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# Introduction

This document describes the reference software and the conformance testing for ISO/IEC 23090-31 Coding Representation for Haptics Phase 1. The reference software includes both encoder and decoder functionality.

The reference software is useful in aiding users of a standard for coding Haptics to establish and test conformance and interoperability, and to educate users and demonstrate the capabilities of the standard. For these purposes, the accompanying software is provided as an aid for the study and implementation of 23090-31 compression of Haptics.

The purpose of this document is to provide the following:

— A set of reference bitstreams conforming to ISO/IEC 23090-31.

— A set of reference bitstreams not conforming to ISO/IEC 23090-31.

— Reference decoder software capable of decoding bitstreams that conform to ISO/IEC 23090-31 in a manner that conforms to the decoding process specified in ISO/IEC 23090-31.

— Reference encoder software capable of producing bitstreams that conform to ISO/IEC 23090-31.

— Description of procedures to test conformance of bitstreams and decoders to ISO/IEC 23090-31.

# Reference Software

## **General**

The purpose of this clause is to provide the following:

— Reference decoder software capable of decoding bitstreams that conform to ISO/IEC 23090-31 in a manner that conforms to the decoding process specified in ISO/IEC 23090-31.

— Reference encoder software capable of producing bitstreams that conform to ISO/IEC 23090-31.

Some examples of uses that may be appropriate for the reference decoder software are as follows:

— As an illustration of how to perform the decoding process specified in ISO/IEC 23090-31.

— As the starting basis for the implementation of a decoder that conforms to ISO/IEC 23090-31.

— For testing the conformance of a decoder implementation with the decoding process specified in ISO/IEC 23090-31.

— For testing the conformance of a bitstream to the constraints specified for bitstream conformance in ISO/IEC 23090-31, as the software can detect and report many bitstream conformance violations.

However, the lack of the detection of any conformance violation by the reference decoder software should not be considered as definitive proof that the bitstream conforms to all constraints specified for bitstream conformance in ISO/IEC 23090-31.

Some examples of uses that may be appropriate for the reference encoder software are as follows:

— As an illustration of how to perform an encoding process that produces bitstreams that conform to the constraints specified for bitstream conformance in ISO/IEC 23090-31.

— As the starting basis for the implementation of an encoder that conforms to ISO/IEC 23090-31.

— As a means of generating bitstreams for testing the conformance of a decoder implementation with the decoding process specified in ISO/IEC 23090-31.

— As a means of evaluating and demonstrating examples of the quality that can be achieved by an encoding process that conforms to ISO/IEC 23090-31.

## **Software location and license**

The reference software is available at <http://standards.iso.org/iso-iec/23090/-33/ed-1/en/reference_software/>

The software license is provided in the file LICENSE included with the software.

## **Software installation**

Installation instructions are provided in the file Readme.md included with the software.

## **Software architecture**

Figure 1 illustrates the overall architecture of the codec. The codec can process both waveform PCM signals (WAV) and descriptive haptic files such as AHAP, IVS or HJIF, the proposed MPEG format. Metadata information is provided to the codec through OHM input files. The encoder can output two types of formats: an interchange file format (.hjif) encoded in JSON, and a binary encoded streaming format (MIHS) that can also be stored as a binary file (.hmpg). The two formats have complementary purposes, and a lossy one-to-one conversion can be operated between them.

The decoder takes as input a binary .hmpg file (the MIHS bitstream) or a .hjif file and either outputs a .hjif file or directly synthesizes the haptic data. The synthesizer allows to render haptic data directly from a .hjif input file or a decoded MIHS stream into a PCM output file if it does not contain wavelet encoded data. If the input file or stream contains wavelet data, it first goes through a wavelet decoder before synthesis.

