/IEC 23003-3:2012, *Information technology — MPEG audio technologies — Part 3: Unified speech and audio coding*

ISO/IEC 23003-4:—<sup>1)</sup>, *Information technology — MPEG audio technologies — Part 4: Dynamic range control*

ISO/IEC 23008-3:—<sup>2)</sup>, *Information technology — High efficient coding and media delivery in heterogeneous environments — Part 3: 3D audio*

ISO/IEC 23091-3, *Information technology — Coding-independent code points — Part 3: Audio*

### 3 Terms, definitions and abbreviated terms

#### 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

##### 3.1.1

##### **bitstream**

encoded audio data

1) Under preparation. Stage at the time of publication: ISO/IEC FDIS 23003-4:2018.

2) Under preparation. Stage at the time of publication: ISO/IEC FDIS 23008-3:2018.

### 3.1.2

#### **conformance test bitstream**

MPEG-H 3DA encoded bitstream used for testing the conformance of a MPEG-H 3DA decoder

### 3.1.3

#### **conformance test case**

combination of one or more conformance test conditions for which one conformance test bitstream is provided

### 3.1.4

#### **conformance test condition**

condition which applies to properties of a conformance test bitstream in order to test a certain functionality of the MPEG-H 3DA decoder

### 3.1.5

#### **conformance test criteria**

one or more conformance test tools with requirements that define whether a given output from a decoder under test fulfils the conformance

### 3.1.6

#### **conformance test data**

conformance test sequences and conformance criteria

### 3.1.7

#### **conformance test sequences**

generic term for conformance test bitstream and decoder settings with a corresponding reference

### 3.1.8

#### **conformance test tool**

tool to compare the reference waveform with the output from a decoder under test

### 3.1.9

#### **decoder setting case**

combination of one or more decoder setting conditions to trigger specific settings of the decoder

### 3.1.10

#### **decoder setting condition**

condition applied to the decoder behaviour in order to test functionality of the MPEG-H 3DA decoder

### 3.1.11

#### **reference waveform**

decoded counterpart of a conformance test bitstream with specific decoder settings

## 3.2 Abbreviated terms

|                      |                                           |
|----------------------|-------------------------------------------|
| 3DA                  | 3D audio                                  |
| MPEG-H 3DA bitstream | data encoded according to ISO/IEC 23008-3 |
| MPEG-H 3DA CPE       | mpegh3daChannelPairElement                |
| MPEG-H 3DA EXT       | mpegh3daExtElement                        |
| MPEG-H 3DA LFE       | mpegh3daLfeElement                        |
| MPEG-H 3DA SCE       | mpegh3daSingleChannelElement              |

## 4 MPEG-H 3D audio conformance testing

### 4.1 General

This clause specifies conformance criteria for both bitstreams and decoders compliant with ISO/IEC 23008-3 as defined in this document. This is done to assist implementers and to ensure interoperability.

### 4.2 Profiles

Profiles are defined in ISO/IEC 23008-3:—<sup>3)</sup>, 4.8. Some conformance criteria apply to MPEG-H 3D audio in general, while others are specific to certain profiles and their respective levels. Conformance shall be tested for the level of the profile with which a given bitstream or decoder claims to comply.

In addition to the conformance requirements described in this clause, a decoder which claims to comply with the MPEG-H 3D audio shall fulfil conformance defined in ISO/IEC 23003-4:—, Clause 9<sup>4)</sup>.

### 4.3 Test procedure

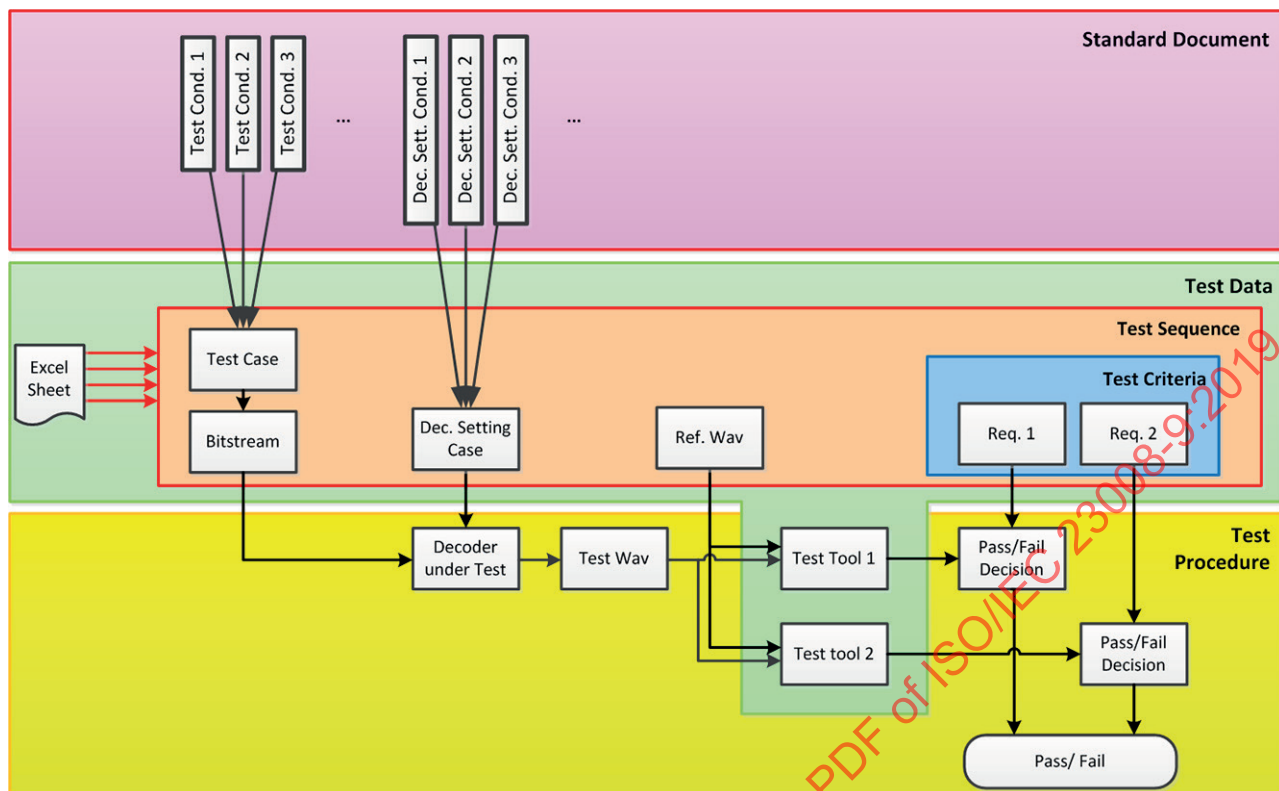
#### 4.3.1 General

To test a decoder for compliance to MPEG-H 3D audio decoding, conformance test data is provided. The package of the conformance test data is described in Figure 1. It is accessible at <http://standards.iso.org/iso-iec/23008/-9/ed-1/en> and contains all conformance test tools, conformance bitstreams, reference waveforms, and a Microsoft® Excel<sup>5)</sup> worksheet ("ConformanceTables.xlsx"). That Microsoft® Excel worksheet defines all the conformance test sequences. To fulfil a conformance test sequence, the decoder under test shall decode the corresponding conformance test bitstream with the given decoder setting case. The output of the decoder under test shall meet the conformance test criteria in comparison with the respective reference waveform. Some conformance test sequences test only the stability of the decoder under test. Such conformance test sequences consist only of the conformance test case with the corresponding conformance test bitstream. The decoder under test shall pass all conformance test sequences.

3) Under preparation. Stage at the time of publication: ISO/IEC FDIS 23008-3:2018.

4) Under preparation. Stage at the time of publication: ISO/IEC FDIS 23008-4:2018.

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**Figure 1 — Conformance testing components**

In case where the decoder under test is followed by additional operations (e.g. quantizing a signal to a 16 bit output signal) the conformance point is prior to such additional operations, i.e. it is permitted to use the actual decoder output (e.g. with more than 16 bit) for conformance testing. Measurements are carried out relative to full scale where the output signals of the decoders are normalized to be in the range between -1.0 and +1.0. The decoded reference waveforms are supplied as “.wav” files. These are always supplied as 24 bit resolution (RIFF (little-endian) data, WAVE audio, pulse code modulation (PCM), 24 bit).

The conformance test criteria define what conformance test tools and parameter are used to compare the reference waveforms with the output waveforms from the decoder under test. The conformance test tools are defined in 4.3.3.

The characteristics of the conformance test bitstream are defined by the corresponding conformance test case. A conformance test case is a combination of all basic conformance test conditions, specified in 7.2, and possibly one or several additional conformance test conditions, specified in 7.3. Note that the same conformance test bitstream may be a part of several conformance test sequences.

The decoder setting case is a combination of the decoder setting conditions. The decoder setting conditions are defined in 7.3.9. If no specific decoder setting case is applicable, then all the decoder settings for the decoder default behaviour shall be used.

#### 4.3.2 Naming convention

The name of the conformance test case is composed of several parts. The first part conveys the information of all basic conformance test conditions. These abbreviations are appended in the order as defined in 7.2. The second part of the name conveys the information of all additional test conditions. The abbreviations of the additional test conditions are defined in Table 1. The abbreviations of the conformance test conditions are in an alphabetical order. All conformance test conditions are connected by an underscore.

The name of the conformance test case is illustrated as follows:

[3daC\_ElemConfIdx]\_[3daC\_SampFreqIdx]\_[FD|LPD|Cct]\_<testCase1>\_<testCase2>

The name for the corresponding conformance test bitstream is the same appended with the transport format extension.

The name of the decoder setting case is composed of several decoder setting conditions. The abbreviations of the decoder setting conditions are defined in [Table 2](#). The abbreviations of the decoder setting conditions are in the order as defined in [7.3.9](#).

The name of the conformance test sequence is composed of the name of the conformance test case and the name of the decoder setting case connected by two underscores.

The name of the conformance test sequence is illustrated as follows:

[3daC\_ElemConfIdx]\_[3daC\_SampFreqIdx]\_[FD|LPD|Cct]\_<testCase1>\_<testCase2>\_\_<decoderSettingCase1>\_<decoderSettingCase2>

The name of the corresponding reference waveform is the same as the name of the conformance test sequence appended with the audio file extension.

**Table 1 — Conformance test abbreviations for additional test conditions**

| Test condition                     | Abbreviation      |
|------------------------------------|-------------------|
| Basic FD window                    | Win               |
| Non-meaningful FD window switching | Nmf               |
| Aliasing symmetries                | Asy               |
| Noise filling                      | Nf                |
| Varying max_sfb                    | Sfb               |
| TNS test condition                 | Tns               |
| M/S stereo                         | Ms                |
| Complex prediction stereo          | Cp                |
| LPC coding                         | Lpc               |
| ACELP core mode                    | Ace               |
| TCX and noise filling              | Tcx               |
| fullband LPD                       | fbL-<x1>-<x2>...  |
| LPD mode coverage and FAC          | Lpd               |
| AVQ test condition                 | avq               |
| stereo LPD                         | sLP-<x1>-<x2>...  |
| Time domain bandwidth extension    | Tbe               |
| Frequency domain prediction        | Fdp               |
| Long-term postfilter               | Lpf               |
| Bass-post filter                   | Bpf               |
| Channel pair element configuration | cpc-<x1>-<x2>-... |
| IGF range signalling               | E-ran-<x>-<y>     |
| IGF tiling                         | E-Cti             |
| IGF whitening                      | E-Wht             |
| IGF envelope noise flattening      | E-Enf             |
| IGF after TNS synth                | E-Ats             |
| IGF no high resolution             | E-Nhr             |
| IGF no independent tiling          | E-Nit             |

**Table 1** (continued)

| Test condition                        | Abbreviation                                                    |
|---------------------------------------|-----------------------------------------------------------------|
| Stereo filling                        | E-SFi                                                           |
| MCT channel signalling                | M-chM-<x>                                                       |
| MCT signalling type                   | M-Typ-<x>                                                       |
| mct stereo filling                    | M-SFi-<x>                                                       |
| MCT mechanics                         | M-Mec                                                           |
| MCT rotation content                  | M-Rot                                                           |
| MCT prediction content                | M-Pre                                                           |
| OAM position and gain                 | O-Pos                                                           |
| OAM transmission rate                 | O-rat-<x>                                                       |
| OAM spread modes                      | O-spr-<x>                                                       |
| Loudness normalization                | D-Ln-Lay-<x0-x1-...>-Gr-<y0-y1-...>-Pr-<z0-z1-...>              |
| Dynamic range control                 | D-Drc-<w0-w1-...>-Lay-<x0-x1-...>-Gr-<y0-y1-...>-Pr-<z0-z1-...> |
| Ducking                               | D-Duck-Gr-<x0-x1-...>-Pr-<y0-y1-...>                            |
| AudioPreRoll, IPF freq. of occurrence | I-foo-<x>                                                       |

**Table 2 — Conformance test abbreviations for decoder setting condition**

| Test condition          | Abbreviation |
|-------------------------|--------------|
| Target layout           | Lay-<x>      |
| Target loudness         | Lou-<x>      |
| DRC effect type request | Eff-<x>      |
| Group preset selection  | Pr-<x>       |
| Conformance point       | Cpo-<x>      |

### 4.3.3 Conformance test tools

#### 4.3.3.1 RMS/LSB measurement

The RMS/LSB measurement is defined in ISO/IEC 14496-26:2010, 7.1.2.2.1.

#### 4.3.3.2 Segmental SNR

The Segmental SNR is defined in ISO/IEC 14496-26:2010, 7.1.2.2.2.

## 5 MPEG-H 3D audio bitstreams

### 5.1 Characteristics, test procedure

Characteristics of bitstreams specify the constraints that are applied by the encoder in generating the bitstream. These syntactic and semantic constraints may, for example, restrict the range or the values of parameters that are encoded directly or indirectly in the bitstreams.

Each MPEG-H 3DA bitstream shall meet the syntactic and semantic requirements specified in this document. The present clause defines the conformance criteria that shall be fulfilled by a compliant bitstream. These criteria are specified for the syntactic elements of the bitstream and for some parameters decoded from the MPEG-H 3DA bitstream payload.

For each tool a set of semantic tests to be performed on the bitstreams is described. To verify whether the syntax is correct is straightforward and therefore not defined herein after. In the description of

the semantic tests it is assumed that the tested bitstreams contain no errors due to transmission or other causes. For each test the condition or conditions that must be satisfied are given, as well as the prerequisites or conditions in which the test can be applied.

## 5.2 MPEG-H 3D audio general configuration

### 5.2.1 mpeg3daConfig()

|                                      |                                                                                      |
|--------------------------------------|--------------------------------------------------------------------------------------|
| <b>mpeg3daProfileLevelIndication</b> | shall be one of the non-reserved values as defined in ISO/IEC 23008-3:—, Table 64    |
| <b>usacSamplingFrequencyIndex</b>    | shall be one of the non-reserved values as defined in ISO/IEC 23003-3:2012, Table 67 |
| <b>usacSamplingFrequency</b>         | no restrictions apply                                                                |
| <b>coreSbrFrameLengthIndex</b>       | shall be one of the non-reserved values as defined in ISO/IEC 23003-3:2012, Table 70 |
| <b>reserved</b>                      | shall be 0                                                                           |
| <b>receiverDelayCompensation</b>     | no restrictions apply                                                                |
| <b>usacConfigExtensionPresent</b>    | no restrictions apply                                                                |

### 5.2.2 FrameworkConfig3d()

No restrictions are applicable to this bitstream element.

### 5.2.3 Signals3d()

|                                   |                                                              |
|-----------------------------------|--------------------------------------------------------------|
| <b>bsNumSignalGroups</b>          | shall be 0 if speakerLayoutType of the reference-Layout is 3 |
| <b>signalGroupType</b>            | shall be 0 if speakerLayoutType of the reference-Layout is 3 |
| <b>differsFromReferenceLayout</b> | shall be 0 if speakerLayoutType of the reference-Layout is 3 |
| <b>saocDmxLayoutPresent</b>       | no restrictions apply                                        |

### 5.2.4 SpeakerConfig3d()

|                             |                                                                                        |
|-----------------------------|----------------------------------------------------------------------------------------|
| <b>speakerLayoutType</b>    | no restrictions apply                                                                  |
| <b>CICPspeakerLayoutIdx</b> | shall be encoded in accordance with ChannelConfiguration as defined in ISO/IEC 23091-3 |
| <b>numSpeakers</b>          | no restrictions apply                                                                  |
| <b>CICPspeakerIdx</b>       | shall be encoded in accordance with Loudspeaker-Geometry as defined in ISO/IEC 23091-3 |



### 5.2.5 mpeg3daFlexibleSpeakerConfig()

|                             |                       |
|-----------------------------|-----------------------|
| <b>angularPrecision</b>     | no restrictions apply |
| <b>alsoAddSymmetricPair</b> | no restrictions apply |

### 5.2.6 mpeg3daSpeakerDescription()

|                           |                                                                                                                                                              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>isCICPspeakerIdx</b>   | no restrictions apply                                                                                                                                        |
| <b>CICPspeakerIdx</b>     | shall be encoded in accordance with Loudspeaker Geometry as defined in ISO/IEC 23091-3                                                                       |
| <b>ElevationClass</b>     | no restrictions apply                                                                                                                                        |
| <b>ElevationAngleIdx</b>  | if angularPrecision == 0, shall have a value between and including 0 and 18;<br>if angularPrecision == 1, shall have a value between and including 0 and 90  |
| <b>ElevationDirection</b> | no restrictions apply                                                                                                                                        |
| <b>AzimuthAngleIdx</b>    | if angularPrecision == 0, shall have a value between and including 0 and 36;<br>if angularPrecision == 1, shall have a value between and including 0 and 180 |
| <b>AzimuthDirection</b>   | no restrictions apply                                                                                                                                        |
| <b>isLFE</b>              | no restrictions apply                                                                                                                                        |

## 5.3 MPEG-H 3D core audio configuration

### 5.3.1 mpeg3daDecoderConfig()

|                             |                       |
|-----------------------------|-----------------------|
| <b>numElements</b>          | no restrictions apply |
| <b>elementLengthPresent</b> | no restrictions apply |
| <b>usacElementType</b>      | no restrictions apply |

### 5.3.2 mpeg3daSingleChannelElementConfig()

No restrictions are applicable to this bitstream element.

### 5.3.3 mpeg3daChannelPairElementConfig()

|                             |                       |
|-----------------------------|-----------------------|
| <b>igfIndependentTiling</b> | no restrictions apply |
| <b>stereoConfigIndex</b>    | no restrictions apply |
| <b>qceIndex</b>             | no restrictions apply |
| <b>shiftIndex0</b>          | no restrictions apply |



|                       |                                                                                                        |
|-----------------------|--------------------------------------------------------------------------------------------------------|
| <b>shiftChannel0</b>  | a shifted channel shall not exceed the maximum channel index of the signal group it is associated with |
| <b>shiftIndex1</b>    | no restrictions apply                                                                                  |
| <b>shiftChannel1</b>  | a shifted channel shall not exceed the maximum channel index of the signal group it is associated with |
| <b>lpdStereoIndex</b> | no restrictions apply                                                                                  |

### 5.3.4 mpeg3daCoreConfig()

|                             |                       |
|-----------------------------|-----------------------|
| <b>tw_mdct</b>              | no restrictions apply |
| <b>fullbandLpd</b>          | no restrictions apply |
| <b>noiseFilling</b>         | no restrictions apply |
| <b>enhancedNoiseFilling</b> | no restrictions apply |
| <b>igfUseEnf</b>            | no restrictions apply |
| <b>igfUseHighRes</b>        | no restrictions apply |
| <b>igfUseWhitening</b>      | no restrictions apply |
| <b>igfAfterTnsSynth</b>     | no restrictions apply |
| <b>igfStartIndex</b>        | no restrictions apply |
| <b>igfStopIndex</b>         | no restrictions apply |

### 5.3.5 mpeg3daLfeElementConfig()

No restrictions are applicable to this bitstream element.