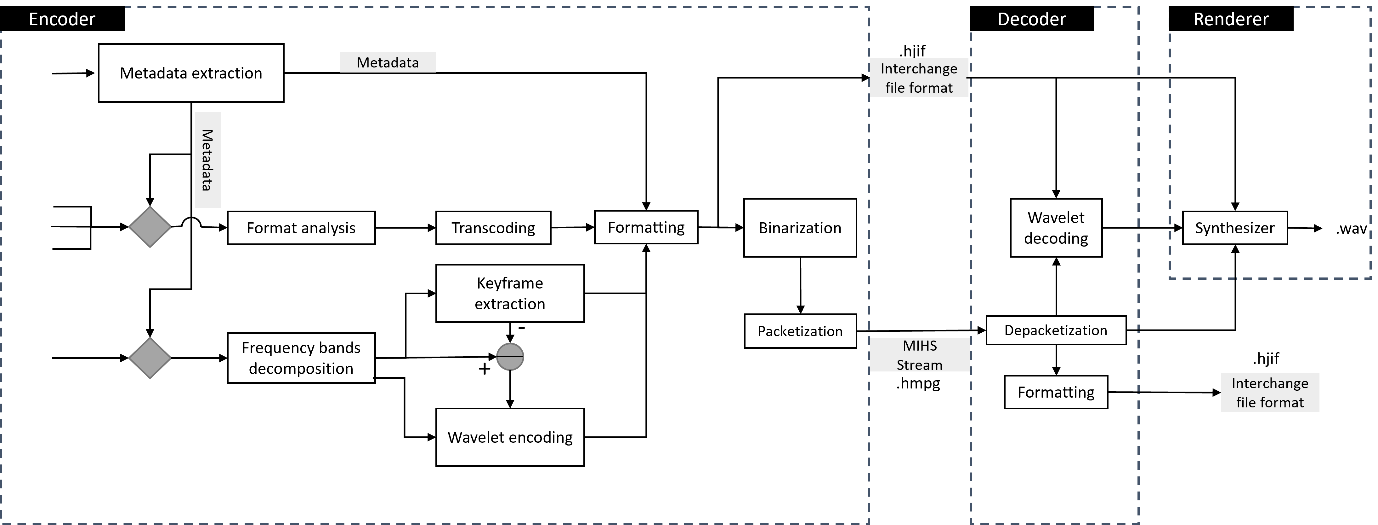


Figure 1 — Overview of the codec architecture

## **Software Usage**

The usage of the encoder, decoder and synthesizer is detailed in a dedicated section of the Readme.md file included with the reference software..

### Examples of encoding

* With an interchange output file:

|  |
| --- |
| ./Encoder -f MyInputFile.wav -o MyInterchangeFile.hjif |

* With a binary output file for a desired bitrate of 16kb/s:

|  |
| --- |
| ./Encoder -f MyInputFile.wav -o MyEncodedFile.hmpg --binary -kb 16 |

### Examples of decoding

|  |
| --- |
| ./Decoder -f MyEncodedFile.hmpg -o MyInterchangeFile.hjif |

### Examples of synthesis

* From an HJIF file

|  |
| --- |
| ./Synthesizer -f MyInterchangeFile.hjif -o MyOutputFile.wav |

* From a HMPG file

|  |
| --- |
| ./Synthesizer -f MyEncodedFile.hmpg -o MyOutputFile.wav |

## **Input Reference files and software evaluation**

For Encoder and Decoder testing, the set of reference files that were used for the implementation of the reference software is provided. This set of files contains three subsets: a training set, a test set, and an evaluation set. Each of these subsets contains data for short vibrotactile filesof typically a few milliseconds each (subset 1\_1), long vibrotactile files of typically a few seconds (subset 1\_2) and kinesthetic test files (subset 1\_3).

This set of files is composed of different input file types, including AHAP, IVS or WAV files and for part of them, an additional metadata OHM files (the OHM format is detailed in annex B of ISO/IEC 23090-31) is provided. The complete list of files is detailed in Annex H.

The reference software is provided with the python script “submission\_process.py” that is used to evaluate the reference software. The script encodes (at different bitrates), decodes, and synthetizes every reference file and outputs a detailed report of the performance of the evaluated codec. The usage of the script is detailed in Table 1. It is parameterized with the companion “config.json” file. This configuration file is setup to run the script with the reference software, but it can be modified to use any other codec that has the same arguments.

Table : Usage for the python script used to evaluate the reference software

|  |  |
| --- | --- |
| usage: submission\_process.py [-h] [--cutoff CUTOFF] [-o OUTPUT] [-b BITRATES [BITRATES ...]] [--padding PADDING]  [--filter\_by\_type FILTER\_BY\_TYPE] [--disable\_wavelet DISABLE\_WAVELET]  [--disable\_vectorial DISABLE\_VECTORIAL] [--bjontegaard BJONTEGAARD]  config\_file CRM\_version | |
|  |  |
| positional arguments: |  |
| config\_file | input config file in JSON format |
| CRM\_version | version of the reference software |
|  |  |
| options: |  |
| -h, --help | show this help message and exit |
| --cutoff CUTOFF | Cutoff frequency. Default is 72.5 |
| -o OUTPUT, --output OUTPUT | output folder (default is `./out`) |
| -b BITRATES [BITRATES ...], --bitrates BITRATES [BITRATES ...] | bitrates used for the encoding (default is `[2, 8, 16, 64]`) |
| --padding PADDING | pad in seconds used for the syntheziser |
| --filter\_by\_type FILTER\_BY\_TYPE | Process input files matching with this type (if not set every file will be proceed) |
| --disable\_wavelet DISABLE\_WAVELET | Disables wavelet encoding |
| --disable\_vectorial DISABLE\_VECTORIAL | Disables vectorial encoding |
| --bjontegaard BJONTEGAARD | Calculates Bjontegaard's metrics and visualy display the difference |

## **Reference software limitations**

As illustrated in Figure 1, the reference software is composed of three blocks: the encoder, the decoder and the synthesizer. The reference decoder is capable of decoding any bitstreams that conform to ISO/IEC 23090-31 in a manner that conforms to the decoding process specified in ISO/IEC 23090-31. The reference encoder is not normative and provide one possible implementation capable of producing bitstreams that conform to ISO/IEC 23090-31. The reference synthesizer is also not normative and provide one possible implementation capable of outputting Waveform PCM signal from the data decoded with the reference synthesizer. Both the encoder and synthesizer provide a reference implementation that is not meant to be exhaustive nor fully optimized. As such these two pieces of software present some limitations:

**Encoder:**

* The Specification allows overlapping effects on a single band but the encoder does not, it automatically add a new band to prevent effects to overlap.
* The encoder does not provide any means to create new synch packets. For instance, when encoding an input PCM file (typically a wave file), the current encoder splits the signal into low and high frequency bands. The low frequencies are encoded using a curve band while the high frequencies are encoded using wavelet band. During packetization, all MIHSPacket for the wavelet band are sync while the MIHSPacket of the curve band are non-sync resulting in non-sync MIHSUnits. While this behavior is compliant with the specification, it is not intuitive. Another encoder could ensure that all MIHSPackets are sync

**Synthesizer:**

* The current implementation of cubic interpolation for curve band is an approximation, it is not an exact interpolation. The solution works with curves defined using extremum but may produce artefacts if intermediate control points are added. The proposed solution is fast and work without artefacts when rendering signals encoded with the reference encoder.

## **Recommended Bitrates**

Annex A, Annex B and Annex C provide guidelines for selecting encoder settings to achieve specific output bitrates. Three different setups for wave files were used:

* Wavelet and Vectorial encoding with a cutoff frequency of 72.5 Hz (Annex A). The bit budget was varied in the whole available range of 1 to 135 bits with the default block length of 1024.
* Wavelet encoding only (Annex B) The bit budget was varied in the whole available range of 1 to 135 bits with the default block length of 1024.
* Vectorial encoding only with a cutoff frequency of 72.5 Hz (Annex C). Vectorial encoding has no parameter to control the bitrate. A single setup was evaluated.

The tables were generated by finding the file with the highest bitrate for the given setting.

Editorial Note: The table will be updated to include average bitrates and PSNR for the whole table.

# Conformance Testing

## **General**

Subclauses 3.2 through 3.4 specify tests for verifying the conformance of bitstreams as well as decoders. Two levels of conformance have been defined as described in Figure 2. One for the HJIF format, one for the HMPG format.

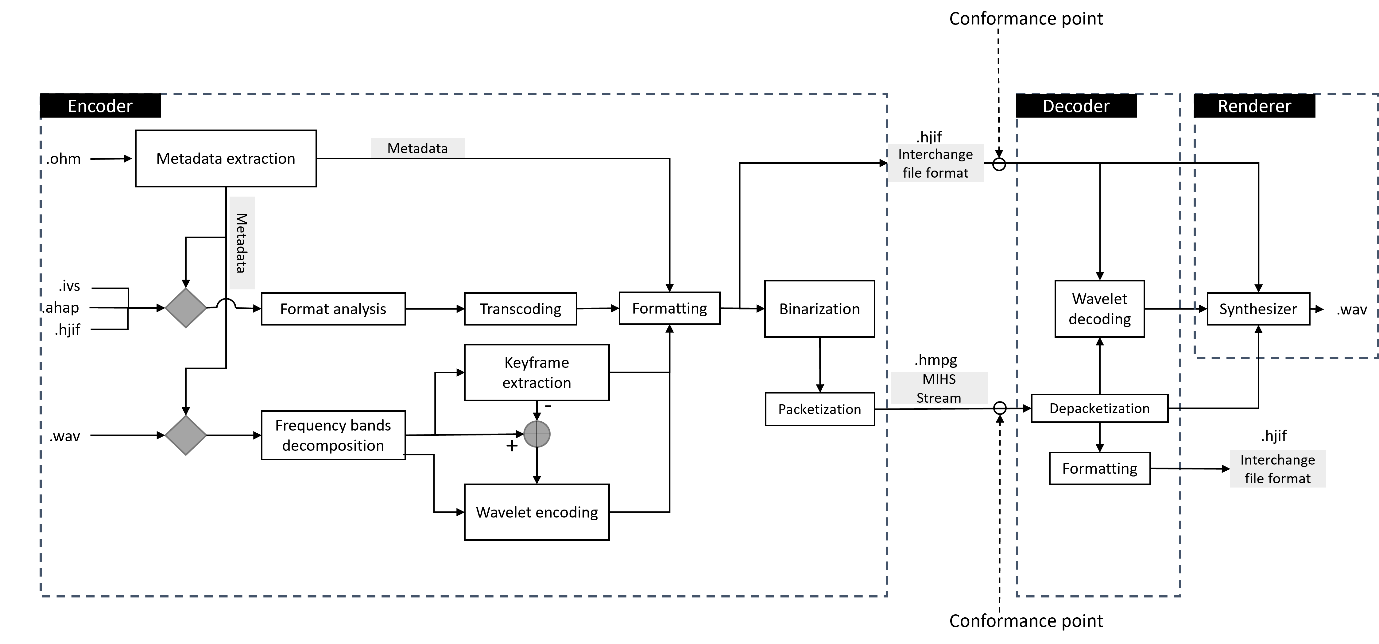


Figure —Overview of the conformance points

## **Conformance testing for Interchange Format**

The process for checking the conformance of HJIF files is shown in Figure 1.