### 5.3.6 mpeg3daExtElementConfig()

Depending on the **usacExtElementType** the following restrictions apply as defined in [Table 3](#).

**Table 3 — Type dependent restrictions for mpeg3daExtElementConfig()**

| <b>usacExt<br/>ElementType<br/>(ID_EXT_ELE_...)</b>            | <b>elemIdx<br/>of mpeg3da<br/>Decoder<br/>Config()</b> | <b>Number of<br/>occurrences</b> | <b>usacExt<br/>Element<br/>Config<br/>Length</b> | <b>usacExt<br/>Element<br/>Default<br/>Length<br/>Present</b> | <b>usacExt<br/>Element<br/>Default<br/>Length</b> | <b>usacExt<br/>Element<br/>Payload<br/>Frag</b> |
|----------------------------------------------------------------|--------------------------------------------------------|----------------------------------|--------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------|
| FILL                                                           | NR                                                     | NR                               | == 0                                             | NR                                                            | NR                                                | == 0                                            |
| MPEGS                                                          | NR                                                     | NR                               | NR                                               | NR                                                            | NR                                                | NR                                              |
| SAOC                                                           | NR                                                     | NR                               | NR                                               | NR                                                            | NR                                                | NR                                              |
| AUDIOPREROLL                                                   | == 0                                                   | ≤ 1                              | == 0                                             | == 0                                                          | N/A                                               | == 0                                            |
| UNI_DRC                                                        | NR                                                     | ≤ 1                              | NR                                               | NR                                                            | NR                                                | == 0                                            |
| <b>Key</b><br>NR: no restrictions apply<br>N/A: not applicable |                                                        |                                  |                                                  |                                                               |                                                   |                                                 |

Table 3 (continued)

| usacExt<br>ElementType<br>(ID_EXT_ELE_...)                     | elemIdx<br>of mpeg-<br>3da<br>Decoder<br>Config() | Number of<br>occurrences | usacExt<br>Element<br>Config<br>Length | usacExt<br>Element<br>Default<br>Length<br>Present | usacExt<br>Element<br>Default<br>Length | usacExt<br>Element<br>Payload<br>Frag |
|----------------------------------------------------------------|---------------------------------------------------|--------------------------|----------------------------------------|----------------------------------------------------|-----------------------------------------|---------------------------------------|
| OBJ_METADATA                                                   | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | NR                                    |
| SAOC_3D                                                        | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | NR                                    |
| HOA                                                            | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | NR                                    |
| FMT_CNVTR                                                      | NR                                                | NR                       | == 0                                   | NR                                                 | NR                                      | NR                                    |
| MCT                                                            | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | == 0                                  |
| TCC                                                            | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | NR                                    |
| HOA_ENH_LAYER                                                  | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | NR                                    |
| HREP                                                           | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | == 0                                  |
| ENHANCED_OBJ_<br>METADATA                                      | NR                                                | NR                       | NR                                     | NR                                                 | NR                                      | NR                                    |
| <b>Key</b><br>NR: no restrictions apply<br>N/A: not applicable |                                                   |                          |                                        |                                                    |                                         |                                       |

**tmp** no restrictions apply

### 5.3.7 mpeg3daConfigExtension()

**numConfigExtensions** no restrictions apply

**usacConfigExtType** no restrictions apply

**usacConfigExtLength** no restrictions apply

**fill\_byte** should be '10100101'

**tmp** no restrictions apply

### 5.3.8 SbrConfig()

The SbrConfig() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

### 5.3.9 Mps212Config()

The Mps212Config() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

## 5.4 MPEG-H 3D core audio frame

### 5.4.1 mpeg3daFrame()

**usacIndependencyFlag** no restrictions apply

**elementLength** no restrictions apply

**5.4.2 mpeg3daSingleChannelElement()**

No restrictions are applicable to this bitstream element.

**5.4.3 mpeg3daChannelPairElement()**

No restrictions are applicable to this bitstream element.

**5.4.4 mpeg3daLfeElement()**

No restrictions are applicable to this bitstream element.

**5.4.5 mpeg3daExtElement()**

Depending on the **usacExtElementType** the restrictions in [Table 4](#) apply.

**Table 4 — Type dependent restrictions for mpeg3daExtElement()**

| <b>usacExtElementType</b><br>(ID_EXT_ELE_...)                  | <b>usacExtElement</b><br><b>Present</b> | <b>usacExtElementUse</b><br><b>DefaultLength</b> | <b>usacExtElement</b><br><b>PayloadLength</b> |
|----------------------------------------------------------------|-----------------------------------------|--------------------------------------------------|-----------------------------------------------|
| FILL                                                           | NR                                      | NR                                               | NR                                            |
| MPEGS                                                          | NR                                      | NR                                               | NR                                            |
| SAOC                                                           | NR                                      | NR                                               | NR                                            |
| AUDIOPREROLL                                                   | NR                                      | == 0                                             | NR                                            |
| UNI_DRC                                                        | NR                                      | NR                                               | NR                                            |
| OBJ_METADATA                                                   | NR                                      | NR                                               | NR                                            |
| SAOC_3D                                                        | NR                                      | NR                                               | NR                                            |
| HOA                                                            | NR                                      | NR                                               | NR                                            |
| FMT_CNVTRTR                                                    | NR                                      | NR                                               | NR                                            |
| MCT                                                            | == 1                                    | NR                                               | > 0                                           |
| TCC                                                            | NR                                      | NR                                               | NR                                            |
| HOA_ENH_LAYER                                                  | NR                                      | NR                                               | NR                                            |
| HREP                                                           | NR                                      | NR                                               | NR                                            |
| ENHANCED_OBJ_METADATA                                          | NR                                      | NR                                               | NR                                            |
| <b>Key</b><br>NR: no restrictions apply<br>N/A: not applicable |                                         |                                                  |                                               |

**usacExtElementStart**

no restrictions apply

**usacExtElementStop**

no restrictions apply

## 5.4.6 ics\_info()

**window\_sequence**

A conformant bitstream shall consist of only meaningful window\_sequence transitions. However, decoders are required to handle non-meaningful window\_sequence transitions as well. The meaningful window\_sequence transitions are shown in ISO/IEC 23003-3:2012, 7.9 (Table 133).

**window\_shape**

no restrictions apply

**max\_sfb**

shall be  $\leq$  num\_swb\_long\_window or num\_swb\_short\_window as appropriate for window\_sequence and sampling frequency and core coder frame length

**scale\_factor\_grouping**

no restrictions apply

## 5.4.7 mpeg3daCoreCoderData()

**core\_mode**

no restrictions apply

**tns\_data\_present**

no restrictions apply

## 5.4.8 StereoCoreToolInfo()

**common\_ltpf**

no restrictions apply

**ltpf\_data\_present**

no restrictions apply

**ltpf\_pitch\_lag\_index**

no restrictions apply

**ltpf\_gain\_index**

no restrictions apply

**tns\_active**

no restrictions apply

**common\_window**

no restrictions apply

**common\_max\_sfb**

no restrictions apply

**max\_sfb1**

shall be  $\leq$  num\_swb\_long\_window or num\_swb\_short\_window as appropriate for window\_sequence and sampling frequency and core coder frame length

**ms\_mask\_present**

no restrictions apply

**ms\_used**

no restrictions apply

**igf\_ms\_mask\_present**

no restrictions apply

**ms\_used**

no restrictions apply

**common\_tw**

no restrictions apply

**common\_tns**

no restrictions apply

|                                    |                                                                                                                                                                                                                                                                                    |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>tns_on_lr</b>                   | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>tns_present_both</b>            | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>tns_data_present[1]</b>         | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>5.4.9 fd_channel_stream()</b>   |                                                                                                                                                                                                                                                                                    |
| <b>global_gain</b>                 | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>noise_level</b>                 | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>noise_offset</b>                | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>ltpf_data_present</b>           | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>ltpf_pitch_lag_index</b>        | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>ltpf_gain_index</b>             | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>fdp_data_present</b>            | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>fdp_spacing_index</b>           | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>prev_aliasing_symmetry</b>      | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>curr_aliasing_symmetry</b>      | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>igf_AllZero</b>                 | shall be 1 if one of the following conditions is true: <ul style="list-style-type: none"> <li>— <math>m\_igfStartSfb == m\_igfStopSfb</math></li> <li>— all values in <math>igf\_curr[ ][ ] == 0</math></li> <li>— <math>swb\_offset[m\_igfStartSfb] \leq igfMin</math></li> </ul> |
| <b>igf_level</b>                   | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>fac_data_present</b>            | shall be 0, if the <i>core_mode</i> of the preceding frame of the same channel was 0 or if <i>mod[3]</i> of the preceding frame of the same channel was > 0                                                                                                                        |
| <b>5.4.10 lpd_channel_stream()</b> |                                                                                                                                                                                                                                                                                    |
| <b>tns_data_present</b>            | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>window_shape</b>                | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>max_sfb</b>                     | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>acelp_core_mode</b>             | no restrictions apply                                                                                                                                                                                                                                                              |
| <b>lpd_mode</b>                    | if <i>fullbandLpd</i> == 0, then <i>lpd_mode</i> shall have a value between and including 0 and 25.<br><br>If <i>fullbandLpd</i> == 1, then <i>lpd_mode</i> shall have a value between and including 0 and 4.                                                                      |
| <b>bpf_control_info</b>            | no restrictions apply                                                                                                                                                                                                                                                              |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>core_mode_last</b>        | shall be encoded with the value of data element core_mode of the previous frame                                                                                                                                                                                                                                                                                                                                                  |
| <b>fac_data_present</b>      | shall be 0,<br><br>if mod[0] of the current frame is > 0 and the core_mode of the preceding frame of the same channel was 0 ("TCX follows FD"), or<br><br>if mod[0] of the current frame is > 0 and mod[nbDiv-1] of the preceding frame of the same channel was > 0 ("TCX follows TCX"), or<br><br>if mod[0] of the current frame is 0 and mod[nbDiv-1] of the preceding frame of the same channel was 0 ("ACELP follows ACELP") |
| <b>short_fac_flag</b>        | shall be encoded with a value of 1 if the window_sequence of the previous frame was 2 (EIGHT_SHORT_SEQUENCE). Otherwise short_fac_flag shall be encoded with a value of 0.                                                                                                                                                                                                                                                       |
| <b>5.4.11 acelp_coding()</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>mean_energy</b>           | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>acb_index</b>             | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ltp_filtering_flag</b>    | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>icb_index</b>             | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>gains</b>                 | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>5.4.12 tcx_coding()</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>noise_factor</b>          | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>global_gain</b>           | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ltpf_data_present</b>     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ltpf_pitch_lag_index</b>  | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ltpf_gain_index</b>       | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>fdp_data_present</b>      | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>fdp_spacing_index</b>     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>igf_AllZero</b>           | shall be 1 if one of the following conditions is true:<br><br>— m_igfStartSfb == m_igfStopSfb<br><br>— all values in igf_curr[ ][ ] == 0                                                                                                                                                                                                                                                                                         |

|                                      |                                                                  |
|--------------------------------------|------------------------------------------------------------------|
|                                      | — $\text{swb\_offset}[\text{m\_igfStartSfb}] \leq \text{igfMin}$ |
| <b>igf_level</b>                     | no restrictions apply                                            |
| <b>arith_reset_flag</b>              | no restrictions apply                                            |
| <b>5.4.13 lpd_stereo_stream()</b>    |                                                                  |
| <b>res_mode</b>                      | no restrictions apply                                            |
| <b>q_mode</b>                        | no restrictions apply                                            |
| <b>ipd_mode</b>                      | no restrictions apply                                            |
| <b>pred_mode</b>                     | no restrictions apply                                            |
| <b>cod_mode</b>                      | no restrictions apply                                            |
| <b>ild_idx</b>                       | no restrictions apply                                            |
| <b>pred_gain_idx</b>                 | no restrictions apply                                            |
| <b>cod_gain_idx</b>                  | no restrictions apply                                            |
| <b>5.4.14 igf_stereo_pred_data()</b> |                                                                  |
| <b>igf_stereo_pred_all</b>           | no restrictions apply                                            |
| <b>cplx_pred_used</b>                | no restrictions apply                                            |
| <b>igf_pred_dir</b>                  | no restrictions apply                                            |
| <b>igf_delta_code_time</b>           | no restrictions apply                                            |
| <b>hcod_sf</b>                       | no restrictions apply                                            |
| <b>5.4.15 igf_data()</b>             |                                                                  |
| <b>igf_UsePrevTileIdx</b>            | no restrictions apply                                            |
| <b>igfCurrTileIdx</b>                | no restrictions apply                                            |
| <b>igf_UsePrevWhiteningLevel</b>     | no restrictions apply                                            |
| <b>igf_WhiteningLevel</b>            | no restrictions apply                                            |
| <b>remainingTilesDifferent</b>       | no restrictions apply                                            |
| <b>igf_WhiteningLevel</b>            | no restrictions apply                                            |
| <b>igfApplyTNF</b>                   | no restrictions apply                                            |

**5.4.16 tbe\_data()**

|                         |                       |
|-------------------------|-----------------------|
| <b>tbe_heMode</b>       | no restrictions apply |
| <b>idxFrameGain</b>     | no restrictions apply |
| <b>idxSubGains</b>      | no restrictions apply |
| <b>lsf_idx[0]</b>       | no restrictions apply |
| <b>lsf_idx[1]</b>       | no restrictions apply |
| <b>tbe_hrConfig</b>     | no restrictions apply |
| <b>tbe_nlConfig</b>     | no restrictions apply |
| <b>idxMixConfig</b>     | no restrictions apply |
| <b>idxShbFrGain</b>     | no restrictions apply |
| <b>idxResSubGains</b>   | no restrictions apply |
| <b>idxShbExcResp[0]</b> | no restrictions apply |
| <b>idxShbExcResp[1]</b> | no restrictions apply |

**5.4.17 tw\_data()**

The `tw_data()` bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

**5.4.18 scale\_factor\_data()**

**hcod\_sf** Shall only be encoded with the values listed in the scalefactor Huffman table. Shall be encoded such that the decoded scalefactors `sf[g][sfb]` are within the range of zero to 255, both inclusive.

**5.4.19 tns\_data()**

The `tns_data()` bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012, 7.8 (Table 130)

**5.4.20 ac\_spectral\_data()**

The `ac_spectral_data()` bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

**5.4.21 arith\_data()**

The `arith_data()` bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

**5.4.22 fac\_data()**

The `fac_data()` bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.



**5.4.23 code\_book\_indices()**

The code\_book\_indices() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

**5.4.24 UsacSbrData()**

The UsacSbrData() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

**5.4.25 Mps212Data()**

The Mps212Data() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-3:2012.

**5.5 Fill element**

**fill\_byte** should be '10100101'

**5.6 MPEG surround configuration, SpatialSpecificConfig()**

The SpatialSpecificConfig() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-1:2007/Amd.1:2008.

**5.7 MPEG surround frame, SpatialFrame()**

The SpatialFrame() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-1:2007/Amd.1:2008.

**5.8 SAOC configuration, SAOCSpecificConfig()**

The SAOCSpecificConfig() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-2:2010/Amd.4:2016.

**5.9 SAOC frame, SAOCFrame()**

The SAOCFrame() bitstream structure and all recursively included bitstream structures shall be restricted as specified in ISO/IEC 23003-2:2010/Amd.4:2016.

**5.10 AudioPreRoll****5.10.1 Recursive presence of AudioPreRoll extension payload**

An access unit which is part of an AudioPreRoll shall not have usacExtElementPresent equal to 1 for the extension payload type ID\_EXT\_ELE\_AUDIOPREROLL. That means there shall be no recursively embedded AudioPreRoll extension payload.

### 5.10.2 AudioPreRoll()

|                         |                       |
|-------------------------|-----------------------|
| <b>configLen</b>        | no restrictions apply |
| <b>applyCrossfade</b>   | no restrictions apply |
| <b>reserved</b>         | should be 0           |
| <b>numPreRollFrames</b> | no restrictions apply |
| <b>auLen</b>            | no restrictions apply |

## 5.11 Dynamic range control configuration

### 5.11.1 mpeg3daUniDrcConfig()

|                                   |                                                                                            |
|-----------------------------------|--------------------------------------------------------------------------------------------|
| <b>drcCoefficientsUniDrcCount</b> | no restrictions apply                                                                      |
| <b>drcInstructionsUniDrcCount</b> | no restrictions apply                                                                      |
| <b>drcInstructionsType</b>        | no restrictions apply                                                                      |
| <b>mae_groupID</b>                | shall match the mae_groupID value of a present mae_GroupDefinition() structure             |
| <b>mae_groupPresetID</b>          | shall match the mae_groupPresetID value of a present mae_GroupPresetDefinition() structure |
| <b>uniDrcConfigExtPresent</b>     | no restrictions apply                                                                      |
| <b>loudnessInfoSetPresent</b>     | no restrictions apply                                                                      |

### 5.11.2 mpeg3daUniDrcChannelLayout()

|                         |                       |
|-------------------------|-----------------------|
| <b>baseChannelCount</b> | no restrictions apply |
|-------------------------|-----------------------|

### 5.11.3 drcCoefficientsUniDrc()

The drcCoefficientsUniDrc() bitstream structure shall be restricted as specified in ISO/IEC 23003-4: —, Clause 9.

### 5.11.4 drcInstructionsUniDrc()

The drcInstructionsUniDrc() bitstream structure shall be restricted as specified in ISO/IEC 23003-4: —, Clause 9.

### 5.11.5 uniDrcConfigExtension()

The uniDrcConfigExtension() bitstream structure shall be restricted as specified in ISO/IEC 23003-4: —, Clause 9.

## 5.12 Dynamic range control frame, uniDrcGain()

The uniDrcGain() bitstream structure shall be restricted as specified in ISO/IEC 23003-4: —, Clause 9.

### 5.13 Object metadata configuration, `ObjectMetadataConfig()`

|                                       |                       |
|---------------------------------------|-----------------------|
| <code>lowDelayMetadataCoding</code>   | no restrictions apply |
| <code>hasCoreLength</code>            | no restrictions apply |
| <code>frameLength</code>              | no restrictions apply |
| <code>hasScreenRelativeObjects</code> | no restrictions apply |
| <code>isScreenRelativeObject</code>   | no restrictions apply |
| <code>hasDynamicObjectPriority</code> | no restrictions apply |
| <code>hasUniformSpread</code>         | no restrictions apply |

### 5.14 Object metadata frame

#### 5.14.1 `object_metadata_efficient()`

|                                      |                       |
|--------------------------------------|-----------------------|
| <code>object_metadata_present</code> | no restrictions apply |
|--------------------------------------|-----------------------|

#### 5.14.2 `object_metadata()`

No restrictions are applicable to this bitstream element.