Semantic Verifier

*Schema*

*HJIF file*

*Report*



*Rules*



*Report*

Schema Verifier

Figure 1 — HJIF conformance tool

As shown in Figure 1, an HJIF input document conformance can be verified in two steps:

Step1. Schema verification: Using a relevant schema, its schema is verified.

Step 2. Semantic verification: Using a set of rule tables, the semantic is verified.

Each step produces a report outlining which item in the document has failed if any.

The following information is provided for the verifiers:

1. For step 1, the schema for the HJIF file is provided to the schema verifier. The list of all rules verified by the schema verifier is detailed in Annex A

For step 2, the rule tables reflect the “shalls” of the haptics specification such as the range of the parameters or the uniqueness of IDs. The complete list of rules is detailed in Annex B. The decoder conformance is specified in ISO/IEC 23090-31, Clause 6.

## **Conformance testing for MIHS stream**

Figure 2 demonstrates the process for checking the conformance of MIHS streams.

*MIHS stream*



*Report*

Haptics MIHS Bitstream verifier

Figure 2 — MIHS conformance tool

As shown in Figure 2, a MIHS input stream’s conformance is verified in a single step: The haptics MIHS bitstream verifier decodes the MIHS streams, decodes each MIHS unit and packets, and checks whether the syntax and conditions of the bitstream are valid according to the haptics specification. The complete list of rules is detailed in Annex C. The output of the verifier is a report. The report can be in the form of HJIF format. However, there is additional information that may be provided by extending the HJIF format, including the silent MIHS units, independent effects, etc.

The bitstream conformance is specified in ISO/IEC 23090-31, Clause 7.

## **HMPG compatibility conformance**

As depicted in Figure 1, HJIF input files can be compressed and packetized into MIHS streams. This conversion however may not be lossless due to the limited number of bits allocated for each property in the binary format. This typically limits the number of elements that may be contained in an array or the ranges of integer or decimal values.

The complete list of properties with their relative limitations is provided in Annex D.

*HJIF file*



*Report*

Compatibility Verifier

Figure : HMPG compatibility checking tool

The output of the verifier is a report with the list of all the constraints that have to be addressed to perform a binary encoding of the HJIF file.

## **Conformance testing for decoder**

Figure 3 demonstrates the conformance-checking process for a haptic decoder.

Haptic decoder

(under conformance test)

*MIHS reference stream*



*HJIF reference file*

HJIF file comparator

*report*

Figure 3 — haptic decoder conformance

As shown in Figure 3, the haptic decoder under the conformance test is checked as the following:

* + - 1. A MIHS reference stream is fed to the decoder.
      2. The output of the decoder is provided to the HJIF comparator along with the HJIF reference file corresponding to the MIHS reference stream.
      3. The HJIF comparator compares the items in the two HJIF files. Considering that the order of items in two HJIF files might be different, the HJIF compares each item in one HJIF file and finds the equivalent one in the other file. If there exists any item in one file that doesn’t have the equivalent in the other file, the HJIF comparator generates an error.

Note that two conforming decoders may produce two different HJIF files, while they convey the same information, might not be byte-to-byte identical. Besides the different conventions of using white spaces, the decoders might produce the arrays in a different order when the standard does not require a certain order of array elements.

The decoder conformance is specified in ISO/IEC 23090-31, Clause 7.

Editorial Note: This clause will be updated when the implementation will be complete

## **HJIF Conformance testing and reference files**

A set of reference files are provided for conformance testing. Annex I and Annex J detail the list of non-conformant test files used to test the implementation of the conformance checks. It also lists the features tested for each file.

Editorial Note: An additional table will be added with the list of files used for compatibility testing

A dedicated script testing all non-conformant files with expected outptut is available with the reference software. It ensures that the decoder identifies all conformance issues defined in the previous clauses. The usage of this script is detailed in Table 2.

Table : Usage for the python script used to check the conformance

|  |  |
| --- | --- |
| usage: conformance\_check.py [-h] config\_file | |
|  | |
| positional arguments: |  |
| config\_file | input config file in JSON format |
|  |  |
| options: |  |
| -h, --help | show this help message and exit |

# Conclusion

This document is a draft document on Conformance and Reference Software for ISO/IEC 23090-31 Haptic Representation and Coding Phase 1.

We recommend WG7 to continue the work related to this ISO/IEC 23090-33.

Editorial Note: The tables in the Annexes will be updated when the implementation of the reference software will be complete.

1. **List of recommended bitrates with wavelet and vectorial encoding**

|  |  |  |
| --- | --- | --- |
| Allocated Bits | Bitrate | File |
| 1 | 8.05 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 2 | 8.53 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 3 | 9.13 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 4 | 9.40 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 5 | 9.54 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 6 | 11.35 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 7 | 13.98 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 8 | 15.56 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 9 | 15.58 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 10 | 15.59 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 11 | 15.90 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 12 | 15.93 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 13 | 15.98 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 14 | 16.01 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 15 | 16.14 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 16 | 17.05 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 17 | 17.36 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 18 | 17.52 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 19 | 17.53 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 20 | 17.54 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 21 | 17.59 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 22 | 17.62 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 23 | 18.05 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 24 | 18.15 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 25 | 19.29 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 26 | 19.78 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 27 | 20.26 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 28 | 21.81 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 29 | 22.19 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 30 | 22.50 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 31 | 22.68 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 32 | 23.98 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 33 | 24.72 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 34 | 25.43 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 35 | 26.15 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 36 | 26.76 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 37 | 28.70 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 38 | 29.19 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 39 | 29.82 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 40 | 31.12 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 41 | 32.34 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 42 | 33.19 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 43 | 33.82 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 44 | 34.35 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 45 | 34.75 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 46 | 37.11 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 47 | 37.77 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 48 | 38.78 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 49 | 39.95 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 50 | 40.86 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 51 | 41.71 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 52 | 42.24 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 53 | 42.42 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 54 | 42.73 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 55 | 45.12 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 56 | 46.12 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 57 | 47.17 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 58 | 48.45 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 59 | 49.24 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 60 | 49.92 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 61 | 50.23 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 62 | 50.43 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 63 | 50.97 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 64 | 53.38 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 65 | 54.58 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 66 | 55.51 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 67 | 56.59 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 68 | 57.47 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 69 | 57.87 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 70 | 58.28 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 71 | 58.45 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 72 | 58.74 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 73 | 61.90 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 74 | 62.93 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 75 | 64.56 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 76 | 65.34 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 77 | 65.88 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 78 | 66.26 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 79 | 66.45 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 80 | 66.68 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 81 | 67.51 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 82 | 70.14 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 83 | 71.54 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 84 | 72.72 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 85 | 73.62 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 86 | 74.04 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 87 | 74.38 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 88 | 74.49 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 89 | 74.52 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 90 | 75.32 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 91 | 78.27 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 92 | 80.30 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 93 | 81.29 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 94 | 81.76 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 95 | 82.12 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 96 | 82.25 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 97 | 82.50 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 98 | 82.56 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 99 | 82.74 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 100 | 86.09 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 101 | 87.37 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 102 | 88.64 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 103 | 89.58 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 104 | 89.99 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 105 | 90.31 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 106 | 90.46 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 107 | 90.51 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 108 | 91.78 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 109 | 95.32 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 110 | 96.96 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 111 | 97.45 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 112 | 98.02 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 113 | 98.29 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 114 | 98.43 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 115 | 98.50 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 116 | 98.54 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 117 | 98.77 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 118 | 101.62 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 119 | 103.91 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 120 | 105.36 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 121 | 105.76 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 122 | 106.05 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 123 | 106.34 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 124 | 106.54 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 125 | 106.60 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 126 | 106.82 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 127 | 110.54 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 128 | 112.46 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 129 | 113.18 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 130 | 114.01 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 131 | 114.21 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 132 | 114.41 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 133 | 114.52 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 134 | 114.54 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 135 | 114.58 | IDCC-vib-Paper-8kHz-16-nopad.wav |

1. **List of recommended bitrates with wavelet encoding only**

|  |  |  |
| --- | --- | --- |
| Allocated Bits | Bitrate | File |
| 1 | 3.19 | APPL-vib-sparkle-8kHz-16-nopad.wav |
| 2 | 3.52 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 3 | 4.12 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 4 | 4.39 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 5 | 4.52 | APPL-vib-inflate-8kHz-16-nopad.wav |
| 6 | 6.11 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 7 | 8.75 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 8 | 12.51 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 9 | 14.79 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 10 | 14.81 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 11 | 14.82 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 12 | 14.86 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 13 | 14.86 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 14 | 14.86 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 15 | 14.87 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 16 | 15.05 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 17 | 16.30 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 18 | 16.60 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 19 | 16.74 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 20 | 16.76 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 21 | 16.80 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 22 | 16.83 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 23 | 16.84 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 24 | 16.85 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 25 | 17.03 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 26 | 19.59 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 27 | 20.49 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 28 | 21.06 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 29 | 23.96 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 30 | 24.87 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 31 | 25.45 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 32 | 25.49 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 33 | 25.52 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 34 | 25.56 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 35 | 25.59 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 36 | 25.65 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 37 | 25.69 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 38 | 25.72 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 39 | 25.77 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 40 | 25.82 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 41 | 26.02 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 42 | 26.07 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 43 | 26.11 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 44 | 26.16 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 45 | 26.18 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 46 | 26.23 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 47 | 26.22 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 48 | 26.24 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 49 | 26.25 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 50 | 26.27 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 51 | 26.39 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 52 | 26.98 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 53 | 27.06 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 54 | 27.35 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 55 | 27.41 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 56 | 27.45 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 57 | 27.45 | APPL-vib-heartbeats-8kHz-16-nopad.wav |
| 58 | 28.42 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 59 | 29.45 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 60 | 30.35 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 61 | 30.77 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 62 | 31.17 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 63 | 31.41 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 64 | 33.71 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 65 | 35.40 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 66 | 36.69 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 67 | 37.51 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 68 | 38.46 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 69 | 38.89 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 70 | 39.18 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 71 | 39.40 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 72 | 39.73 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 73 | 41.16 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 74 | 43.32 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 75 | 44.73 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 76 | 45.73 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 77 | 46.48 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 78 | 47.17 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 79 | 47.28 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 80 | 47.33 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 81 | 47.51 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 82 | 50.13 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 83 | 51.44 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 84 | 53.20 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 85 | 54.08 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 86 | 54.61 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 87 | 55.05 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 88 | 55.25 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 89 | 55.38 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 90 | 55.43 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 91 | 56.89 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 92 | 59.44 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 93 | 61.42 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 94 | 62.29 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 95 | 62.91 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 96 | 63.20 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 97 | 63.27 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 98 | 63.39 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 99 | 63.42 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 100 | 66.19 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 101 | 68.56 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 102 | 69.95 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 103 | 70.57 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 104 | 70.87 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 105 | 71.09 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 106 | 71.32 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 107 | 71.40 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 108 | 71.55 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 109 | 74.08 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 110 | 76.18 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 111 | 77.74 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 112 | 78.67 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 113 | 79.01 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 114 | 79.19 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 115 | 79.36 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 116 | 79.39 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 117 | 80.08 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 118 | 82.69 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 119 | 84.81 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 120 | 86.11 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 121 | 86.67 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 122 | 87.06 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 123 | 87.30 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 124 | 87.41 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 125 | 87.43 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 126 | 87.92 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 127 | 90.04 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 128 | 93.12 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 129 | 94.50 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 130 | 94.97 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 131 | 95.22 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 132 | 95.35 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 133 | 95.37 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 134 | 95.39 | IDCC-vib-Paper-8kHz-16-nopad.wav |
| 135 | 95.39 | IDCC-vib-Paper-8kHz-16-nopad.wav |