#### 5.14.3 `object_metadata_efficient()`

|                                        |                                                      |
|----------------------------------------|------------------------------------------------------|
| <code>has_differential_metadata</code> | shall be 0 if <code>usacIndependencyFlag == 1</code> |
|----------------------------------------|------------------------------------------------------|

#### 5.14.4 `intracoded_object_metadata_efficient()`

|                                 |                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>ifperiod</code>           | The number of audio frames for which OAM data are processed as indicated by <code>ifperiod</code> shall not exceed subsequent frames for which <code>usacIndependencyFlag == 1</code> . |
| <code>common_azimuth</code>     | no restrictions apply                                                                                                                                                                   |
| <code>default_azimuth</code>    | no restrictions apply                                                                                                                                                                   |
| <code>position_azimuth</code>   | no restrictions apply                                                                                                                                                                   |
| <code>common_elevation</code>   | no restrictions apply                                                                                                                                                                   |
| <code>default_elevation</code>  | no restrictions apply                                                                                                                                                                   |
| <code>position_elevation</code> | no restrictions apply                                                                                                                                                                   |
| <code>common_radius</code>      | no restrictions apply                                                                                                                                                                   |
| <code>default_radius</code>     | no restrictions apply                                                                                                                                                                   |
| <code>position_radius</code>    | no restrictions apply                                                                                                                                                                   |
| <code>common_gain</code>        | no restrictions apply                                                                                                                                                                   |
| <code>default_gain</code>       | no restrictions apply                                                                                                                                                                   |

|                                        |                       |
|----------------------------------------|-----------------------|
| <b>gain_factor</b>                     | no restrictions apply |
| <b>common_spread</b>                   | no restrictions apply |
| <b>default_spread</b>                  | no restrictions apply |
| <b>default_spread_width</b>            | no restrictions apply |
| <b>default_spread_height</b>           | no restrictions apply |
| <b>default_spread_depth</b>            | no restrictions apply |
| <b>spread</b>                          | no restrictions apply |
| <b>spread_width</b>                    | no restrictions apply |
| <b>spread_height</b>                   | no restrictions apply |
| <b>spread_depth</b>                    | no restrictions apply |
| <b>common_dynamic_object_priority</b>  | no restrictions apply |
| <b>default_dynamic_object_priority</b> | no restrictions apply |
| <b>dynamic_object_priority</b>         | no restrictions apply |

#### 5.14.5 differential\_object\_metadata()

|                               |                       |
|-------------------------------|-----------------------|
| <b>bits_per_point</b>         | no restrictions apply |
| <b>fixed_azimuth</b>          | no restrictions apply |
| <b>flag_azimuth</b>           | no restrictions apply |
| <b>nbits_azimuth</b>          | no restrictions apply |
| <b>differential_azimuth</b>   | no restrictions apply |
| <b>fixed_elevation</b>        | no restrictions apply |
| <b>flag_elevation</b>         | no restrictions apply |
| <b>nbits_elevation</b>        | no restrictions apply |
| <b>differential_elevation</b> | no restrictions apply |
| <b>fixed_radius</b>           | no restrictions apply |
| <b>flag_radius</b>            | no restrictions apply |
| <b>nbits_radius</b>           | no restrictions apply |
| <b>differential_radius</b>    | no restrictions apply |
| <b>fixed_gain</b>             | no restrictions apply |
| <b>flag_gain</b>              | no restrictions apply |
| <b>nbits_gain</b>             | no restrictions apply |
| <b>differential_gain</b>      | no restrictions apply |

|                                                      |                                                |
|------------------------------------------------------|------------------------------------------------|
| <b>fixed_spread</b>                                  | no restrictions apply                          |
| <b>flag_spread</b>                                   | no restrictions apply                          |
| <b>nbits_spread</b>                                  | no restrictions apply                          |
| <b>differential_spread</b>                           | no restrictions apply                          |
| <b>flag_spread_width</b>                             | no restrictions apply                          |
| <b>nbits_spread_width</b>                            | no restrictions apply                          |
| <b>differential_spread_width</b>                     | no restrictions apply                          |
| <b>flag_spread_height</b>                            | no restrictions apply                          |
| <b>nbits_spread_height</b>                           | no restrictions apply                          |
| <b>differential_spread_height</b>                    | no restrictions apply                          |
| <b>flag_spread_depth</b>                             | no restrictions apply                          |
| <b>nbits_spread_depth</b>                            | no restrictions apply                          |
| <b>differential_spread_depth</b>                     | no restrictions apply                          |
| <b>fixed_dynamic_object_priority</b>                 | no restrictions apply                          |
| <b>flag_dynamic_object_priority</b>                  | no restrictions apply                          |
| <b>nbits_dynamic_object_priority</b>                 | no restrictions apply                          |
| <b>differential_dynamic_object_priority</b>          | no restrictions apply                          |
| <b>5.14.6 offset_data()</b>                          |                                                |
| <b>bitfield_syntax</b>                               | no restrictions apply                          |
| <b>offset_bitfield</b>                               | no restrictions apply                          |
| <b>npoints</b>                                       | no restrictions apply                          |
| <b>foffset</b>                                       | no restrictions apply                          |
| <b>5.14.7 object_metadata_low_delay()</b>            |                                                |
| <b>has_intracoded_object_metadata</b>                | shall be 1 if <b>usacIndependencyFlag</b> == 1 |
| <b>5.14.8 intracoded_object_metadata_low_delay()</b> |                                                |
| <b>fixed_azimuth</b>                                 | no restrictions apply                          |
| <b>default_azimuth</b>                               | no restrictions apply                          |
| <b>common_azimuth</b>                                | no restrictions apply                          |
| <b>default_azimuth</b>                               | no restrictions apply                          |
| <b>position_azimuth</b>                              | no restrictions apply                          |

|                                        |                       |
|----------------------------------------|-----------------------|
| <b>fixed_elevation</b>                 | no restrictions apply |
| <b>default_elevation</b>               | no restrictions apply |
| <b>common_elevation</b>                | no restrictions apply |
| <b>default_elevation</b>               | no restrictions apply |
| <b>position_elevation</b>              | no restrictions apply |
| <b>fixed_radius</b>                    | no restrictions apply |
| <b>default_radius</b>                  | no restrictions apply |
| <b>common_radius</b>                   | no restrictions apply |
| <b>default_radius</b>                  | no restrictions apply |
| <b>position_radius</b>                 | no restrictions apply |
| <b>fixed_gain</b>                      | no restrictions apply |
| <b>default_gain</b>                    | no restrictions apply |
| <b>common_gain</b>                     | no restrictions apply |
| <b>default_gain</b>                    | no restrictions apply |
| <b>gain_factor</b>                     | no restrictions apply |
| <b>fixed_spread</b>                    | no restrictions apply |
| <b>default_spread</b>                  | no restrictions apply |
| <b>default_spread_width</b>            | no restrictions apply |
| <b>default_spread_height</b>           | no restrictions apply |
| <b>default_spread_depth</b>            | no restrictions apply |
| <b>common_spread</b>                   | no restrictions apply |
| <b>default_spread</b>                  | no restrictions apply |
| <b>spread</b>                          | no restrictions apply |
| <b>spread_width</b>                    | no restrictions apply |
| <b>spread_height</b>                   | no restrictions apply |
| <b>spread_depth</b>                    | no restrictions apply |
| <b>fixed_dynamic_object_priority</b>   | no restrictions apply |
| <b>default_dynamic_object_priority</b> | no restrictions apply |
| <b>common_dynamic_object_priority</b>  | no restrictions apply |
| <b>default_dynamic_object_priority</b> | no restrictions apply |
| <b>dynamic_object_priority</b>         | no restrictions apply |

**5.14.9 dynamic\_object\_metadata()**

|                      |                       |
|----------------------|-----------------------|
| <b>flag_absolute</b> | no restrictions apply |
|----------------------|-----------------------|

|                            |                       |
|----------------------------|-----------------------|
| <b>has_object_metadata</b> | no restrictions apply |
|----------------------------|-----------------------|

**5.14.10 single\_dynamic\_object\_metadata()**

|                         |                       |
|-------------------------|-----------------------|
| <b>position_azimuth</b> | no restrictions apply |
|-------------------------|-----------------------|

|                           |                       |
|---------------------------|-----------------------|
| <b>position_elevation</b> | no restrictions apply |
|---------------------------|-----------------------|

|                        |                       |
|------------------------|-----------------------|
| <b>position_radius</b> | no restrictions apply |
|------------------------|-----------------------|

|                    |                       |
|--------------------|-----------------------|
| <b>gain_factor</b> | no restrictions apply |
|--------------------|-----------------------|

|               |                       |
|---------------|-----------------------|
| <b>spread</b> | no restrictions apply |
|---------------|-----------------------|

|                     |                       |
|---------------------|-----------------------|
| <b>spread_width</b> | no restrictions apply |
|---------------------|-----------------------|

|                      |                       |
|----------------------|-----------------------|
| <b>spread_height</b> | no restrictions apply |
|----------------------|-----------------------|

|                     |                       |
|---------------------|-----------------------|
| <b>spread_depth</b> | no restrictions apply |
|---------------------|-----------------------|

|                                |                       |
|--------------------------------|-----------------------|
| <b>dynamic_object_priority</b> | no restrictions apply |
|--------------------------------|-----------------------|

|              |                       |
|--------------|-----------------------|
| <b>nbits</b> | no restrictions apply |
|--------------|-----------------------|

|                     |                       |
|---------------------|-----------------------|
| <b>flag_azimuth</b> | no restrictions apply |
|---------------------|-----------------------|

|                                    |                       |
|------------------------------------|-----------------------|
| <b>position_azimuth_difference</b> | no restrictions apply |
|------------------------------------|-----------------------|

|                       |                       |
|-----------------------|-----------------------|
| <b>flag_elevation</b> | no restrictions apply |
|-----------------------|-----------------------|

|                                      |                       |
|--------------------------------------|-----------------------|
| <b>position_elevation_difference</b> | no restrictions apply |
|--------------------------------------|-----------------------|

|                    |                       |
|--------------------|-----------------------|
| <b>flag_radius</b> | no restrictions apply |
|--------------------|-----------------------|

|                                   |                       |
|-----------------------------------|-----------------------|
| <b>position_radius_difference</b> | no restrictions apply |
|-----------------------------------|-----------------------|

|                  |                       |
|------------------|-----------------------|
| <b>flag_gain</b> | no restrictions apply |
|------------------|-----------------------|

|                               |                       |
|-------------------------------|-----------------------|
| <b>gain_factor_difference</b> | no restrictions apply |
|-------------------------------|-----------------------|

|                    |                       |
|--------------------|-----------------------|
| <b>flag_spread</b> | no restrictions apply |
|--------------------|-----------------------|

|                          |                       |
|--------------------------|-----------------------|
| <b>spread_difference</b> | no restrictions apply |
|--------------------------|-----------------------|

|                          |                       |
|--------------------------|-----------------------|
| <b>flag_spread_width</b> | no restrictions apply |
|--------------------------|-----------------------|

|                                |                       |
|--------------------------------|-----------------------|
| <b>spread_width_difference</b> | no restrictions apply |
|--------------------------------|-----------------------|

|                           |                       |
|---------------------------|-----------------------|
| <b>flag_spread_height</b> | no restrictions apply |
|---------------------------|-----------------------|

|                                 |                       |
|---------------------------------|-----------------------|
| <b>spread_height_difference</b> | no restrictions apply |
|---------------------------------|-----------------------|

|                          |                       |
|--------------------------|-----------------------|
| <b>flag_spread_depth</b> | no restrictions apply |
|--------------------------|-----------------------|

|                                           |                       |
|-------------------------------------------|-----------------------|
| <b>spread_depth_difference</b>            | no restrictions apply |
| <b>flag_dynamic_object_priority</b>       | no restrictions apply |
| <b>dynamic_object_priority_difference</b> | no restrictions apply |

#### 5.15 EnhancedObjectMetadataConfig()

|                                      |                       |
|--------------------------------------|-----------------------|
| <b>hasDiffuseness</b>                | no restrictions apply |
| <b>hasCommonGroupDiffuseness</b>     | no restrictions apply |
| <b>hasExcludedSectors</b>            | no restrictions apply |
| <b>hasCommonGroupExcludedSectors</b> | no restrictions apply |
| <b>useOnlyPredefinedSectors</b>      | no restrictions apply |
| <b>hasClosestSpeakerCondition</b>    | no restrictions apply |
| <b>closestSpeakerThresholdAngle</b>  | no restrictions apply |
| <b>hasDivergence</b>                 | no restrictions apply |
| <b>divergenceAzimuthRange</b>        | no restrictions apply |
| <b>useOnlyPredefinedSectors</b>      | no restrictions apply |

#### 5.16 EnhancedObjectMetadataFrame()

|                                  |                                                                                    |
|----------------------------------|------------------------------------------------------------------------------------|
| <b>keepDiffuseness</b>           | no restrictions apply                                                              |
| <b>diffuseness</b>               | no restrictions apply                                                              |
| <b>keepExclusion</b>             | no restrictions apply                                                              |
| <b>numExclusionSectors</b>       | no restrictions apply                                                              |
| <b>excludeSectorIndex</b>        | shall be one of the non-reserved values as defined in ISO/IEC 23008-3:—, Table 146 |
| <b>usePredefinedSector</b>       | no restrictions apply                                                              |
| <b>excludeSectorIndex</b>        | no restrictions apply                                                              |
| <b>excludeSectorMinAzimuth</b>   | no restrictions apply                                                              |
| <b>excludeSectorMaxAzimuth</b>   | no restrictions apply                                                              |
| <b>excludeSectorMinElevation</b> | no restrictions apply                                                              |
| <b>excludeSectorMaxElevation</b> | no restrictions apply                                                              |
| <b>closestSpeakerPayout</b>      | no restrictions apply                                                              |
| <b>keepDiffuseness</b>           | no restrictions apply                                                              |
| <b>diffuseness</b>               | no restrictions apply                                                              |
| <b>keepDivergence</b>            | no restrictions apply                                                              |



|                                      |                                                                     |
|--------------------------------------|---------------------------------------------------------------------|
| <b>divergence</b>                    | no restrictions apply                                               |
| <b>keepExclusion</b>                 | no restrictions apply                                               |
| <b>numExclusionSectors</b>           | no restrictions apply                                               |
| <b>excludeSectorIndex</b>            | no restrictions apply                                               |
| <b>usePredefinedSector</b>           | no restrictions apply                                               |
| <b>excludeSectorIndex</b>            | no restrictions apply                                               |
| <b>excludeSectorMinAzimuth</b>       | no restrictions apply                                               |
| <b>excludeSectorMaxAzimuth</b>       | no restrictions apply                                               |
| <b>excludeSectorMinElevation</b>     | no restrictions apply                                               |
| <b>excludeSectorMaxElevation</b>     | no restrictions apply                                               |
| <b>5.17 SAOC 3D Config</b>           |                                                                     |
| <b>5.17.1 SAOC3DSpecificConfig()</b> |                                                                     |
| <b>bsSamplingFrequencyIndex</b>      | shall be equal to <b>usacSamplingFrequencyIndex</b>                 |
| <b>bsSamplingFrequency</b>           | shall be equal to <b>usacSamplingFrequency</b>                      |
| <b>bsFreqRes</b>                     | shall not be 0                                                      |
| <b>bsDoubleFrameLengthFlag</b>       | no restrictions apply                                               |
| <b>bsNumSaocDmxChannels</b>          | shall be equal to (numSAOCTransportChannels – bsNumSaocDmxObjects)  |
| <b>bsNumSaocDmxObjects</b>           | shall be equal to (numSAOCTransportChannels – bsNumSaocDmxChannels) |
| <b>bsDecorrelationMethod</b>         | no restrictions apply                                               |
| <b>bsNumSaocObjects</b>              | no restrictions apply                                               |
| <b>bsRelatedTo</b>                   | no restrictions apply                                               |
| <b>bsOneIOC</b>                      | no restrictions apply                                               |
| <b>bsSaocDmxMethod</b>               | no restrictions apply                                               |
| <b>bsDualMode</b>                    | no restrictions apply                                               |
| <b>bsBandsLow</b>                    | no restrictions apply                                               |
| <b>bsDcuFlag</b>                     | shall be 0                                                          |
| <b>bsDcuMandatory</b>                | shall be 0                                                          |
| <b>bsDcuDynamic</b>                  | shall be 0                                                          |
| <b>bsDcuMode</b>                     | shall be 0                                                          |
| <b>bsDcuParam</b>                    | shall be 0                                                          |

### 5.17.2 SAOC3DgetNumChannels()

No restrictions are applicable to this bitstream element.

### 5.17.3 SAOC3DExtensionConfig()

No restrictions are applicable to this bitstream element.

### 5.17.4 SAOC3DExtensionConfigData()

No restrictions are applicable to this bitstream element.

### 5.17.5 SAOCExtensionConfig()

The SAOCExtensionConfig() bitstream structure and all sub bitstream structures shall be restricted as specified in ISO/IEC 23003-2:2010/Amd.4:2016.

## 5.18 SAOC 3D frame

### 5.18.1 Saoc3DFrame()

|                           |                                                |
|---------------------------|------------------------------------------------|
| <b>bsIndependencyFlag</b> | shall be 1 if <b>usacIndependencyFlag</b> == 1 |
| <b>bsDcuDynamicUpdate</b> | no restrictions apply                          |
| <b>bsDcuMode</b>          | no restrictions apply                          |
| <b>bsDcuParam</b>         | no restrictions apply                          |

### 5.18.2 SAOC3DFramingInfo()

|                       |                       |
|-----------------------|-----------------------|
| <b>bsFramingType</b>  | no restrictions apply |
| <b>bsNumParamSets</b> | no restrictions apply |
| <b>bsParamSlot</b>    | no restrictions apply |

### 5.18.3 EcDataSaoc()

The SAOCExtensionConfig() bitstream structure and all sub bitstream structures shall be restricted as specified in ISO/IEC 23003-2:2010/Amd.4:2016.

### 5.18.4 ByteAlign()

The SAOCExtensionConfig() bitstream structure and all sub bitstream structures shall be restricted as specified in ISO/IEC 23003-2:2010/Amd.4:2016.

### 5.18.5 SAOC3DExtensionFrame()

No restrictions are applicable to this bitstream element.

### 5.18.6 SAOC3DExtensionFrameData()

No restrictions are applicable to this bitstream element.

**5.18.7 SAOCEExtensionFrame()**

The SAOCEExtensionConfig() bitstream structure and all sub bitstream structures shall be restricted as specified in ISO/IEC 23003-2:2010/Amd.4:2016

**5.18.8 HOAConfig()**

|                             |                                     |
|-----------------------------|-------------------------------------|
| <b>HoaOrder</b>             | shall NOT have values [30, ..., 38] |
| <b>IsScreenRelative</b>     | no restrictions apply               |
| <b>UsesNfc</b>              | no restrictions apply               |
| <b>NfcReferenceDistance</b> | no restrictions apply               |

**5.18.9 HOADecoderConfig()**

|                                      |                                                                                                                                                                        |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MinAmbHoaOrder</b>                | shall be smaller than or equal to $\min(\text{floor}(\sqrt{\text{numHOATransportChannels}} - 1), \text{HoaOrder})$                                                     |
|                                      | shall be according to ISO/IEC 23008-3:—, Table 14                                                                                                                      |
| <b>SingleLayer</b>                   | no restrictions apply                                                                                                                                                  |
| <b>codedLayerCh</b>                  | shall be smaller than NumOfAdditionalCoders                                                                                                                            |
| <b>CodedSpatialInterpolationTime</b> | shall be coded according to ISO/IEC 23008-3:—, Table 209                                                                                                               |
| <b>SpatialInterpolationMethod</b>    | no restrictions apply                                                                                                                                                  |
| <b>CodedVVecLength</b>               | shall NOT be 3                                                                                                                                                         |
| <b>MaxGainCorrAmpExp</b>             | no restrictions apply                                                                                                                                                  |
| <b>HOAFrameLengthIndicator</b>       | shall NOT be 3 according to ISO/IEC 23008-3:—, Table 208                                                                                                               |
| <b>DiffOrder</b>                     | the value of <b>DiffOrder</b> shall not result in a $\text{MaxHoaOrderToBeTransmitted} > \text{HOAOrder}$ . <b>DiffOrder</b> < <b>HOAOrder</b> - <b>MinAmbHoaOrder</b> |
| <b>NumVVecVqElementsBits</b>         | restricted to values [0..7]                                                                                                                                            |
| <b>UsePhaseShiftDecorr</b>           | no restrictions apply                                                                                                                                                  |

**5.18.10 HOAEnhConfig()**

|                 |                                  |
|-----------------|----------------------------------|
| <b>LayerIdx</b> | shall be [0, ..., NumLayers - 1] |
|-----------------|----------------------------------|

**5.18.11 HOADecoderEnhConfig ()**

|                                    |                       |
|------------------------------------|-----------------------|
| <b>MaxNoOfDirSigsForPrediction</b> | no restrictions apply |
| <b>NoOfBitsPerScalefactor</b>      | no restrictions apply |
| <b>PredSubbandsIdx</b>             | no restrictions apply |

|                                   |                       |
|-----------------------------------|-----------------------|
| <b>bsNumOfPredSubbands</b>        | no restrictions apply |
| <b>FirstSBRSubbandIdx</b>         | no restrictions apply |
| <b>MaxNumOfPredDirsLog2</b>       | no restrictions apply |
| <b>MaxNumOfPredDirsPerBand</b>    | no restrictions apply |
| <b>DirGridTableIdx</b>            | shall NOT be 3        |
| <b>ParSubbandTableIdx</b>         | no restrictions apply |
| <b>bsNumOfParSubbands</b>         | no restrictions apply |
| <b>LastFirstOrderSubbandIdx</b>   | no restrictions apply |
| <b>UseRealCoeffsPerParSubband</b> | no restrictions apply |

#### 5.18.12 getSubbandWidths ()

|                         |                       |
|-------------------------|-----------------------|
| <b>CodedBwFirstBand</b> | no restrictions apply |
| <b>bw_diff</b>          | no restrictions apply |

### 5.19 HOA frame

#### 5.19.1 HOAFrame()

|                            |                                                |
|----------------------------|------------------------------------------------|
| <b>hoaIndependencyFlag</b> | shall be 1 if <b>usacIndependencyFlag</b> == 1 |
|----------------------------|------------------------------------------------|

#### 5.19.2 HOAEnhFrame ()

No restrictions are applicable to this bitstream element.

#### 5.19.3 ChannelSideInfoData()

|                          |                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------|
| <b>ChannelType</b>       | shall be coded according to ISO/IEC 23008-3:—, Table 195                              |
| <b>ActiveDirsIds</b>     | shall be [0, ..., 900] according to ISO/IEC 23008-3:—, Table F.9                      |
| <b>NewChannelTypeOne</b> | no restrictions apply                                                                 |
| <b>NbitsQ</b>            | if <b>hoaIndependencyFlag</b> == 1 then the two MSBs of NbitsQ shall not be 00 binary |
| <b>CodebkIdx</b>         | shall NOT be 4, 5, 6                                                                  |
| <b>CbFlag</b>            | no restrictions apply                                                                 |
| <b>bA</b>                | no restrictions apply                                                                 |
| <b>bB</b>                | no restrictions apply                                                                 |

|               |                       |
|---------------|-----------------------|
| <b>uintC</b>  | no restrictions apply |
| <b>PFlag</b>  | no restrictions apply |
| <b>CbFlag</b> | no restrictions apply |

**5.19.4 AddAmbHoaInfoChannel()**

|                                |                                                |
|--------------------------------|------------------------------------------------|
| <b>AmbCoeffTransitionState</b> | shall NOT be 3                                 |
| <b>CodedAmbCoeffIdx</b>        | shall be smaller than MaxNumAddActiveAmbCoeffs |
| <b>AmbCoeffIdxTransition</b>   | no restrictions apply                          |

**5.19.5 HOAGainCorrectionData()**

|                                |                       |
|--------------------------------|-----------------------|
| <b>GainCorrPrevAmpExp</b>      | no restrictions apply |
| <b>CodedGainCorrectionExp</b>  | no restrictions apply |
| <b>GainCorrectionException</b> | no restrictions apply |

**5.19.6 VVectorData()**

|                |                                   |  |              |          |
|----------------|-----------------------------------|--|--------------|----------|
| <b>VvecIdx</b> | shall be smaller than or equal to |  | dependent on |          |
|                |                                   |  | CodebkIdx    | HoaOrder |
|                | 899                               |  | 0            | N/A      |
|                | 33                                |  | 1, 2         | N/A      |
|                | 63                                |  | 3            | N/A      |
|                | 31                                |  | 7            | = 4      |
|                | $(\text{HoaOrder} + 1)^2 - 1$     |  | 7            | $\neq 4$ |

|                  |                                                                           |
|------------------|---------------------------------------------------------------------------|
| <b>SgnVal</b>    | no restrictions apply                                                     |
| <b>WeightIdx</b> | no restrictions apply                                                     |
| <b>VecVal</b>    | no restrictions apply                                                     |
| <b>huffVal</b>   | shall be Huffman-coded according to ISO/IEC 23008-3:—, Tables F.15 – F.24 |
| <b>intAddVal</b> | no restrictions apply                                                     |

**5.19.7 HOAPredictionInfo()**

|                           |                       |
|---------------------------|-----------------------|
| <b>PSPredictionActive</b> | no restrictions apply |
| <b>KindOfCodedPredIds</b> | no restrictions apply |
| <b>NumActivePredIds</b>   | no restrictions apply |
| <b>PredIds</b>            | no restrictions apply |

|                      |                       |
|----------------------|-----------------------|
| <b>ActivePred</b>    | no restrictions apply |
| <b>PredDirSigIds</b> | no restrictions apply |
| <b>PredGains</b>     | no restrictions apply |

#### 5.19.8 HOADirectionalPredictionInfo()

|                                      |                       |
|--------------------------------------|-----------------------|
| <b>UseDirectionalPrediction</b>      | no restrictions apply |
| <b>KeepPreviousPredDirsFlag</b>      | no restrictions apply |
| <b>NumOfGlobalPredDirs</b>           | no restrictions apply |
| <b>GlobalPredDirIds</b>              | no restrictions apply |
| <b>KeepPreviousDirPredMatrixFlag</b> | no restrictions apply |
| <b>UseHuffmanCodingDiffAngle</b>     | no restrictions apply |
| <b>DirIsActive</b>                   | no restrictions apply |
| <b>RelDirGridIdx</b>                 | no restrictions apply |

#### 5.19.9 readDirPredDiffValues()

|                         |                       |
|-------------------------|-----------------------|
| <b>DecodedMagDiff</b>   | no restrictions apply |
| <b>DecodedAngleDiff</b> | no restrictions apply |

#### 5.19.10 HOAParInfo ()

|                                       |                       |
|---------------------------------------|-----------------------|
| <b>UsePar</b>                         | no restrictions apply |
| <b>KeepPreviousParMatrixFlag</b>      | no restrictions apply |
| <b>ParDecorrSigsSelectionTableIdx</b> | no restrictions apply |
| <b>UseReducedNoOfUpmixSigs</b>        | no restrictions apply |
| <b>UseParUpmixSig</b>                 | no restrictions apply |
| <b>UseParHuffmanCodingDiffAbs</b>     | no restrictions apply |
| <b>UseParHuffmanCodingDiffAngle</b>   | no restrictions apply |

#### 5.19.11 readParDiffValues ()

|                                   |                                                                   |
|-----------------------------------|-------------------------------------------------------------------|
| <b>HuffmanCodedParMagDiff</b>     | shall be Huffman-coded according to ISO/IEC 23008-3:—, Table F.37 |
| <b>HuffmanCodedRealParMagDiff</b> | shall be Huffman-coded according to ISO/IEC 23008-3:—, Table F.38 |
| <b>runLengthCodedVal</b>          | no restrictions apply                                             |
| <b>CodedParMagDiff</b>            | no restrictions apply                                             |

|                              |                                                                   |
|------------------------------|-------------------------------------------------------------------|
| <b>runLengthCodedVal</b>     | no restrictions apply                                             |
| <b>HuffCodedParAngleDiff</b> | shall be Huffman-coded according to ISO/IEC 23008-3:—, Table F.39 |
| <b>CodedParAngleDiff</b>     | no restrictions apply                                             |

## 5.20 FMT converter frame, **FormatConverterFrame()**

|                        |                       |
|------------------------|-----------------------|
| <b>rendering3DType</b> | no restrictions apply |
|------------------------|-----------------------|

## 5.21 Multi-channel coding tool config, **MCTConfig ()**

|                    |                                                                                                |
|--------------------|------------------------------------------------------------------------------------------------|
| <b>mctChanMask</b> | the number of all non-zero entries in <b>mctChanMask[]</b> shall be greater than or equal to 2 |
|--------------------|------------------------------------------------------------------------------------------------|

## 5.22 Multi-channel coding tool frame

### 5.22.1 **MultichannelCodingBoxRotation ()**

|                          |                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>channelPairIndex</b>  | shall have a value between and including 0 and $nMCTChannels \cdot (nMCTChannels - 1) / 2 - 1$ ,<br>with $nMCTChannels$ = number of all non-zero entries in <b>mctChanMask[]</b>                      |
| <b>hasMctMask</b>        | no restrictions apply                                                                                                                                                                                 |
| <b>hasBandwiseAngles</b> | no restrictions apply                                                                                                                                                                                 |
| <b>isMCTShort</b>        | no restrictions apply                                                                                                                                                                                 |
| <b>numMaskBands</b>      | no restrictions apply                                                                                                                                                                                 |
| <b>mctMask</b>           | no restrictions apply                                                                                                                                                                                 |
| <b>mct_delta_time</b>    | <b>mct_delta_time</b> shall be 0 if <b>MCTSignalingType</b> of the previous and the current frame changes between one of the following values: 0 and 1, 0 and 3, 1 and 2, or 2 and 3 (and vice versa) |
| <b>hcod_angle</b>        | no restrictions apply                                                                                                                                                                                 |

### 5.22.2 **MultichannelCodingBoxPrediction ()**

|                         |                                                                                                                                                                                  |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>channelPairIndex</b> | shall have a value between and including 0 and $nMCTChannels \cdot (nMCTChannels - 1) / 2 - 1$ ,<br>with $nMCTChannels$ = number of all non-zero entries in <b>mctChanMask[]</b> |
| <b>hasMctMask</b>       | no restrictions apply                                                                                                                                                            |
| <b>hasBandwiseCoeff</b> | no restrictions apply                                                                                                                                                            |
| <b>isMCTShort</b>       | no restrictions apply                                                                                                                                                            |

|                       |                                                                                                                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>numMaskBands</b>   | no restrictions apply                                                                                                                                                                                 |
| <b>mctMask</b>        | no restrictions apply                                                                                                                                                                                 |
| <b>pred_dir</b>       | no restrictions apply                                                                                                                                                                                 |
| <b>mct_delta_time</b> | <b>mct_delta_time</b> shall be 0 if <b>MCTSignalingType</b> of the previous and the current frame changes between one of the following values: 0 and 1, 0 and 3, 1 and 2, or 2 and 3 (and vice versa) |
| <b>hcod_sf</b>        | no restrictions apply                                                                                                                                                                                 |

### 5.22.3 MultichannelCodingFrame()

|                         |                       |
|-------------------------|-----------------------|
| <b>MCTSignalingType</b> | no restrictions apply |
| <b>keepTree</b>         | no restrictions apply |
| <b>numPairs</b>         | no restrictions apply |
| <b>hasStereoFilling</b> | no restrictions apply |

### 5.23 Tonal component coding configuration, TccConfig()

|                  |                |
|------------------|----------------|
| <b>tccMode[]</b> | shall not be 3 |
|------------------|----------------|

### 5.24 Tonal component coding frame

#### 5.24.1 General

**Conformance test bitstream** shall contain tonal component coding frame compressed data stored in **TccGroupOfSegments()** as defined in ISO/IEC 23008-3.

Each compressed data shall meet the syntactic and semantic requirements specified in ISO/IEC 23008-3.

#### 5.24.2 TccGroupOfSegments()

|                             |                                                                                                                                                              |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>tccDataPresent</b>       | no restrictions apply                                                                                                                                        |
| <b>numTrajectories</b>      | no restrictions apply                                                                                                                                        |
| <b>isContinued</b>          | no restrictions apply                                                                                                                                        |
| <b>segLength</b>            | no restrictions apply                                                                                                                                        |
| <b>amplQuant</b>            | no restrictions apply                                                                                                                                        |
| <b>amplTransformCoeffDC</b> | no restrictions apply                                                                                                                                        |
| <b>amplTransformIndex</b>   | The corresponding <b>huffWord</b> shall be encoded with the values listed in the Huffman table, <b>huff_idxTab</b> , defined in ISO/IEC 23008-3:—, Table 119 |
| <b>amplTransformCoeffAC</b> | The corresponding <b>huffWord</b> shall be encoded with the values listed in the Huffman table, <b>huff_acTab</b> , defined in ISO/IEC 23008-3:—, Table 120  |



|                                       |                                                                                                                                                              |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>amplSgn</b>                        | no restrictions apply                                                                                                                                        |
| <b>freqQuant</b>                      | no restrictions apply                                                                                                                                        |
| <b>freqTransformCoeffDC</b>           | no restrictions apply                                                                                                                                        |
| <b>freqTransformIndex</b>             | The corresponding <b>huffWord</b> shall be encoded with the values listed in the Huffman table, <b>huff_idxTab</b> , defined in ISO/IEC 23008-3:—, Table 119 |
| <b>freqTransformCoeffAC</b>           | The corresponding <b>huffWord</b> shall be encoded with the values listed in the Huffman table, <b>huff_acTab</b> , defined in ISO/IEC 23008-3:—, Table 120  |
| <b>freqSgn</b>                        | no restrictions apply                                                                                                                                        |
| <b>5.25 HREP config, HREPConfig()</b> |                                                                                                                                                              |
| <b>extendedGainRange</b>              | no restrictions apply                                                                                                                                        |
| <b>extendedBetaFactorPrecision</b>    | no restrictions apply                                                                                                                                        |
| <b>isHREPActive</b>                   | no restrictions apply                                                                                                                                        |
| <b>lastFFTLLine</b>                   | <b>lastFFTLLine</b> shall be greater than or equal to <b>transitionWidthLines</b>                                                                            |
| <b>transitionWidthLines</b>           | <b>transitionWidthLines</b> shall be smaller than or equal to <b>lastFFTLLine</b>                                                                            |
| <b>defaultBetaFactorIdx</b>           | no restrictions apply                                                                                                                                        |
| <b>useCommonSettings</b>              | no restrictions apply                                                                                                                                        |
| <b>5.26 HREP frame, HREPFrame()</b>   |                                                                                                                                                              |
| <b>useRawCoding</b>                   | no restrictions apply                                                                                                                                        |
| <b>gainIdx</b>                        | no restrictions apply                                                                                                                                        |
| <b>useDefaultBetaFactorIdx</b>        | no restrictions apply                                                                                                                                        |
| <b>betaFactorIdx</b>                  | no restrictions apply                                                                                                                                        |
| <b>5.27 ICG config, ICGConfig()</b>   |                                                                                                                                                              |
| <b>ICPresent</b>                      | no restrictions apply                                                                                                                                        |
| <b>ICinCPE</b>                        | no restrictions apply                                                                                                                                        |
| <b>ICGPreAppliedPresent</b>           | no restrictions apply                                                                                                                                        |
| <b>ICGPreAppliedCPE</b>               | no restrictions apply                                                                                                                                        |

## 5.28 SignalGroupInformation Config, SignalGroupInformation ()

|                      |                       |
|----------------------|-----------------------|
| <b>groupPriority</b> | no restrictions apply |
| <b>fixedPosition</b> | no restrictions apply |

## 5.29 DownmixMatrix

### 5.29.1 downmixConfig()

|                             |                       |
|-----------------------------|-----------------------|
| <b>downmixConfigType</b>    | shall not be 3        |
| <b>passiveDownmixFlag</b>   | no restrictions apply |
| <b>phaseAlignStrength</b>   | no restrictions apply |
| <b>immersiveDownmixFlag</b> | no restrictions apply |

### 5.29.2 DownmixMatrixSet()

|                                                |                                                                                                                        |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>downmixIdCount</b>                          | no restrictions apply                                                                                                  |
| <b>downmixId</b>                               | shall not be 0x00, shall not be 0x7F. All values of downmixID within one DownmixMatrixSet() shall be pairwise distinct |
| <b>downmixType</b>                             | shall be 0 or 1                                                                                                        |
| <b>CICPspeakerLayoutIdx</b> (downmixType == 0) | shall be encoded in accordance with ChannelConfiguration as defined in ISO/IEC 23091-3                                 |
| <b>CICPspeakerLayoutIdx</b> (downmixType == 1) | shall be encoded in accordance with ChannelConfiguration as defined in ISO/IEC 23091-3                                 |
| <b>bsDownmixMatrixCount</b>                    | no restrictions apply                                                                                                  |
| <b>bsNumAssignedGroupIDs</b>                   | no restrictions apply                                                                                                  |
| <b>Signal_groupID</b>                          | no restrictions apply                                                                                                  |
| <b>DmxMatrixLenBits</b>                        | no restrictions apply                                                                                                  |

### 5.29.3 DownmixMatrix()

|                         |                       |
|-------------------------|-----------------------|
| <b>equalizerPresent</b> | no restrictions apply |
| <b>precisionLevel</b>   | shall not be 3        |
| <b>maxGain</b>          | no restrictions apply |
| <b>minGain</b>          | no restrictions apply |
| <b>isAllSeparable</b>   | no restrictions apply |
| <b>isSeparable</b>      | no restrictions apply |
| <b>isAllSymmetric</b>   | no restrictions apply |

|                                  |                       |
|----------------------------------|-----------------------|
| <b>isSymmetric</b>               | no restrictions apply |
| <b>mixLFEOnlyToLFE</b>           | no restrictions apply |
| <b>rawCodingCompactMatrix</b>    | no restrictions apply |
| <b>compactDownmixMatrix</b>      | no restrictions apply |
| <b>useCompactTemplate</b>        | no restrictions apply |
| <b>runLGRParam</b>               | no restrictions apply |
| <b>zeroRunLength</b>             | no restrictions apply |
| <b>compactDownmixMatrix</b>      | no restrictions apply |
| <b>fullForAsymmetricInputs</b>   | no restrictions apply |
| <b>rawCodingNonzeros</b>         | no restrictions apply |
| <b>gainLGRParam</b>              | no restrictions apply |
| <b>5.29.4 DecoderGainValue()</b> |                       |
| <b>gainValueIndex</b>            | no restrictions apply |
| <b>5.29.5 ReadRange()</b>        |                       |
| <b>range</b>                     | no restrictions apply |
| <b>rangeExtra</b>                | no restrictions apply |
| <b>5.29.6 EqualizerConfig()</b>  |                       |
| <b>numEqualizers</b>             | no restrictions apply |
| <b>eqPrecisionLevel</b>          | no restrictions apply |
| <b>eqExtendedRange</b>           | no restrictions apply |
| <b>numSections</b>               | no restrictions apply |
| <b>qFactorIndex</b>              | no restrictions apply |
| <b>qFactorExtra</b>              | no restrictions apply |
| <b>centerGainIndex</b>           | no restrictions apply |
| <b>scalingGainIndex</b>          | no restrictions apply |
| <b>hasEqualizer</b>              | no restrictions apply |

### 5.30 Loudness info

#### 5.30.1 mpeg3daLoudnessInfoSet()

|                                        |                                                                                            |
|----------------------------------------|--------------------------------------------------------------------------------------------|
| <b>loudnessInfoCount</b>               | no restrictions apply                                                                      |
| <b>loudnessInfoType</b>                | no restrictions apply                                                                      |
| <b>mae_groupID</b>                     | shall match the mae_groupID value of a present mae_GroupDefinition() structure             |
| <b>mae_groupPresetID</b>               | shall match the mae_groupPresetID value of a present mae_GroupPresetDefinition() structure |
| <b>loudnessInfoAlbumPresent</b>        | no restrictions apply                                                                      |
| <b>loudnessInfoAlbumCount</b>          | no restrictions apply                                                                      |
| <b>loudnessInfoSetExtensionPresent</b> | no restrictions apply                                                                      |

#### 5.30.2 loudnessInfo()

The uniDrcGainExtension() bitstream structure shall be restricted as specified in ISO/IEC 23003-4:—, Clause 9.

#### 5.30.3 loudnessInfoSetExtension()

The uniDrcGainExtension() bitstream structure shall be restricted as specified in ISO/IEC 23003-4:—, Clause 9.