1. **List of recommended bitrates with vectorial encoding only**

|  |  |
| --- | --- |
| Bitrate | File |
| 6.18 | APPL-vib-sparkle-8kHz-16-nopad.wav |

1. **List of HJIF schema constraints**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Structure** | **Property** | **Constraint** | **Clause** | **Constraint#** |
| Experience | Version | Matches XXXX or XXXX-Y | 6.2.1 | 1 |
| timescale | Greater than zero | 6.2.1 | 2 |
| perceptions | Contains at least one item | 6.2.1 | 3 |
| Avatars | id | Greater than zero | 6.2.2 | 4 |
| lod | Greater or equal to zero. | 6.2.2 | 5 |
| type | Constrained value | 6.2.2 | 6 |
| Perception | id | Greater or equal to zero. | 6.2.3 | 7 |
| perception modality | Constrained value | 6.2.3 | 8 |
| priority | Greater or equal to zero. | 6.2.3 | 9 |
| avatar id | Greater or equal to zero. | 6.2.3 | 10 |
| channels | Contains at least one item | 6.2.3 | 11 |
| Sync | timestamp | Greater or equal to zero | 6.2.4 | 12 |
| timescale | Greater than zero | 6.2.4 | 13 |
| Haptic device properties | id | Greater or equal to zero. | 6.2.5 | 14 |
| body part mask | Greater or equal to zero. | 6.2.5 | 15 |
| Lower than 4294967295. | 6.5.2 | 16 |
| maximum frequency | Greater or equal to zero. | 6.2.5 | 17 |
| minimum frequency | Greater or equal to zero. | 6.2.5 | 18 |
| resonance frequency | Greater or equal to zero. | 6.2.5 | 19 |
| maximum amplitude | Greater or equal to zero. | 6.2.5 | 20 |
| impedance | Greater or equal to zero. | 6.2.5 | 21 |
| maximum voltage | Greater or equal to zero. | 6.2.5 | 22 |
| maximum current | Greater or equal to zero. | 6.2.5 | 23 |
| maximum displacement | Greater or equal to zero. | 6.2.5 | 24 |
| weight | Greater or equal to zero. | 6.2.5 | 25 |
| size | Greater or equal to zero. | 6.2.5 | 26 |
| type | Constrained value | 6.2.5 | 27 |
| Haptic channel | id | Greater or equal to zero. | 6.2.6 | 28 |
| priority | Greater or equal to zero. | 6.2.6 | 29 |
| reference device id | Greater or equal to zero. | 6.2.6 | 30 |
| gain | Greater or equal to zero. | 6.2.6 | 31 |
| mixing coefficient | Greater or equal to zero. | 6.2.6 | 32 |
| body part mask | Greater or equal to zero. | 6.2.6 | 33 |
| Lower than 4294967295. | 6.5.2 | 34 |
| body part target | Constrained values | 6.2.6 | 35 |
| frequency sampling | Greater or equal to zero. | 6.2.6 | 36 |
| sample count | Greater or equal to zero. | 6.2.6 | 37 |
| Vector | X | In the range [-127;127] | 6.2.7 | 38 |
| Y | In the range [-127;127] | 6.2.7 | 39 |
| Z | In the range [-127;127] | 6.2.7 | 40 |
| Haptic band | band type | Constrained value | 6.2.8 | 41 |
| priority | Greater or equal to zero. | 6.2.8 | 42 |
| curve type | Constrained value | 6.2.8 | 43 |
| block length | Greater than 16 | 6.2.8 | 44 |
| lower frequency limit | In the range [0;10000] | 6.2.8 | 45 |
| upper frequency limit | In the range [0;10000] | 6.2.8 | 46 |
| Haptic effect | id | Positive or equal to zero | 6.2.9 | 47 |
| effect type | Constrained value | 6.2.9 | 48 |
| position | Greater or equal to zero | 6.2.9 | 49 |
| phase | In the range [0;2pi] | 6.2.9 | 50 |
| base signal | Constrained value | 6.2.9 | 51 |
| Haptic keyframe | amplitude modulation | In the range [-1;1] | 6.2.10 | 52 |
| frequency modulation | In the range [0;10000] | 6.2.10 | 53 |
| relative position | Greater or equal to zero | 6.2.10 | 54 |