### 5.31 Audioscene info

#### 5.31.1 mae\_AudioSceneInfo

|                                      |                       |
|--------------------------------------|-----------------------|
| <b>mae_isMainStream</b>              | no restrictions apply |
| <b>mae_audioSceneInfoIDPresent</b>   | no restrictions apply |
| <b>mae_audioSceneInfoID</b>          | no restrictions apply |
| <b>mae_numGroups</b>                 | no restrictions apply |
| <b>mae_numSwitchGroups</b>           | no restrictions apply |
| <b>mae_numGroupPresets</b>           | no restrictions apply |
| <b>mae_bsMetaDataElementIDoffset</b> | no restrictions apply |
| <b>mae_metaDataElementIDmaxAvail</b> | no restrictions apply |

**5.31.2 mae\_Data()**

|                        |                                              |
|------------------------|----------------------------------------------|
| <b>mae_numDataSets</b> | no restrictions apply                        |
| <b>mae_dataType</b>    | each data type shall only occur once at most |
| <b>mae_dataLength</b>  | no restrictions apply                        |
| <b>tmp</b>             | no restrictions apply                        |

**5.31.3 mae\_GroupDefinition()**

|                                       |                                                                                              |
|---------------------------------------|----------------------------------------------------------------------------------------------|
| <b>mae_groupID</b>                    | shall not be the same value for different groups                                             |
| <b>mae_allowOnOff</b>                 | no restrictions apply                                                                        |
| <b>mae_defaultOnOff</b>               | no restrictions apply                                                                        |
| <b>mae_allowPositionInteractivity</b> | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMinAzOffset</b>   | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMaxAzOffset</b>   | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMinElOffset</b>   | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMaxElOffset</b>   | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMinDistFactor</b> | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMaxDistFactor</b> | shall be identical for groups contained in the same switch group                             |
| <b>mae_allowGainInteractivity</b>     | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMinGain</b>       | shall be identical for groups contained in the same switch group                             |
| <b>mae_interactivityMaxGain</b>       | shall be identical for groups contained in the same switch group                             |
| <b>mae_bsGroupNumMembers</b>          | no restrictions apply                                                                        |
| <b>mae_hasConjunctMembers</b>         | no restrictions apply                                                                        |
| <b>mae_startID</b>                    | no restrictions apply                                                                        |
| <b>mae_metaDataElementID</b>          | groups that are part of switch groups shall consist of one or multiple complete signalGroups |

#### 5.31.4 mae\_SwitchGroupDefinition()

|                                      |                                                                       |
|--------------------------------------|-----------------------------------------------------------------------|
| <b>mae_switchGroupID</b>             | shall not be the same value for different switch groups               |
| <b>mae_switchGroupAllowOnOff</b>     | no restrictions apply                                                 |
| <b>mae_switchGroupDefaultOnOff</b>   | no restrictions apply                                                 |
| <b>mae_bsSwitchGroupNumMembers</b>   | no restrictions apply                                                 |
| <b>mae_switchGroupMemberID</b>       | shall only reference groups which have a value of mae_allowOnOff of 1 |
| <b>mae_switchGroupDefaultGroupID</b> | no restrictions apply                                                 |

#### 5.31.5 mae\_Description()

|                                     |                                                                 |
|-------------------------------------|-----------------------------------------------------------------|
| <b>mae_bsNumDescriptionBlocks</b>   | no restrictions apply                                           |
| <b>mae_descriptionGroupID</b>       | shall only address values of mae_groupID once at the most       |
| <b>mae_descriptionSwitchGroupID</b> | shall only address values of mae_switchGroupID once at the most |
| <b>mae_descriptionGroupPresetID</b> | shall only address values of mae_groupPresetID once at the most |
| <b>mae_bsNumDescLanguages</b>       | no restrictions apply                                           |
| <b>mae_bsDescriptionLanguage</b>    | no restrictions apply                                           |
| <b>mae_bsDescriptionDataLength</b>  | no restrictions apply                                           |
| <b>mae_descriptionData</b>          | no restrictions apply                                           |

#### 5.31.6 mae\_ContentData()

|                                   |                       |
|-----------------------------------|-----------------------|
| <b>mae_bsNumContentDataBlocks</b> | no restrictions apply |
| <b>mae_ContentDataGroupID</b>     | no restrictions apply |
| <b>mae_contentKind</b>            | no restrictions apply |
| <b>mae_hasContentLanguage</b>     | no restrictions apply |
| <b>mae_contentLanguage</b>        | no restrictions apply |

#### 5.31.7 mae\_CompositePair()

|                                |                       |
|--------------------------------|-----------------------|
| <b>mae_bsNumCompositePairs</b> | no restrictions apply |
| <b>mae_CompositeElementID</b>  | no restrictions apply |

**5.31.8 mae\_GroupPresetDefinition()**

|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>mae_groupPresetID</b>                           | shall not be the same value for different presets                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>mae_groupPresetKind</b>                         | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_bsGroupPresetNumConditions</b>              | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetReferenceID</b>                  | shall only reference groups or switch groups which have a value of mae_allowOnOff of 1 or mae_switchGroupAllowOnOff of 1, respectively<br><br>not more than one condition shall be defined for a group<br><br>not more than one condition shall be defined for a switch group<br><br>not more than one condition shall be defined for groups which are part of the same switch group<br><br>for a group which is part of a switch group no condition shall be defined if a condition for the switch group is already defined |
| <b>mae_groupPresetConditionOnOff</b>               | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetDisableGainInteractivity</b>     | shall be 1 if mae_allowGainInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetGainFlag</b>                     | shall be 0 if mae_allowGainInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetGain</b>                         | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetDisablePositionInteractivity</b> | shall be 1 if mae_allowPositionInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>mae_groupPresetPositionFlag</b>                 | shall be 0 if mae_allowPositionInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>mae_groupPresetAzOffset</b>                     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetElOffset</b>                     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>mae_groupPresetDistFactor</b>                   | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**5.31.9 mae\_ProductionScreenSizeData()**

|                                 |                       |
|---------------------------------|-----------------------|
| <b>hasNonStandardScreenSize</b> | no restrictions apply |
| <b>bsScreenSizeAz</b>           | no restrictions apply |
| <b>bsScreenSizeTopEl</b>        | no restrictions apply |
| <b>bsScreenSizeBottomEl</b>     | no restrictions apply |

**5.31.10 mae\_LoudnessCompensationData ()**

|                                                 |                       |
|-------------------------------------------------|-----------------------|
| <b>mae_loudnessCompGroupLoudnessPresent</b>     | no restrictions apply |
| <b>mae_bsLoudnessCompGroupLoudness</b>          | no restrictions apply |
| <b>mae_loudnessCompDefaultParamsPresent</b>     | no restrictions apply |
| <b>mae_loudnessCompDefaultIncludeGroup</b>      | no restrictions apply |
| <b>mae_loudnessCompDefaultMinMaxGainPresent</b> | no restrictions apply |
| <b>mae_bsLoudnessCompDefaultMinGain</b>         | no restrictions apply |
| <b>mae_bsLoudnessCompDefaultMaxGain</b>         | no restrictions apply |
| <b>mae_loudnessCompPresetParamsPresent</b>      | no restrictions apply |
| <b>mae_loudnessCompPresetIncludeGroup</b>       | no restrictions apply |
| <b>mae_loudnessCompPresetMinMaxGainPresent</b>  | no restrictions apply |
| <b>mae_bsLoudnessCompPresetMinGain</b>          | no restrictions apply |
| <b>mae_bsLoudnessCompPresetMaxGain</b>          | no restrictions apply |

**5.31.11 mae\_ProductionScreenSizeDataExtension()**

|                                              |                       |
|----------------------------------------------|-----------------------|
| <b>mae_overwriteProductionScreenSizeData</b> | no restrictions apply |
| <b>bsScreenSizeLeftAz</b>                    | no restrictions apply |
| <b>bsScreenSizeRightAz</b>                   | no restrictions apply |
| <b>mae_NumPresetProductionScreens</b>        | no restrictions apply |
| <b>mae_productionScreenGroupPresetID</b>     | no restrictions apply |
| <b>mae_hasNonStandardScreenSize</b>          | no restrictions apply |
| <b>isCenteredInAzimuth</b>                   | no restrictions apply |
| <b>bsScreenSizeAz</b>                        | no restrictions apply |
| <b>bsScreenSizeLeftAz</b>                    | no restrictions apply |
| <b>bsScreenSizeRightAz</b>                   | no restrictions apply |
| <b>bsScreenSizeTopEl</b>                     | no restrictions apply |
| <b>bsScreenSizeBottomEl</b>                  | no restrictions apply |

**5.31.12 mae\_GroupPresetDefinitionExtension()**

|                                              |                       |
|----------------------------------------------|-----------------------|
| <b>mae_hasSwitchGroupConditions</b>          | no restrictions apply |
| <b>mae_isSwitchGroupCondition</b>            | no restrictions apply |
| <b>mae_hasDownmixIdGroupPresetExtensions</b> | no restrictions apply |



|                                                    |                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>mae_numDownmixIdGroupPresetExtensions</b>       | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetDownmixId</b>                    | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_bsGroupPresetNumConditions</b>              | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_isSwitchGroupCondition</b>                  | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetSwitchGroupID</b>                | shall only reference switch groups which have a value of mae_switchGroupAllowOnOff of 1<br><br>not more than one condition shall be defined for a switch group                                                                                                                                                                                                                       |
| <b>mae_groupPresetGroupID</b>                      | shall only reference groups which have a value of mae_allowOnOff of 1<br><br>not more than one condition shall be defined for a group<br><br>not more than one condition shall be defined for groups which are part of the same switch group<br><br>for a group which is part of a switch group no condition shall be defined if a condition for the switch group is already defined |
| <b>mae_groupPresetConditionOnOff</b>               | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetDisableGainInteractivity</b>     | shall be 1 if mae_allowGainInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetGainFlag</b>                     | shall be 0 if mae_allowGainInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetGain</b>                         | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetDisablePositionInteractivity</b> | shall be 1 if mae_allowPositionInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                            |
| <b>mae_groupPresetPositionFlag</b>                 | shall be 0 if mae_allowPositionInteractivity of the referenced group is 0                                                                                                                                                                                                                                                                                                            |
| <b>mae_groupPresetAzOffset</b>                     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetElOffset</b>                     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>mae_groupPresetDistFactor</b>                   | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>5.31.13 mae_DrcUserInterfaceInfo()</b>          |                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>version</b>                                     | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>bsNumTargetLoudnessConditions</b>               | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>bsTargetLoudnessValueUpper</b>                  | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |
| <b>drcSetEffectAvailable</b>                       | no restrictions apply                                                                                                                                                                                                                                                                                                                                                                |

## 5.32 HOA matrix

5.32.1 `HoaRenderingMatrixSet()`

|                                        |                                                                                        |
|----------------------------------------|----------------------------------------------------------------------------------------|
| <code>numOfHoaRenderingMatrices</code> | no restrictions apply                                                                  |
| <code>HoaRenderingMatrixId</code>      | no restrictions apply                                                                  |
| <code>CICPSpeakerLayoutIdx</code>      | shall be encoded in accordance with ChannelConfiguration as defined in ISO/IEC 23091-3 |
| <code>HoaMatrixLenBits</code>          | no restrictions apply                                                                  |

5.32.2 `HoaRenderingMatrix()`

|                                            |                                                            |
|--------------------------------------------|------------------------------------------------------------|
| <code>precisionLevel</code>                | no restrictions apply                                      |
| <code>isNormalized</code>                  | no restrictions apply                                      |
| <code>gainLimitPerHoaOrder</code>          | no restrictions apply                                      |
| <code>maxGain</code>                       | no restrictions apply                                      |
| <code>minGain</code>                       | no restrictions apply                                      |
| <code>isFullMatrix</code>                  | no restrictions apply                                      |
| <code>firstSparseOrder</code>              | shall be smaller than or equal to <code>maxHoaOrder</code> |
| <code>hasLfeRendering</code>               | no restrictions apply                                      |
| <code>numPairs</code>                      | no restrictions apply                                      |
| <code>zerothOrderAlwaysPositive</code>     | no restrictions apply                                      |
| <code>isAllValueSymmetric</code>           | no restrictions apply                                      |
| <code>isAnyValueSymmetric</code>           | no restrictions apply                                      |
| <code>boolVal (valueSymmetricPairs)</code> | no restrictions apply                                      |
| <code>isAllSignSymmetric</code>            | no restrictions apply                                      |
| <code>isAnySignSymmetric</code>            | no restrictions apply                                      |
| <code>boolVal (signSymmetricPairs)</code>  | no restrictions apply                                      |
| <code>isAllSignSymmetric</code>            | no restrictions apply                                      |
| <code>isAnySignSymmetric</code>            | no restrictions apply                                      |
| <code>boolVal (signSymmetricPairs)</code>  | no restrictions apply                                      |
| <code>hasVerticalCoef</code>               | no restrictions apply                                      |

5.32.3 `DecoderHoaMatrixData()`

|                       |                       |
|-----------------------|-----------------------|
| <code>hasValue</code> | no restrictions apply |
| <code>signVal</code>  | no restrictions apply |

#### 5.32.4 DecoderHoaGainValue()

No restrictions are applicable to this bitstream element.

### 5.33 Restrictions depending on profiles and levels

#### 5.33.1 General

Depending on the profile and level associated with the MPEG-H 3DA bitstream, further restriction may apply.

#### 5.33.2 Low complexity profile

##### 5.33.2.1 General

Additional to the restrictions specified in this document, all MPEG-H bitstreams which claim to comply to the low complexity profile, shall fulfil the profile restrictions defined in ISO/IEC 23008-3:—, 4.8.2.2.

##### 5.33.2.2 mpeg3daConfig()

The variables `usacSamplingFrequencyIndex`, `usacSamplingFrequency` and `coreSbrFrameLengthIndex` shall be encoded with a value specified in [Table 5](#).

**Table 5 — Specification of mpeg3daConfig()**

| Restriction applies to            | Level                |                      |                      |                      |                        |
|-----------------------------------|----------------------|----------------------|----------------------|----------------------|------------------------|
|                                   | 1                    | 2                    | 3                    | 4                    | 5                      |
| <b>usacSamplingFrequencyIndex</b> | 0x03 - 0x08,<br>0x1f | 0x03 - 0x08,<br>0x1f | 0x03 - 0x08,<br>0x1f | 0x03 - 0x08,<br>0x1f | 0x00 - 0x08,<br>0x1f   |
| <b>usacSamplingFrequency</b>      | 29400, 14700         | 29400, 14700         | 29400, 14700         | 29400, 14700         | 58800, 29400,<br>14700 |
| <b>coreSbrFrameLengthIndex</b>    | 1                    | 1                    | 1                    | 1                    | 1                      |

##### 5.33.2.3 mpeg3daDecoderConfig()

The variable **elementLengthPresent** shall be 1, if the Configuration Extension type `ID_CONFIG_EXT_AUDIOSCENE_INFO` exists and the value **mae\_numSwitchGroups** in bitstream structure `mae_AudioSceneInfo()` is larger than 0.

##### 5.33.2.4 Mpeg3daChannelPairElementConfig()

The variable **qceIndex** shall be 0.

##### 5.33.2.5 mpeg3daCoreConfig()

The variable **tw\_mdct** shall be 0.

In case **igfStartIndex** signals an audio frequency higher than 8 kHz, **igfUseEnf** shall be 0.

##### 5.33.2.6 StereoCoreToolInfo()

If the independent noise filling (INF) of the intelligent gap filling (IGF) is activated (i.e. if **igfUseEnf**==1), then the complex prediction tool shall be restricted to real-only prediction, i.e. **complex\_coef** shall be 0.

If stereo filling is activated (i.e. if **stereo\_filling**==1), then the complex prediction tool shall be restricted to real-only prediction, i.e. **complex\_coef** shall be 0.

## 5.33.2.7 MultichannelCodingFrame()

The variable **numPairs** shall be encoded with a value specified in [Table 6](#).

Table 6 — Specification of numPairs in MultichannelCodingFrame()

| Restriction applies to | Level |     |      |      |      |
|------------------------|-------|-----|------|------|------|
|                        | 1     | 2   | 3    | 4    | 5    |
| <b>numPairs</b>        | <=5   | <=9 | <=16 | <=28 | <=28 |

## 5.33.2.8 mpeg3daExtElement() for extension payload type ID\_EXT\_ELE\_AUDIOPREROLL

The value **usacExtElementPresent** for extension payload type ID\_EXT\_ELE\_AUDIOPREROLL shall be 1 at maximum once per 0.5 seconds of audio data.

## 5.33.2.9 AudioPreRoll()

The value **numPreRollFrames** shall be encoded with 0 or 1.

## 5.33.2.10 mpeg3daUniDrcConfig()

The value **drcCoefficientsUniDrcCount** shall be encoded with a value not larger than 4. The value **drcInstructionsUniDrcCount** shall be encoded with a value specified in [Table 7](#). **loudnessInfoSetPresent** shall be encoded with a value of 0.

Table 7 — Specification of drcInstructionUniDrcCount in mpeg3daUniDrcConfig()

| Restriction applies to            | Level |      |      |      |      |
|-----------------------------------|-------|------|------|------|------|
|                                   | 1     | 2    | 3    | 4    | 5    |
| <b>drcInstructionsUniDrcCount</b> | <=16  | <=16 | <=32 | <=32 | <=32 |

## 5.33.2.11 drcCoefficientsUniDrc()

The values **drcFrameSizePresent** and **timeDeltaMinPresent** shall be encoded with 0. The value for **gainInterpolationType** shall be encoded with 1. The value **bandCount** shall be encoded with a value specified in [Table 8](#).

Table 8 — Specification of bandCount in drcCoefficientsUniDrc()

| Restriction applies to | Level |     |     |     |     |
|------------------------|-------|-----|-----|-----|-----|
|                        | 1     | 2   | 3   | 4   | 5   |
| <b>bandCount</b>       | <=2   | <=4 | <=4 | <=4 | <=4 |

## 5.33.2.12 drcInstructionsUniDrc()

The value **dependsOnDrcSetPresent** shall be encoded with 0 if **downmixId** is equal to 0. Additionally, **bsSequenceIndex** shall be unique in simultaneously applied DRC sets except for **bsSequenceIndex** equal to 0. **bsSequenceIndex** shall be identical for all channels if **downmixId** is not equal to 0.

## 5.33.2.13 ObjectMetadataConfig() in extension config type ID\_EXT\_ELE\_OBJ\_METADATA

The value **lowDelayMetadataCoding** shall be encoded with 1. The variable **frameLength** shall be encoded with 3, 7 or 15.

**5.33.2.14 HOAConfig()**

HoaOrder shall be encoded as defined in [Table 9](#)

**Table 9 — Restrictions for HoaOrder**

| Restriction applies to HoaOrder | Level |     |     |     |     |
|---------------------------------|-------|-----|-----|-----|-----|
|                                 | 1     | 2   | 3   | 4   | 5   |
| in case UsesNfc == 0            | <=2   | <=4 | <=6 | <=6 | <=6 |
| in case UsesNfc == 1            | N/A   | <=1 | <=2 | <=3 | <=3 |

UsesNfc shall be encoded as defined in [Table 10](#)

**Table 10 — Restrictions for UsesNfc**

| Restriction applies to                                                                                   | Level |                 |   |   |   |
|----------------------------------------------------------------------------------------------------------|-------|-----------------|---|---|---|
|                                                                                                          | 1     | 2               | 3 | 4 | 5 |
| UsesNfc                                                                                                  | 0     | No restrictions |   |   |   |
| There shall not be more than one occurrence of UsesNfc == 1 in signal groups of type SignalGroupTypeHOA. |       |                 |   |   |   |

**5.33.2.15 HOADecoderConfig()**

HOAFrameLengthIndicator

shall not be 3

NOTE The value of this bitstream syntax element has no effect in LC Profile, because the outputFrameLength of the core decoder is always 1024 (see ISO/IEC 23008-3:—, Table 208)

UsePhaseShiftDecorr

shall not be 1

**5.33.2.16 HOADecoderEnhConfig()**

MaxNoOfDirSigsForPrediction

shall be encoded according to [Table 11](#)

**Table 11 — Restrictions for bsMaxNoOfDirSigsForPrediction**

| Restriction applies to        | Level |     |                 |   |   |
|-------------------------------|-------|-----|-----------------|---|---|
|                               | 1     | 2   | 3               | 4 | 5 |
| bsMaxNoOfDirSigsForPrediction | <=1   | <=2 | no restrictions |   |   |

PredSubbandsIdx

shall be 0

ParSubbandTableIdx

shall be 0

**5.33.2.17 mae\_AudioSceneInfo()**

The values **mae\_numGroups**, **mae\_numSwitchGroups** and **mae\_numGroupPresets** shall be encoded with a value specified in [Table 12](#).

Table 12 — Specification of mae\_AudioSceneInfo()

| Restriction applies to | Level |     |      |      |      |
|------------------------|-------|-----|------|------|------|
|                        | 1     | 2   | 3    | 4    | 5    |
| mae_numGroups          | <=5   | <=9 | <=16 | <=28 | <=28 |
| mae_numSwitchGroups    | <=2   | <=4 | <=8  | <=14 | <=14 |
| mae_numGroupPresets    | <=4   | <=4 | <=8  | <=16 | <=31 |

## 5.33.2.18 mae\_GroupPresetDefinition()

The value **mae\_bsGroupPresetNumConditions** shall be encoded with a value specified in [Table 13](#).

Table 13 — Specification of mae\_bsGroupPresetNumConditions in mae\_GroupPresetDefinition()

| Restriction applies to         | Level |    |     |     |     |
|--------------------------------|-------|----|-----|-----|-----|
|                                | 1     | 2  | 3   | 4   | 5   |
| mae_bsGroupPresetNumConditions | <5    | <9 | <16 | <16 | <16 |

## 5.33.2.19 mae\_Description()

The values **mae\_bsNumDescLanguages** and **mae\_bsDescriptionDataLength** shall be encoded with a value specified in [Table 14](#).

Table 14 — Specification of mae\_Description()

| Restriction applies to      | Level |      |      |      |      |
|-----------------------------|-------|------|------|------|------|
|                             | 1     | 2    | 3    | 4    | 5    |
| mae_bsNumDescLanguages      | <4    | <4   | <4   | <8   | <16  |
| mae_bsDescriptionDataLength | <256  | <256 | <256 | <256 | <256 |

## 5.33.2.20 mae\_GroupPresetDefinitionExtension()

The value **mae\_numDownmixIdGroupPresetExtensions** shall be encoded with a value specified in [Table 15](#).

Table 15 — Specification of mae\_numDownmixIdGroupPresentExtensions in mae\_GroupPresetDefinitionExtension()

| Restriction applies to                | Level |     |     |      |      |
|---------------------------------------|-------|-----|-----|------|------|
|                                       | 1     | 2   | 3   | 4    | 5    |
| mae_numDownmixIdGroupPresetExtensions | <=4   | <=4 | <=8 | <=16 | <=31 |

## 5.33.2.21 downmixConfig()

phaseAlignStrength shall be 0

## 5.33.2.22 EnhancedObjectMetadataConfig

If **spread[o]** or **spread\_width[o]** of a given object o is not 0, then **divergence[o]** shall be 0.

If **divergence[o]** of a given object o is not 0, then **spread[o]** shall be 0 (in case of uniform spread) and **spread\_width[o]** shall be 0 (in case of non-uniform spread).

## 6 MPEG-H 3D audio interfaces to the MPEG-H 3D audio decoder

### 6.1 Characteristics and test procedure

Characteristics of the decoder interfaces specify the constraints that are applicable to the interface parameters which are provided to the decoder. These syntactic and semantic constraints may, for example, restrict the range or the values of parameters that are provided directly or indirectly to the decoder.

Each MPEG-H 3DA audio decoder interface shall meet the syntactic and semantic requirements specified in this document. The present clause defines the conformance criteria that shall be fulfilled by compliant decoder interface implementations. These criteria are specified for the syntactic elements of the decoder interface. For interfaces, which can also be realised as part of a bitstream (such as the interface for user interaction) the same constraints apply.

For each interface a set of semantic tests to be performed on the interface parameters is described. To verify whether the syntax is correct is straightforward and therefore not defined herein after. For each test the condition or conditions that must be satisfied are given, as well as the prerequisites or conditions in which the test can be applied.

### 6.2 Interface for local setup information

#### 6.2.1 mpeg3daLocalSetupInformation()

|                                      |                                                               |
|--------------------------------------|---------------------------------------------------------------|
| <b>bsRenderingType</b>               | no restrictions apply                                         |
| <b>bsNumWIREoutputs</b>              | shall not be larger than (numAudioChannels + numAudioObjects) |
| <b>WireID</b>                        | no restrictions apply                                         |
| <b>hasLocalScreenSizeInformation</b> | no restrictions apply                                         |

#### 6.2.2 LoudspeakerRendering()

|                                      |                       |
|--------------------------------------|-----------------------|
| <b>bsNumLoudspeakers</b>             | no restrictions apply |
| <b>hasLoudspeakerDistance</b>        | no restrictions apply |
| <b>hasLoudspeakerCalibrationGain</b> | no restrictions apply |
| <b>useTrackingMode</b>               | no restrictions apply |
| <b>hasKnownPosition</b>              | no restrictions apply |
| <b>loudspeakerAzimuth</b>            | no restrictions apply |
| <b>loudspeakerElevation</b>          | no restrictions apply |
| <b>loudspeakerDistance</b>           | shall not be 0        |
| <b>loudspeakerCalibrationGain</b>    | no restrictions apply |
| <b>externalDistanceCompensation</b>  | no restrictions apply |

### 6.2.3 BinauralRendering()

No specific restrictions apply to the elements of BinauralRendering() and its further referenced bitstream elements, such as: BinauralFirData(), FdBinauralRenderParam(), VoffBrirParam(), SfrBrirParam(), QtdlBrirParam(), TdBinauralRenderParam().

### 6.2.4 LocalScreenSizeInformation()

|                                           |                       |
|-------------------------------------------|-----------------------|
| <b>isCenteredInAzimuth</b>                | no restrictions apply |
| <b>bsLocalScreenSizeAz</b>                | no restrictions apply |
| <b>bsLocalScreenSizeLeftAz</b>            | no restrictions apply |
| <b>bsLocalScreenSizeRightAz</b>           | no restrictions apply |
| <b>hasLocalScreenElevationInformation</b> | no restrictions apply |
| <b>bsLocalScreenSizeTopEl</b>             | no restrictions apply |
| <b>bsLocalScreenSizeBottomEl</b>          | no restrictions apply |

## 6.3 Interface for user interaction

### 6.3.1 mpeg3daElementInteraction()

|                                          |                       |
|------------------------------------------|-----------------------|
| <b>ei_InteractionSignatureDataLength</b> | no restrictions apply |
| <b>ei_InteractionSignatureDataType</b>   | no restrictions apply |
| <b>ei_InteractionSignatureData</b>       | no restrictions apply |
| <b>hasLocalZoomAreaSize</b>              | no restrictions apply |

### 6.3.2 ElementInteractionData ()

|                           |                                                                                                                     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>ei_interactionMode</b> | in case mae_numGroupPresets equals zero ei_interactionMode shall be zero, otherwise ei_interactionMode shall be one |
| <b>ei_numGroups</b>       | shall be the same number as mae_numGroups                                                                           |
| <b>ei_groupPresetID</b>   | shall contain a valid preset ID (ID of a preset defined in the bitstream)                                           |

### 6.3.3 ei\_GroupInteractivityStatus ()

|                          |                                                                                            |
|--------------------------|--------------------------------------------------------------------------------------------|
| <b>ei_groupID</b>        | shall contain a valid groupID (ID of a group defined in the bitstream)                     |
| <b>ei_onOff</b>          | no restrictions apply                                                                      |
| <b>ei_routeToWIRE</b>    | no restrictions apply                                                                      |
| <b>routeToWireID</b>     | no restrictions apply                                                                      |
| <b>ei_changePosition</b> | shall be 1 if the value mae_allowPositionInteractivity of the corresponding group equals 1 |



|                      |                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------|
| <b>ei_azOffset</b>   | no restrictions apply                                                                         |
| <b>ei_elOffset</b>   | no restrictions apply                                                                         |
| <b>ei_distFact</b>   | no restrictions apply                                                                         |
| <b>ei_changeGain</b> | shall be set to 1 if the value mae_allowGainInteractivity of the corresponding group equals 1 |
| <b>ei_gain</b>       | no restrictions apply                                                                         |

#### 6.3.4 LocalZoomAreaSize()

|                       |                       |
|-----------------------|-----------------------|
| <b>bsZoomAzCenter</b> | no restrictions apply |
| <b>bsZoomAz</b>       | no restrictions apply |
| <b>bsZoomElCenter</b> | no restrictions apply |
| <b>bsZoomEl</b>       | no restrictions apply |

### 6.4 Interface for loudness normalization and dynamic range control

The uniDrcInterface() bitstream structure and all sub-structures shall be restricted as specified in ISO/IEC 23003-4: —, Clause 9.

### 6.5 Interface for scene displacement data, mpeg3daSceneDisplacementData()

|                 |                       |
|-----------------|-----------------------|
| <b>sd_yaw</b>   | no restrictions apply |
| <b>sd_pitch</b> | no restrictions apply |
| <b>sd_roll</b>  | no restrictions apply |

## 7 MPEG-H 3D audio decoders

### 7.1 General

The set of conformance test conditions described in this document shall be applied to verify that a given MPEG-H 3DA decoder implementation complies with this document. Test conditions are designed to test each tool in isolation and thus, determine the requirements for the corresponding conformance criteria. However, some tools show interactions and dependencies. To cover such dependencies, test cases are defined that can be composed of one or more test conditions.

Every conformance test case results in one or more conformance test sequences. One line in the electronic insert “ConformanceTables.xlsx” (accessible at <http://standards.iso.org/iso-iec/23008/-9/ed-1/en>) represents one conformance test sequence. The tool or tool combination tested by a given test sequence can be deduced from its filename, as it follows the nomenclature defined in 4.3.2.

To claim conformance for the MPEG-H 3DA LC Profile, the output of the implementation under test shall meet the conformance test criteria against the reference waveform by applying the appropriate conformance test tools. The required conformance test tools as well as the conformance test criteria of each conformance test sequence are listed in the electronic insert “ConformanceTables.xlsx” (accessible at <http://standards.iso.org/iso-iec/23008/-9/ed-1/en>). All conformance test tools are defined in 4.3.3.

If a test case defines default behaviour, this should be fulfilled by all conformance test sequences if not specified different explicitly. For example, default behaviour for a tool can be that it is switched off.

The frequency of occurrence for independent frames (frames with **usacIndependencyFlag** == 1) should be at least once every 50 frames in each conformance test bitstream.

If not otherwise specified, the audio signal representation shall not leave the allowed value range of the chosen data representation at any point in the decoder processing chain. In other words, no "clipping" shall occur at any point in the decoder processing chain.

The conformance test sequences can be found at <http://standards.iso.org/iso-iec/23008/-9/ed-1/en>.

## 7.2 Basic conformance test conditions

### 7.2.1 Element configuration test condition

#### 7.2.1.1 General

This test condition shall be applied to verify the proper decoder behaviour in case of several signal groups, reference layouts, speaker configurations, signals of channels, objects, SAOC, HOA and the definitions for SCE, CPE and LFE.

#### 7.2.1.2 Test sequences

The test bitstream shall contain the configuration which is given by a specific 3daC\_ElemConflDx as shown in Table 16. This specifies a reference Layout, which shall be one of the 3daC\_SpeakerConflDx defined in Table 17. Additionally the 3daC\_ElemConflDx defines the Signalgroups and their order. If the SignalGroupType is **SignalGroupTypeChannels**, it can be either the reference Layout ("r") or a 3daC\_SpeakerConflDx, which is defined in Table 17. If the signalGroupType is **SignalGroupTypeObject**, it is specified with Obj<numOfChannels>. If the signalGroupType is **SignalGroupTypeHOA**, it is specified with Hoa<numOfChannels>. Also the 3daC\_ElemConflDx specifies the order of the usacElementTypes ID\_USAC\_SCE, ID\_USAC\_CPE, ID\_USAC\_LFE. Please note that there might be some ID\_USAC\_EXT Elements added, which are not defined in this test case.

Table 16 — 3daC\_ElemConflDx for conformance

| 3daC_Elem<br>ConflDx | Reference layout<br>(defined by 3daC_<br>SpeakerConflDx) | Signalgroups<br>(defined by 3daC_<br>SpeakerConflDx) | Core coder elements with order in the<br>element loop in mpegH3daFrame() |
|----------------------|----------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------------|
| C0                   | 0                                                        | r                                                    | 16 × SCE                                                                 |
| C1                   | 1                                                        | r                                                    | SCE                                                                      |
| C2                   | 2                                                        | r                                                    | CPE                                                                      |
| C6                   | 6                                                        | r                                                    | CPE – SCE – LFE – CPE                                                    |
| C19                  | 19                                                       | r                                                    | CPE – SCE – LFE – CPE – CPE – CPE – CPE                                  |
| C100                 | 6                                                        | r                                                    | 6 × SCE                                                                  |
| C102                 | 6                                                        | Two signal groups:<br>r, 2                           | 6 × SCE – CPE                                                            |
| C103                 | 2                                                        | Two signal groups:<br>r, r                           | 2 × CPE                                                                  |
| C104                 | 104                                                      | r                                                    | CPE – SCE – CPE – CPE – CPE                                              |
| O1                   | 6                                                        | Obj<1>                                               | SCE                                                                      |
| O9                   | 6                                                        | Obj<9>                                               | 9 × SCE                                                                  |
| H1                   | 6                                                        | Hoa<1>                                               | SCE                                                                      |
| H4                   | 6                                                        | Hoa<4>                                               | 4 × SCE                                                                  |
| H8                   | 6                                                        | Hoa<8>                                               | 8 × SCE                                                                  |

Table 16 (continued)

| 3daC_Elem<br>ConfIdx | Reference layout<br>(defined by 3daC_<br>SpeakerConfIdx) | Signalgroups<br>(defined by 3daC_<br>SpeakerConfIdx) | Core coder elements with order in the<br>element loop in mpeg3daFrame() |
|----------------------|----------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------|
| H9                   | 6                                                        | Hoa<9>                                               | 9 × SCE                                                                 |
| H16                  | 6                                                        | Hoa<16>                                              | 16 × SCE                                                                |
| M1                   | 6                                                        | Three signal groups:<br>r , Obj<2>, Hoa<8>           | SCE – CPE – LFE – CPE –<br>2 × SCE –<br>8 × SCE                         |

Table 17 — 3daC\_SpeakerConfIdx for conformance

| 3daC_SpeakerConfIdx | Description                                                                                                                                                                                                                                                                    |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                   | speakerLayoutType == 3<br>numSpeakers = 16                                                                                                                                                                                                                                     |
| 1                   | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=1                                                                                                                                                                                                                               |
| 2                   | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=2                                                                                                                                                                                                                               |
| 6                   | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=6                                                                                                                                                                                                                               |
| 7                   | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=7                                                                                                                                                                                                                               |
| 15                  | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=15                                                                                                                                                                                                                              |
| 16                  | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=16                                                                                                                                                                                                                              |
| 19                  | speakerLayoutType == 0<br>CICPSpeakerLayoutIdx=19                                                                                                                                                                                                                              |
| 104                 | speakerLayoutType == 1<br>numSpeakers = 9<br>CICPSpeakerIdx[0] = 2<br>CICPSpeakerIdx[1] = 0<br>CICPSpeakerIdx[2] = 1<br>CICPSpeakerIdx[3] = 4<br>CICPSpeakerIdx[4] = 5<br>CICPSpeakerIdx[5] = 17<br>CICPSpeakerIdx[6] = 18<br>CICPSpeakerIdx[7] = 30<br>CICPSpeakerIdx[8] = 31 |

## 7.2.2 Sampling rate

### 7.2.2.1 General

This test condition shall be applied to verify the proper decoder behaviour for different sampling frequencies.

### 7.2.2.2 Test sequences

The test bitstream shall contain the configuration which is given by a specific 3daC\_SampFreqIdx defined in [Table 18](#).

**Table 18 — 3daC\_SampFreqIdx for conformance**

| 3daC_SampFreqIdx | Description                                                     | Corresponding sampling frequency as defined in ISO/IEC 23003-3<br>Hz |
|------------------|-----------------------------------------------------------------|----------------------------------------------------------------------|
| 0                | usacSamplingFrequencyIndex=0x0                                  | 96 000                                                               |
| 1                | usacSamplingFrequencyIndex=0x1                                  | 88 200                                                               |
| 2                | usacSamplingFrequencyIndex=0x2                                  | 64 000                                                               |
| 3                | usacSamplingFrequencyIndex=0x3                                  | 48 000                                                               |
| 4                | usacSamplingFrequencyIndex=0x4                                  | 44 100                                                               |
| 5                | usacSamplingFrequencyIndex=0x5                                  | 32 000                                                               |
| 6                | usacSamplingFrequencyIndex=0x6                                  | 24 000                                                               |
| 7                | usacSamplingFrequencyIndex=0x7                                  | 22 050                                                               |
| 8                | usacSamplingFrequencyIndex=0x8                                  | 16 000                                                               |
| 32               | usacSamplingFrequencyIndex=0x1F<br>usacSamplingFrequency=14700  | N/A                                                                  |
| 33               | usacSamplingFrequencyIndex=0x1F<br>usacSamplingFrequency=29 400 | N/A                                                                  |
| 34               | usacSamplingFrequencyIndex=0x1F<br>usacSamplingFrequency=58 800 | N/A                                                                  |

### 7.2.3 Core mode tests [Fd|Lpd|Cct]

#### 7.2.3.1 General

This test condition shall be applied to verify the proper decoder behaviour for the core modes.

#### 7.2.3.2 Test sequences

The test condition shall contain one of the following 3 conditions:

- FD only [Fd];
- LPD only [Lpd];
- toggle between FD and LPD [Cct] (short for "common core coding tools").

In case of FD only, the core\_mode in bitstream structure mpeg3daCoreData() shall always be 0.

In case of LPD only, the core\_mode in bitstream structure mpeg3daCoreData() shall always be 1. Note that if an MPEG-H 3DA LFE exists, this channel will be encoded only with FD.

In case of switching between FD and LPD, the following conditions shall be fulfilled:

- If a MPEG-H 3DA CPE exists, at least one MPEG-H 3DA CPE shall toggle between FD and LPD simultaneously.
- If at least two MPEG-H 3DA CPE exists, at least one MPEG-H 3DA CPE shall toggle between FD and LPD differently for each channel, so that at least 25 % of the frames are coded differently.

- For each pair of channels (without the two channels of one MPEG-H 3DA CPE and MPEG-H 3DA LFE) there values for `core_mode` shall be differently for at least one frame.
- Each channels (without MPEG-H 3DA LFE) shall toggle at least 10 times from FD to LPD and 10 times from LPD to FD.

### 7.3 Additional test conditions

#### 7.3.1 3D audio core (FD)

##### 7.3.1.1 Basic FD window test condition [Win]

###### 7.3.1.1.1 General

This test condition shall be applied to verify the proper decoder for all meaningful FD window sequence transitions. Meaningful window sequence transitions are listed in ISO/IEC 23003-3:2012, 7.9.3.1 (Table 133).

###### 7.3.1.1.2 Test sequences

This test condition shall contain the following conditions:

- For all channels (except MPEG-H 3DA LFE) every meaningful FD window sequence transition shall be triggered.
- For all channels (except MPEG-H 3DA LFE) every meaningful FD window sequence transition shall be triggered with sine window (`window_shape 0`) and KBD window (`window_shape 1`).
- If there is at least one MPEG-H 3DA CPE, **common\_window** shall be at least one time 1 and at least one time 0.
- If there are at least two MPEG-H 3DA CPEs, for at least one of them **window\_sequence** shall be different for both channels in at least 50 % of the frames and **window\_shape** shall be different for at least 25 % of the frames and all combinations of **window\_sequence** and **window\_shape** for **ch** equal 1 and **window\_sequences** and **window\_shape** for **ch** equal 2 shall be signalled at least once.