1. **List of HJIF semantic checks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Structure** | **Property** | **Constraint** | **Clause** | **Constraint#** |
| Experience | version | The year of the version shall be greater than 2023 | 6.2.1 | 1 |
| The number of the amendement if present shall be greater than 0 | 6.2.1 | 2 |
| profile | Value equals to "Main" or "Simple parametric" |  | 3 |
| level | Value equals to 1 or 2 | Annex D | 4 |
| date | The date format shall follow the ISO 8601 standard | 6.2.1 | 5 |
| timescale | The value of the timescale shall be strictly equal to 1000 for the "Simple Parametric" profile and no greater than 48 000 for the "Main" profile. | Annex D | 6 |
| Avatar | id | Every avatar ID shall be unique. | 6.2.2 | 7 |
| mesh | The URI shall follow the syntax defined in RFC3986. |  | 8 |
| Perception | id | Every perception ID shall be unique. | 6.2.3 | 9 |
| perception modality | Check that the value matches the profile and level | 6.2.3 | 10 |
| avatar id | An avatar with this ID shall exist in the avatar array of the experience or the value shall be equal to 0 | 6.2.3 | 11 |
| semantic scheme | Valid URN | 6.2.3 | 12 |
| channels | The number of channels shall be smaller than the maximum number of channels specified for the profile | Annex D | 12 |
| Reference Device | Id | Every reference device ID shall be unique within a given perception. | 6.2.5 | 13 |
| maximum frequency | The maximum frequency should be greater than the minimum frequency | 6.2.5 | 14 |
| resonance frequency | The resonance frequency should be greater than the minimum frequency and smaller than the maximum frequency | 6.2.5 | 15 |
| Channel | id | Every Channel ID shall be unique within a given perception. | 6.2.6 | 16 |
| reference device id | A reference device with this ID shall exist in the reference device array of the perception or the value shall be equal to 0 | 6.2.6 | 17 |
| actuator resolution | Values greater or equal to zero. | 6.2.6 | 18 |
| actuator target | The value shall be within the actuator resolution range | 6.2.6 | 19 |
| bands | The number of bands shall be smaller than the maximum number of bands specified for the profile | Annex D | 20 |
| direction | If non-zero, the vector shall be a unit vector. |  | 21 |
| Band | band type | The band type for the "Simple Parametric" profile shall be limited to Transient, Curve or Vectorial. | 6.2.8 | 22 |
| block length | When converted to samples, the vaule shall be greater or equal to 16 and shall be a power of 2. | 6.2.8 | 23 |
| upper frequency limit | The upper frequency limit should be greater than the lower frequency limit | 6.2.8 | 24 |
| Effect | Id | Effects from the library shall have an ID and this ID shall be unique within a given perception. | 6.2.9 | 25 |
| effect type | For the "Simple Parametric" profile composite effect shall not supported. | Annex D | 26 |
| Semantic | The semantic keywords shall be defined in the semantic scheme of the perception | 6.2.9 | 27 |
| keyframes | This property shall not exist when band\_type=“WaveletWave”. | 6.2.9 | 28 |