###### 7.3.1.1.3 Default behaviour

If this test condition is not active, the default behaviour should be that all FD frames use always ONLY\_LONG\_SEQUENCE and sine window shape (`window_shape` equals 0).

##### 7.3.1.2 Non-meaningful FD window switching test condition [Nmf]

###### 7.3.1.2.1 General

This test condition should be applied to monitor the decoder behaviour in case FD window sequence transitions not specified in ISO/IEC 23003-3:2012, 7.9.3.1 (Table 133) that occur in a given bitstream.

###### 7.3.1.2.2 Test sequences

All non-meaningful FD window transitions shall be signalled at least once with sine window shape (`window_shape` equals 0) and at least once with KBD window shape (`window_shape` equals 1) in every channel (except MPEG-H 3DA LFE).

For every channel where FD mode and LPD mode is used, there shall be at least one transition from FD to LPD where the FD-window has signalled LONG\_WINDOW and LONG\_STOP\_WINDOW with window shape sine and KBD and at least one transition from LPD to FD where FD has signalled LONG\_WINDOW and LONG\_START\_WINDOW with window shape sine and KBD.

For every channel where FD mode and LPD mode is used, there shall be at least one transition from FD to LPD where either **prev\_aliasing\_symmetry** or **curr\_aliasing\_symmetry** or both equal 1.

It shall be assured that the decoder does not crash during decoding.

The decoder behaviour at non-meaningful FD window transitions is not covered by this document, hence no decoded waveforms are provided.

#### 7.3.1.2.3 Default behaviour

If this test condition is not active, the default behaviour should be that all FD frames use always ONLY\_LONG\_SEQUENCE and sine window shape (window\_shape equals 0).

#### 7.3.1.3 Aliasing symmetries test condition [Asy]

##### 7.3.1.3.1 General

This test condition shall be applied to verify the proper behaviour of the extended aliasing symmetries of MPEG-H 3D audio.

##### 7.3.1.3.2 Test sequences

This test condition shall contain the following conditions:

- For all channels (except MPEG-H 3DA LFE) every combination of **prev\_aliasing\_symmetry** and **curr\_aliasing\_symmetry** shall be triggered.
- **usacIndependencyFlag** shall be 1 for at least 10 % of the frames.

##### 7.3.1.3.3 Default behaviour

If this test condition is not active, the default behaviour should be that all FD frames trigger **curr\_aliasing\_symmetry** and **prev\_aliasing\_symmetry** equal to 0.

#### 7.3.1.4 Noise filling test condition [Nf]

##### 7.3.1.4.1 General

This test condition shall be applied to verify the proper behaviour of the noise filling tool of MPEG-H 3D audio and the correct signalling of its parameters.

##### 7.3.1.4.2 Test sequences

This test condition shall contain the following conditions:

- For all audio elements **noiseFilling** in *mpegh3daCoreConfig()* shall be 1 (except MPEG-H 3DA LFE).
- The values of **noise\_level** and **noise\_offset** vary from frame to frame. All possible combinations of **noise\_filling** and **noise\_offset** shall be triggered in every audio channel stream at least once, without the combination of **noise\_filling** equal to 0 and **noise\_offset** not equal to 0.
- Each pair of two different audio channel streams (except MPEG-H 3DA LFE) shall use a different value of **noise\_filling** or **noise\_offset** for at least one frame.

##### 7.3.1.4.3 Default behaviour

If this test condition is not active, the default behaviour should be to set **noiseFilling** to 0 in *mpegh3daCoreConfig()* for all audio elements.

### 7.3.1.5 Varying max\_sfb test condition [Sfb]

#### 7.3.1.5.1 General

This test condition shall be applied to ensure the correct decoder behaviour in case varying values of **max\_sfb** are signalled by the bitstream.

#### 7.3.1.5.2 Test sequences

The value of **max\_sfb** transmitted in `ics_info()` varies in the range from 0 to the maximum. The upper bound is determined by the given sampling rate.

If at least one MPEG-H 3DA CPE exists, at least one MPEG-H 3DA CPE shall signal different values of **max\_sfb** in more than 50 % of the frames for each channel. This MPEG-H 3DA CPE shall use **common\_window** equals 1 at least once while transmitting two different **max\_sfb**.

#### 7.3.1.5.3 Default behaviour

This conformance test condition does not have default behaviour.

### 7.3.1.6 TNS test condition [Tns]

#### 7.3.1.6.1 General

This test condition shall be applied to verify the proper behaviour of the temporal noise shaping (TNS) tool of MPEG-H 3D audio and the correct signalling of its parameters.

#### 7.3.1.6.2 Test sequences

All bitstreams containing TNS data are indicated by the bit **tns\_active** in `StereoCoreToolInfo()` and **tns\_data\_present** in `mpegh3daCoreCoderData()`. All TNS parameters mentioned in [Table 19](#) shall be applied at least once for each audio channel element. For MPEG-H 3DA CPE, additionally the parameters in [Table 20](#) shall be applied. Each pair of audio channel streams (except MPEG-H 3DA LFE) shall use at least for one frame different values.

**Table 19 — TNS parameters**

| Bitstream field                                             | Values          |
|-------------------------------------------------------------|-----------------|
| n_filt                                                      | 0...3(0, 1)     |
| coef_res                                                    | 0, 1            |
| length                                                      | 1, maxSfb       |
| order                                                       | 15 (7), 7(3), 1 |
| direction                                                   | 0, 1            |
| coef_compress                                               | 0, 1            |
| Coef                                                        | 0, 15 (7)       |
| NOTE The values in parenthesis are applied to short blocks. |                 |

**Table 20 — TNS stereo parameters**

| Bitstream field     | Values |
|---------------------|--------|
| Tns_data_present[1] | 0, 1   |
| Tns_on_lr           | 0, 1   |
| Tns_present_both    | 0, 1   |
| Common_tns          | 0, 1   |



### 7.3.1.6.3 Default behaviour

If this test condition is not active, the default behaviour should be to set **tns\_active** to 0 in *StereoCoreToolsInfo()* and to set **tns\_data\_present** to 0 in *mpegh3daCoreCoderData()* for all audio channel streams.

### 7.3.1.7 M/S stereo test condition [Ms]

#### 7.3.1.7.1 General

This test condition shall be applied to verify the proper behaviour of the M/S stereo tool of the MPEG-H 3DA decoder.

#### 7.3.1.7.2 Test sequences

Bitstreams make use of the M/S stereo tool. An overview of affected bitstream parameters is shown in [Table 21](#).

**Table 21 — M/S stereo parameters**

| Bitstream element | Value | Description                                           |
|-------------------|-------|-------------------------------------------------------|
| ms_mask_present   | 0     | M/S not active                                        |
|                   | 1     | M/S active on some scale factor bands                 |
|                   | 2     | M/S active on all scale factor bands                  |
| ms_used           | 0, 1  | Indicates the use of M/S stereo per scale factor band |

All bitstreams activating the M/S stereo tool shall cover the values as described above for every channel. Additionally, for every scale factor band **ms\_used** shall be set to 0 at least once and set to 1 at least once.

#### 7.3.1.7.3 Default behaviour

If this test condition is not active, the default behaviour should be that **ms\_mask\_present** is set to 0.

### 7.3.1.8 Complex prediction stereo test condition [Cp]

#### 7.3.1.8.1 General

This test condition shall be applied to ensure the functionality of the complex prediction stereo tool of the MPEG-H 3DA decoder.

#### 7.3.1.8.2 Test sequences

Bitstreams activate the complex prediction stereo tool of MPEG-H 3DA. The affected bitstream values are listed in [Table 22](#).

**Table 22 — Complex prediction stereo parameters**

| Bitstream element | Value | Description                                                 |
|-------------------|-------|-------------------------------------------------------------|
| ms_mask_present   | 0     | Complex prediction not active                               |
|                   | 3     | Complex prediction active                                   |
| cplx_pred_used    | 0, 1  | Indicates the use of complex prediction per prediction band |
| cplx_pred_all     | 0, 1  | Complex prediction on all prediction bands                  |



Table 22 (continued)

| Bitstream element | Value | Description                                                                               |
|-------------------|-------|-------------------------------------------------------------------------------------------|
| complex_coef      | 0, 1  | Transmit complex coefficients (1) or real only coefficients (0)                           |
| delta_code_time   | 0, 1  | Time differential coding (1) or frequency differential coding (0)                         |
| use_prev_frame    | 0, 1  | Use only current frame (0) or use both current and previous frame (1) for MDST estimation |
| pred_dir          | 0, 1  | Prediction from mid to side (0) or from side to mid (1)                                   |

All bitstreams activating the complex prediction stereo tool shall cover all values as described above for every channel. Additionally **cplx\_pred\_used** shall be for every sfb at least one time 0 and one time 1.

### 7.3.1.8.3 Default behaviour

If this test condition is not active, the default behaviour should be that **ms\_mask\_present** is set to 0.

### 7.3.1.9 Multichannel coding tool (MCT)

#### 7.3.1.9.1 General

The MCT tool is very complex to define in only one conformance test condition. That is why there are several conformance test conditions for this tool, which all start with "M-". In case no MCT related conformance test condition is active (respectively no conformance test condition is active, which is defined in 7.3.1.9), no extension payload with ID\_EXT\_ELE\_MCT shall be written.

#### 7.3.1.9.2 MCT global configuration

#### 7.3.1.9.3 MCT channel signalling [M-chM-<x>]

##### 7.3.1.9.3.1 General

This test condition shall be applied to verify the proper behaviour of the bitstream syntax element **mctChanMask[]** defined in MCTConfig().

##### 7.3.1.9.3.2 Test sequences

Bitstreams make use of the MCT and cover all possible activation states of distinct channels for MCT processing. Activation of MCT via **mctChanMask[]** is reflected by a hexadecimal value (<x>) that is appended to M-chM as follows: The bit representation of the hexadecimal value consists of all audio signals being part of the bit stream, irrespective of any grouping via signal groups and element type, where the least significant bit (LSB) represents the last audio signal and the most significant bit (MSB) represents the first audio signal. Note that an LFE element shall always be set to 0 and that if all elements of **mctChanMask[]** are zero for one signal group, no extension element with MCT payload is allowed.

##### 7.3.1.9.3.3 Default behaviour

If this test condition is not active, the default behaviour should be to set **mctChanMask[]** to 1 for all audio channels **bsNumberOfSignals[grp]+1** of a signal group grp except for LFE channels where it is 0.

### 7.3.1.9.4 MCT payload

#### 7.3.1.9.4.1 MCT signalling Type [M-Typ-<x>]

##### General

This test condition shall be applied to verify the proper behaviour of the decoder for the bitstream syntax element **MCTSignalingType**.

##### Test sequences

This test shall contain test conditions according to [Table 23](#):

**Table 23 — MCTSignalingType**

| M-Typ | MCTSignalingType | Description                                                                            |
|-------|------------------|----------------------------------------------------------------------------------------|
| 0     | 0                | Prediction only                                                                        |
| 1     | 1                | Rotation only                                                                          |
| 2     | 2                | Prediction with Stereo Filling                                                         |
| 3     | 3                | Rotation with Stereo Filling                                                           |
| 10    | 0,1,2,3          | Switching of all MCTSignalingTypes (every transition shall occur at least once)        |
| 11    | 2,3              | MCTSignalingType indicating Stereo Filling (this value shall toggle at least 20 times) |

Additionally, **mct\_delta\_time** shall toggle at least 10 times in both directions. In case of several MCTSignalingTypes within one bitstream, **mct\_delta\_time** shall be 1 when switching from 0 to 2 or 1 to 3 or vice versa at least once if possible.

##### Default behaviour

If this condition is not active, the default behaviour should be to use MCTSignalingType=0, exclusively.

#### 7.3.1.9.4.2 MCT stereo filling [M-SFi-<x>]

##### General

This test condition shall be applied to verify the proper behaviour of the decoder for the bitstream syntax element **hasStereoFilling[]** when **MCTSignalingType** is larger than 1.

##### Test sequences

This test shall contain test conditions according to [Table 24](#):

**Table 24 — hasStereoFilling[]**

| MCTSteFi | hasStereoFilling | Description                                 |
|----------|------------------|---------------------------------------------|
| 0        | 0                | Stereo Filling inactive                     |
| 1        | 1                | Stereo Filling active                       |
| 2        | 0,1              | Stereo Filling shall be active and inactive |

Additionally **isMCTShort** shall toggle between 0 and 1 (note that this means that not only ONLY\_LONG\_SEQUENCE is used)

##### Default behaviour

If this test condition is not active, the default behaviour should be to use **hasStereoFilling[pair]=0**, for all pairs pair.

#### 7.3.1.9.4.3 MCT mechanics [M-Mec]

##### General

This test condition shall be applied to verify the proper behaviour of the decoder for the bitstream syntax element **numPairs** and **keepTree** for different window sequences.

##### Test sequences

This test condition shall contain the following conditions:

- **numPairs** shall cover all valid values and remain constant over multiple frames;
- **keepTree** shall be 1 at least once for 10 consecutive frames.

##### Default behaviour

If this test condition is not active, the default behaviour should be to use a constant value for **numPairs** and **keepTree**=0.

#### 7.3.1.9.4.4 MCT rotation content [M-Rot]

##### General

This test condition shall be applied to verify the proper behaviour of the decoder for bitstream syntax elements used for MCT rotation processing.

##### Test sequences

This test condition shall contain the following conditions:

- all combinations of **hasMctMask** and **hasBandwiseCoeff** shall be covered;
- **mct\_delta\_time** shall toggle between 0 and 1;
- **numMaskBands** shall cover all valid values;
- **mctMask[]** shall be 0 and 1 for any pair of scale factor bands throughout the test sequences where transmitted;
- **dpcm\_beta[]** shall cover all possible values throughout the test sequences;
- **isMCTShort** shall toggle between 0 and 1 (note that this means that not only ONLY\_LONG\_SEQUENCE is used).

##### Default behaviour

If this condition is not active, the default behaviour should be to transmit **hasMctMask**=0, **hasBandwiseCoeff**=0 and a constant **dpcm\_beta[]**.

#### 7.3.1.9.4.5 MCT prediction content [M-Pre]

##### General

This test condition shall be applied to verify the proper behaviour of the decoder for bitstream syntax elements used for MCT prediction processing.

##### Test sequences

This test condition shall contain the following conditions:

- all combinations of **hasMctMask** and **hasBandwiseCoeff** shall be covered;
- **pred\_dir** shall toggle between 0 and 1;

- **mct\_delta\_time** shall toggle between 0 and 1;
- **numMaskBands** shall cover all valid values;
- **mctMask[]** shall be 0 and 1 for any pair of scale factor bands throughout the test sequences where transmitted;
- **dpcm\_alpha\_q\_re[]** shall cover all possible values throughout the test sequences;
- **isMCTShort** shall toggle between 0 and 1 (note that this means that not only ONLY\_LONG\_SEQUENCE is used).

#### Default behaviour

If this condition is not active, the default behaviour should be to transmit **hasMctMask=0**, **hasBandwiseCoeff=0** and a constant **dpcm\_alpha\_q\_re[]**.

### 7.3.2 3D audio core (LPD)

#### 7.3.2.1 LPC coding test condition [Lpc]

##### 7.3.2.1.1 General

The test condition shall be applied to verify the functionality of the linear predictive coding (LPC) filter and the proper decoding of LPC parameters in the bitstream.

##### 7.3.2.1.2 Test sequences

The test bitstream shall be designed such that:

- If not specified differently (with a combination of several conformance test conditions), all LPD frames shall be encoded using MDCT-based TCX.
- For each LPC filter (LPC1, LPC2, LPC3 and LPC4 for no Full band LPD and LPC1 and LPC4 for Full band LPD), every possible absolute and relative quantization mode in ISO/IEC 23008-3:—, Table 91 (fullbandLPD==1) or in ISO/IEC 23003-3:2012, Table 143 (fullbandLPD==0) is to be used at least once.
- All entries in the first stage approximation codebook are to be used at least once.

##### 7.3.2.1.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that the LPC filters exhibit weak resonances.

#### 7.3.2.2 ACELP core mode test condition [Ace]

##### 7.3.2.2.1 General

This test condition shall be applied to verify the correct decoding of frames encoded with the ACELP coding scheme.

##### 7.3.2.2.2 Test sequences

The test bitstream shall be designed such that:

- Every possible value of the bitfields **mean\_energy** (4 possibilities, see ISO/IEC 23003-3:2012, Table 145), **acb\_index[]** (512 or 64 possibilities, depending on the subframe position), **ltp\_filtering\_flag[]** (two possibilities) and **gains[]** (128 possibilities) is to be used at least once.

- In order to guarantee a complete and balanced coverage of all 8 algebraic codebooks defined in ISO/IEC 23003-3:2012, 7.14.5.2, each algebraic codebooks shall be employed at least once and the frequency of occurrence of all codebooks should be evenly distributed.
- If several channels are encoded in a bitstream, each pair of channels shall be encoded with two different codebook types for at least one frame.

### 7.3.2.2.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that all frames are encoded using TCX mode without restriction regarding the length of TCX. If ACELP is employed nonetheless, the pitch gain should be less than 0.1.

### 7.3.2.3 TCX and noise filling test condition [Tcx]

#### 7.3.2.3.1 General

This test condition shall be applied to verify the correct decoding of frames encoded with the TCX coding scheme. Furthermore, the TCX noise filling is covered.

#### 7.3.2.3.2 Test sequences

The test bitstream shall be designed such that:

- noiseFilling is set to 1.
- Every possible value of the bitfields noise\_factor (8 possibilities) and global\_gain (128 possibilities) is used at least once in each channel. Additionally each pair of the channels shall be encoded with a different noise\_factor and different global\_gain at least for one frame.
- In order to guarantee a complete and balanced coverage of all MDCT window lengths and all transitions between these, the usage of the various MDCT window lengths is as follows:
  - If Fullband LPD is active, where [x x] represents the two LPD coding modes mod[0..2] for one frame and 1, and 2 are the mode values that determine the MDCT window length as described in ISO/IEC 23008-3:—, Table 87:
    - [1 1] for at least 100 frames and at most 150 frames;
    - [2 2] for at least 100 frames and at most 150 frames;
    - [1 1][2 2] for at least 100 frames and at most 150 frames.
  - If Fullband LPD is inactive, where [x1 x2 x3 x4] represents the four LPD coding modes mod[0..3] for one frame and 1, 2 and 3 are the mode values that determine the MDCT window length as described in ISO/IEC 23003-3:2012, Table 92:
    - [1 1 1 1] for at least 100 frames and at most 150 frames;
    - [2 2 2 2] for at least 100 frames and at most 150 frames;
    - [3 3 3 3] for at least 100 frames and at most 150 frames;
    - [1 1 1 1][1 1 2 2][1 1 2 2][2 2 2 2][2 2 1 1][2 2 1 1][3 3 3 3][2 2 2 2][3 3 3 3][3 3 3 3] for at least 100 frames and at most 150 frames.
- If several channels are encoded in the bitstream, each pair of the channels shall be encoded with two different coding modes for at least one frame.

### 7.3.2.3.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that all frames are encoded with tcx (no restriction regarding the length of tcx).

### 7.3.2.4 fullband LPD test condition [fbL-<x1>-<x2>-..]

#### 7.3.2.4.1 General

This test condition shall be applied to verify the proper behaviour of the fullband LPD tool of the MPEG-H 3DA decoder.

#### 7.3.2.4.2 Test sequences

The name of the test includes parameters (<x1>, <x2>, ..) corresponding to the elements present in *mpegh3daDecoderConfig()*, except for ID\_USAC\_LFE and ID\_USAC\_EXT. The parameter x<id> denotes if fullband LPD tool is active or inactive, when set to 0 or 1 respectively, in the valid channel elements of order <id>. All parameters are connected by "-".

The test bitstream shall be designed such that, all elements set **fullbandLpd** to 0 or 1 in *mpegh3daCoreConfig()* corresponding to the parameter mentioned above.

#### 7.3.2.4.3 Default behaviour

If this test condition is not active, the default behaviour should be that fullband LPD is active for all elements i.e. **fullbandLpd** is set to 1 in *mpegh3daCoreConfig()*.

### 7.3.2.5 LPD mode coverage and FAC test condition [Lpd]

#### 7.3.2.5.1 General

This test condition shall be applied to ensure the proper decoding of frames encoded in LPD mode. It also covers all allowed transitions between LPD coding schemes (ACELP / TCX).

#### 7.3.2.5.2 Test sequences

The test bitstream shall be designed such that the following sequence is encoded:

- if Fullband LPD is active, all transitions of the different lpd\_modes from ISO/IEC 23008-3:—, Table 87 shall occur at least one time at every possible position.
- if Fullband LPD is inactive, all transitions of the different lpd\_mode from ISO/IEC 23003-3:2012, Table 92 shall occur at least one time at every possible position.

#### 7.3.2.5.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that all frames are encoded with TCX (no restriction regarding the length of tcx).

### 7.3.2.6 AVQ test condition [Avq]

#### 7.3.2.6.1 General

This test condition shall be applied to test the AVQ quantization tool of the USAC decoder.

### 7.3.2.6.2 Test sequences

The test bitstream is designed such that:

- All frames are encoded using ACELP and short MDCT-based TCX. The sequence shall be as follows:  
[0 0] [1 1] [0 1] [1 0] (fullbandLPD==1) or [0 0 1 1] [1 1 0 0] [0 1 0 1] [1 0 1 0] (fullbandLPD==0).
- For quantization of the FAC information, every absolute leader from ISO/IEC 23003-3:2012, Table 141 is to be used at least once.

### 7.3.2.6.3 Default behaviour

This conformance test condition does not have default behaviour.

### 7.3.2.7 Stereo LPD test condition [sLP-<x1>-<x2>-..]

#### 7.3.2.7.1 General

This test condition shall be applied to verify the proper behaviour of the stereo LPD tool of the MPEG-H 3DA decoder.

#### 7.3.2.7.2 Test sequences

The name of the test includes parameters (<x1>, <x2>, ..) corresponding to the ID\_USAC\_CPE elements present in *mpegh3daDecoderConfig()*. The parameter x<id> denotes if stereo LPD tool is active or inactive, when set to 0 or 1 respectively, in the channel pair element of order <id>. All parameters are connected by "-".

The test bitstream shall be designed such that:

- All ID\_USAC\_CPE shall set the syntax element **lpdStereoIndex** to 0 or 1 in *mpegh3daChannelPairElementConfig()* corresponding to the parameter mentioned above.
- If **lpdStereoIndex** is set to 1, all possible values of the tool parameters as shown in [Table 25](#) shall be tested.

**Table 25 — LPD stereo parameters**

| Bitstream field | Values   |
|-----------------|----------|
| res_mode        | 0,1      |
| q_mode          | 0, 1     |
| ipd_mode        | 0,1,2,3  |
| pred_mode       | 0,1      |
| cod_mode        | 0, 1,2,3 |

#### 7.3.2.7.3 Default behaviour

If this test condition is not active, the default behaviour should be that LPD stereo is inactive i.e. **lpdStereoIndex** is set to 0 for all elements.

### 7.3.2.8 Time domain bandwidth extension test condition [Tbe]

#### 7.3.2.8.1 General

This test condition shall be applied to test the time domain bandwidth extension from ACELP of the USAC decoder.



### 7.3.2.8.2 Test sequences

This test condition only affects channel elements where **fullbandLPD** is set to 1.

The affected bitstream values are listed in [Table 26](#).

**Table 26 — Time domain bandwidth extension parameters**

| Bitstream field  | Values  |
|------------------|---------|
| tbe_heMode       | 0, 1    |
| idxFrameGain     | 0...31  |
| idxSubGains      | 0...31  |
| lfs_idx[0]       | 0...127 |
| lfs_idx[1]       | 0...127 |
| tbe_hrConfig     | 0, 1    |
| tbe_nlConfig     | 0, 1    |
| idxMixConfig     | 0...3   |
| idxShbFrGain     | 0...63  |
| idxResSubGains   | 0...31  |
| idxShbExcResp[0] | 0...127 |
| idxShbExcResp[1] | 0...15  |

All bitstreams activating the time domain bandwidth extension test condition shall cover all values as described above for every channel where **fullbandLPD** is set to 1. Additionally all possible combinations of the values **tbe\_nlConfig** and **idxMixConfig** shall be triggered. And for **tbe\_heMode** equal to 0 the value **idxSubGains** shall be at least one time odd and one time even.

### 7.3.2.8.3 Default behaviour

If this conformance test condition is not active, the value of **tbe\_heMode** should be 1 and **idxFrameGain** 0.

## 7.3.3 3D audio core (FD and LPD)

### 7.3.3.1 Frequency domain prediction test condition [Fdp]

#### 7.3.3.1.1 General

This test condition shall be applied to verify the proper behaviour of the frequency domain prediction tool of MPEG-H 3D audio and the correct signalling of its parameters for the FD mode as well as for the LPD mode.

#### 7.3.3.1.2 Test sequences

The test bitstream shall be designed such that:

- The value **fdp\_data\_present** shall be set to 1 for 20 consecutive frames at least once for each channel (except MPEG-H 3DA LFE).
- Every possible value (0 ... 255) shall be set for **fdp\_spacing\_index** for each channel (except MPEG-H 3DA LFE).
- For every channel **fdp\_data\_present** shall be set at least one time to 1 in the first frame after **usacIndependencyFlag** is set to 1.



- For every channel where FD mode and LPD mode is used, there shall be at least one transition from FD to LPD and at least one transition from LPD to FD where for the first frame after the transition **fdp\_data\_present** is set to 1.
- For every channel where LPD mode is used and sometimes **lg** is equal to **ccfl**, **fdp\_data\_present** shall be set at least one time to 1 in the first frame after **lg** is not equal to **ccfl**.
- For each pair of channels the **fdp\_spacing\_index** shall be different for at least one frame.

#### 7.3.3.1.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that **fdp\_data\_present** is set to 0. Note that this value can occur in *fd\_channel\_stream()*, and *tcx\_coding()*.

#### 7.3.3.2 Long-term postfilter test condition [Lpf]

##### 7.3.3.2.1 General

This test condition shall be applied to verify the proper behaviour of the long-term postfilter tool of MPEG-H 3D audio and the correct signalling of its parameters for the FD mode as well as for the LPD mode

##### 7.3.3.2.2 Test sequences

The test bitstream shall be designed such that:

- the value **ltpf\_data\_present** shall be set to 1 for at least 80 % of the frames for each channel (except MPEG-H 3DA LFE);
- every possible value (0 ... 3) shall be set for **ltpf\_gain\_index** for each channel (except MPEG-H 3DA LFE);
- every possible value (0 ... 511) shall be set for **ltpf\_pitch\_lag\_index**;
- if at least one MPEG-H 3DA CPE exists, **common\_ltpf** shall be set at least once to 1 and at least once to 0;
- for every channel where FD mode and LPD mode is used, there shall be at least one transition from FD to LPD and at least one transition from LPD to FD where both frames of this channel have **ltpf\_data\_present** set to 1;
- for each pair of channels the **ltpf\_gain\_index** and **ltpf\_pitch\_lag\_index** shall be different for at least one frame.

##### 7.3.3.2.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that **ltpf\_data\_present** is set to 0. Note that this value can occur in *fd\_channel\_stream()*, *StereoCoreToolInfo()* and *tcx\_coding()*.

#### 7.3.3.3 Bass-post filter test condition [Bpf]

##### 7.3.3.3.1 General

This test condition shall be applied to verify the behaviour of the bass-post filter of the USAC decoder in LPD coding mode.

##### 7.3.3.3.2 Test sequences

This test condition only affects channel Elements where fullbandLPD is set to 0.

The test bitstream shall be designed such that for the channel Elements where fullbandLPD is set to 0:

- The frames are encoded using alternately the MDCT-based TCX coding mode and the ACELP coding mode. From time to time there shall be 5 to 10 consecutive frames TCX coding mode and 20 to 25 consecutive frames ACELP coding mode.
- The bass-post filter is switched on (bpf\_control\_info=1) and off (bpf\_control\_info=0). From time to time this shall toggle frequently every 2-3 frames.
- Every possible value of the acb\_index parameter (512 or 64 possibilities, depending on the subframe position) is used at least once for the ACELP frames where the bass-post filter is enabled.
- For each pair of channels (except MPEG-H 3DA LFE) the bpf\_control\_info shall be different for both channels for at least one frame.
- for every channel where FD mode and LPD mode is used, there shall be at least one transition from FD to LPD and at least one transition from LPD to FD where bpf\_control\_info is set to 1 and one where bpf\_control\_info is set to 0 for each LPDmode. Note that the bpf\_control\_info can only be set in the LPD-channelstream.

#### 7.3.3.3.3 Default behaviour

If this conformance test condition is not active, the default behaviour should be that bpf\_control\_info is set to 0. Note this is only possible if Fullband LPD is deactivated.

#### 7.3.3.4 Enhanced noise filling test conditions

##### 7.3.3.4.1 General

The enhanced noise filling tool is very versatile. Therefore several conformance test conditions are defined for this tool. Each condition is named with "E-" at the beginning. In case no Enhanced Noise Filling related conformance test condition is active, the syntax elements **noiseFilling** and **enhancedNoiseFilling** shall be 0. If no Enhanced Noise Filling related conformance test condition is active without the Stereo Filling Test condition, **enhancedNoiseFilling** shall be 0.

If **enhancedNoiseFilling** is set to 1, then igf\_AllZero shall be 0 in the majority of occurrences if not otherwise prohibited.

##### 7.3.3.4.2 IGF range signalling [E-ran-<x>-<y>]

###### 7.3.3.4.2.1 General

This test condition shall be applied to verify the proper behaviour of the syntax element **igfStartIndex** and **igfStopIndex** as defined in mpeg3daCoreConfig().

###### 7.3.3.4.2.2 Test sequences

The scalefactor bands where ENF is active are signalled by **igfStartIndex** and **igfStopIndex**. Each possible combination of these indices is reflected by two decimal values appended to E-ran, one for **igfStartIndex** (<x>) and one for **igfStopIndex** (<y>), where <x> is in the range of [00, 01, ..., 31] and <y> in the range of [00, 01, ..., 15].

###### 7.3.3.4.2.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfStartIndex** equals 21 and **igfStopIndex** equals 15.

### 7.3.3.4.3 IGF tiling [E-Cti]

#### 7.3.3.4.3.1 General

This test condition shall be applied to verify the proper behaviour of the syntax element **igf\_UsePrevTileIdx** and **igfCurrTileIdx** as defined in `igf_data()`.

#### 7.3.3.4.3.2 Test sequences

This test shall contain test conditions according to [Table 27](#). The number of tiles `igfNTiles` corresponds to the **igfStartIndex** and **igfStopIndex**. Those variables can be changed with the test condition "E-ran".

**Table 27 — igf\_UsePrevTileIdx and igfCurrTileIdx**

| Bitstream field                 | Values                                  |
|---------------------------------|-----------------------------------------|
| <code>igf_UsePrevTileIdx</code> | 0, 1                                    |
| <code>igfCurrTileIdx[0]</code>  | 0...3                                   |
| <code>igfCurrTileIdx[1]</code>  | 0...3, if <code>igfNTiles &gt; 1</code> |
| <code>igfCurrTileIdx[2]</code>  | 0...3, if <code>igfNTiles &gt; 2</code> |
| <code>igfCurrTileIdx[3]</code>  | 0...3, if <code>igfNTiles &gt; 3</code> |

Additionally, all pairs of **igfCurrTileIdx[]** shall be different at least one time.

#### 7.3.3.4.3.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfCurrTileIdx** is equal to 3 in each accessible element.

### 7.3.3.4.4 IGF whitening [E-Wht]

#### 7.3.3.4.4.1 General

This test condition shall be applied to verify the proper behaviour of the syntax element **igf\_UsePrevWhiteningLevel**, **remainingTilesDifferent** and **igf\_WhiteningLevel** as defined in `igf_data()`.

#### 7.3.3.4.4.2 Test sequences

In order to use this test condition the syntax element **igfUseWhitening** shall equal 1.

This test shall contain test conditions according to [Table 28](#). The number of tiles `igfNTiles` corresponds to the **igfStartIndex** and **igfStopIndex**. Those variables can be changed with the test condition "E-ran".

**Table 28 — igf\_UsePrevWhiteningLevel, remainingTilesDifferent and igf\_WhiteningLevel**

| Bitstream field                        | Values                                  |
|----------------------------------------|-----------------------------------------|
| <code>igf_UsePrevWhiteningLevel</code> | 0, 1                                    |
| <code>remainingTilesDifferent</code>   | 0, 1                                    |
| <code>igf_WhiteningLevel[0]</code>     | 0...2                                   |
| <code>igf_WhiteningLevel[1]</code>     | 0...2, if <code>igfNTiles &gt; 1</code> |
| <code>igf_WhiteningLevel[2]</code>     | 0...2, if <code>igfNTiles &gt; 2</code> |
| <code>igf_WhiteningLevel[3]</code>     | 0...2, if <code>igfNTiles &gt; 3</code> |

Additionally, all pairs of **igf\_WhiteningLevel[]** shall be different at least one time.

#### 7.3.3.4.4.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfUseWhitening** is equal to 0.

#### 7.3.3.4.5 IGF envelope noise flattening [E-Enf]

##### 7.3.3.4.5.1 General

This test condition shall be applied to verify the proper behaviour of the syntax element **igfApplyTNF** as defined in `igf_data()`. Besides the temporal noise flattening (TNF) tool this test condition will also test the independent noise filling (INF) which does not feature a dedicated payload syntax element but will be activated with the syntax element **igfUseEnf**, which is also mandatory for the temporal noise flattening.

##### 7.3.3.4.5.2 Test sequences

If this test condition is active, the value **igfUseEnf** shall be equal to 1.

Beside that this test shall contain test conditions according to [Table 29](#).

**Table 29 — igfApplyTNF**

| Bitstream field          | Values |
|--------------------------|--------|
| <code>igfApplyTNF</code> | 0, 1   |

Additionally, **igfApplyTNF** shall toggle at least 10 times in both directions.

##### 7.3.3.4.5.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfUseEnf** equals 0.

#### 7.3.3.4.6 IGF After TNS Synth [E-Ats]

##### 7.3.3.4.6.1 General

This test condition shall be applied to verify the proper behaviour of the syntax element **igfAfterTnsSynth** as defined in `mpegh3daCoreConfig()`.

##### 7.3.3.4.6.2 Test sequences

If this test condition is active, the value **igfAfterTnsSynth** shall be equal to 1.

##### 7.3.3.4.6.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfAfterTnsSynth** is equal to 0.

#### 7.3.3.4.7 IGF no high resolution [E-Nhr]

##### 7.3.3.4.7.1 General

This test condition shall be applied to verify the proper behaviour of the use of not high resolution.

##### 7.3.3.4.7.2 Test sequences

If this test condition is active, the value **igfUseHighRes** in `mpegh3daCoreConfig()` shall be equal to 0.

### 7.3.3.4.7.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfUseHighRes** in `mpegh3daCoreConfig()` is equal to 1.

### 7.3.3.4.8 IGF no independent tiling [E-Nit]

#### 7.3.3.4.8.1 General

This test condition shall be applied to verify the proper behaviour of not using independent tiling.

#### 7.3.3.4.8.2 Test sequences

To test the behaviour of not independent Tiling, the value **igfIndependentTiling** in `mpegh3daChannelPairElementConfig()` shall be equal to 0.

This test shall contain values according to [Table 30](#).

**Table 30 — Not independent tiling parameters**

| Bitstream field                                                             | Values     |
|-----------------------------------------------------------------------------|------------|
| <code>igf_ms_mask_present</code>                                            | 0, 1, 2, 3 |
| <code>ms_used</code><br>(related to <code>igf_ms_mask_present == 1</code> ) | 0, 1       |
| <code>igf_stereo_pred_all</code>                                            | 0, 1       |
| <code>cplx_pred_used</code><br>(in <code>igf_stereo_pred_data()</code> )    | 0, 1       |
| <code>igf_pred_dir</code>                                                   | 0, 1       |
| <code>igf_delta_code_time</code>                                            | 0, 1       |

#### 7.3.3.4.8.3 Default behaviour

If this test condition is not active, the default behaviour shall be that **igfIndependentTiling** in `mpegh3daChannelPairElementConfig()` is equal to 1.

### 7.3.3.4.9 Stereo filling [E-SFi]

#### 7.3.3.4.9.1 General

This test condition shall be applied to verify the proper behaviour of the stereo filling tool.

#### 7.3.3.4.9.2 Test sequences

In order to use this test condition the syntax element **noiseFilling** shall be 1.

This test shall contain test conditions according to [Table 31](#):

**Table 31 — Stereo filling**

| Bitstream field            | Values   |
|----------------------------|----------|
| <code>common_window</code> | 0, 1     |
| <code>noise_level</code>   | [0]      |
| <code>noise_offset</code>  | [1...31] |

Additionally the following conditions shall be fulfilled:

- For at least one MPEG-H 3DA CPE, **common\_window** shall be always set to 1.
- Mostly if **common\_window** is set to 1 (at least 80 %), **noise\_level** shall be set to 0 and **noise\_offset** unequal to 0 for the second channel (activates stereo filling).
- All valid combinations of **noise\_level** equal to 0 and **noise\_offset** unequal to 0 shall be triggered at least once.

#### 7.3.3.4.9.3 Default behaviour for stereo filling

If this test condition is not active, the default behaviour should be that **noiseFilling** is set to 0.

#### 7.3.3.5 Channel pair element configuration [cpc-<x1>-<x2>-...]

##### 7.3.3.5.1 General

This test condition shall be applied to verify the proper decoder behaviour for different CPE configurations.

##### 7.3.3.5.2 Test sequences

The name of this test condition contains as many parameters (<x1>,<x2>,...) as ID\_USAC\_CPE. The order of the parameter shall be in sync with the order of the ID\_USAC\_CPE in *mpegh3daDecoderConfig()*. All parameters are connected by "-". If the parameter is an integer, the corresponding **shiftIndex1** of the specific ID\_USAC\_CPE shall be 1 and **shiftChannel1** shall be set to the value of the corresponding parameter. If the parameter is "x" **shiftIndex1** of the specific ID\_USAC\_CPE shall be set to 0.

##### 7.3.3.5.3 Default behaviour

If this test condition is not active, the default behaviour should be that **shiftIndex1** is set to 0.

#### 7.3.3.6 Tonal component coding [Tcc-<x1>-<x2>-...]

##### 7.3.3.6.1 General

This test condition shall be applied to verify the correct decoder behaviour for the tonal component coding tool.

##### 7.3.3.6.2 Test sequences

For the purpose of conformance testing the variable **tccConfig** is defined as shown in [Table 32](#).

**Table 32 — Meaning of tccConfig**

| tccConfig value | Meaning                                                                                                                   |
|-----------------|---------------------------------------------------------------------------------------------------------------------------|
| 0               | No TCC data frames transmitted for corresponding SCE/CPE element.                                                         |
| 1               | One TCC frame transmitted for corresponding SCE/CPE. In case of CPE, TCC data are applied for both of the audio channels. |
| 2               | Two different TCC frames transmitted for corresponding CPE.                                                               |

One value of **tccConfig** is defined for each ID\_USAC\_SCE or ID\_USAC\_CPE in the conformance test bitstream and the name of the test condition reflects the values of **tccConfig** in the suffixes <x1>, <x2>, etc.

Specific test conditions are defined as shown in [Table 33](#).