1. **List of HMPG constraints**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **MIHS Unit** | **MIHS Packet** | **Structure** | **Property** | **Constraint** |
| \* | - | mpegiHapticUnit | MIHSUnitType | An MIHS unit may have one of the following types: Initialization, Temporal, Spatial, Silent |
| \* | - | mpegiHapticUnit | MIHSUnitSync | Table 30 lists the possible values for MIHSUnitSync |
| \* | \* | mpegiHapticPacket | MIHSPacketType | An MIHS packet shall have one of the following types: Timing, MetadataExperience, MetadataPerception, MetdataChannel, MetadataBand, Data, EffectLibrary, CRC16 or CRC32, GlobalCRC16 or GlobalCRC32 |
| \* | CRC16, GlobalCRC16 | readCRC | CRC16Value | The algorithm to compute CRC value is given subclause 7.3.8 |
| \* | CRC32, GlobalCRC32 | readCRC | CRC32Value | The algorithm to compute CRC value is given subclause 7.3.8 |
| \* |  |  | MIHSUnit | MIHS Unit header and packets |
| \* |  |  | MIHSUnit | Decoders shall skip units with an unknown MIHSUnitType |
| Initialization | - | mpegiHapticUnit | MIHSUnitType | The first MIHS unit in a haptic stream shall be an initialization unit |
| Initialization | - | mpegiHapticUnit | MIHSUnitDuration | The duration of an initialization unit duration shall be zero |
| Initialization | - | mpegiHapticUnit | MIHSUnitSync | An initialization unit is a sync unit |
| Initialization | Timing | mpegiHapticPacket | MIHSPacketType | An initialization unit shall contain one timing MIHS packet |
| Initialization | MetadataExperience | mpegiHapticPacket | MIHSPacketType | A haptic experience metadata MIHS packet may be sent at regular intervals in an initialization MIHS unit |
| Initialization | MetadataExperience | readMetadataExperience | version | List of chars in the following format: XXXX or XXXX-Y |
| Initialization | MetadataExperience | readMetadataExperience | profile | Profile definition in Annex D |
| Initialization | MetadataExperience | readMetadataExperience | level | Level definition in Annex D |
| Initialization | MetadataExperience | readMetadataExperience | date | The date format shall follow the ISO 8601 standard |
| Initialization | MetadataExperience | readAvatar | id | Positive non-zero |
| Initialization | MetadataExperience | readAvatar | id | Unique among avatars |
| Initialization | MetadataExperience | readAvatar | avatarType | The possible values for avatarType are listed in Table 37 |
| Initialization | MetadataExperience | readAvatar | meshLength | Only present if avatarType is custom |
| Initialization | MetadataExperience | readAvatar | mesh | URI |
| Initialization | MetadataPerception | mpegiHapticPacket | MIHSPacketType | Haptic perception metadata MIHS packets may be sent at regular intervals in an initialization MIHS unit |
| Initialization | MetadataPerception | readMetadataPerception | id | Unique among perceptions |
| Initialization | MetadataPerception | readMetadataPerception | perceptionModality | Table 39 lists the possible values for perceptionModality |
| Initialization | MetadataPerception | readMetadataPerception | avatarId | Zero if no avatar assigned or positive non-zero if avatar assigned |
| Initialization | MetadataPerception | readMetadataPerception | avatarId | Unique ID of the associated avatar body model defined in subclause 7.2.7 |
| Initialization | MetadataPerception | readMetadataPerception | schemeURN | URN |
| Initialization | MetadataPerception | readReferenceDevice | id | Positive not equal to 255 (8-bit unsigned version of -1) |
| Initialization | MetadataPerception | readReferenceDevice | id | Unique among reference devices in a perception |
| Initialization | MetadataPerception | readReferenceDevice | type | Table 41 lists the possible values for type |
| Initialization | MetadataChannel | mpegiHapticPacket | MIHSPacketType | Haptic channel metadata MIHS packets may be sent at regular intervals in an initialization MIHS unit |
| Initialization | MetadataChannel | readMetadataChannel | id | Unique among channels in a perception |
| Initialization | MetadataChannel | readMetadataChannel | perceptionId | ID of the perception to which the channel is attached |
| Initialization | MetadataChannel | readMetadataChannel | deviceId | -1 (unsigned 8-bit 255) if no reference device assigned or positive if reference device assigned |
| Initialization | MetadataChannel | readMetadataChannel | deviceId | ID of the associated device |
| Initialization | MetadataChannel | readMetadataChannel | trackResolution | Positive in each of X, Y, Z |
| Initialization | MetadataChannel | readMetadataChannel | bodyPartTarget | Per Table 9 |
| Initialization | MetadataChannel | readMetadataChannel | actuatorTarget | Within trackResolution permitted values |
| Initialization | MetadataChannel | readMetadataChannel | direction | Unit vector |
| Initialization | MetadataBand | mpegiHapticPacket | MIHSPacketType | Haptic band metadata MIHS packets may be sent at regular intervals in an initialization MIHS unit |
| Initialization | MetadataBand | readMetadataBand | id | Unique among bands in a channel |
| Initialization | MetadataBand | readMetadataBand | perceptionId | ID of the perception to which the band belongs |
| Initialization | MetadataBand | readMetadataBand | channelId | ID of the channel to which the band belongs |
| Initialization | MetadataBand | readMetadataBand | bandType | Table 44 lists the possible values for bandTtype |
| Initialization | MetadataBand | readMetadataBand | curveType | Table 45 lists the possible values for curveType |
| Initialization | MetadataLibraryEffects | mpegiHapticPacket | MIHSPacketType | A haptic effect library MIHS packet may be sent at regular intervals in an initialization MIHS unit |
| Initialization | MetadataLibraryEffects | readLibrary | perceptionId | ID of the perception to which the library is attached |
| Initialization | MetadataLibraryEffects | readLibraryEffect | id | Unique in the effect library |
| Initialization | MetadataLibraryEffects | readLibraryEffect | effectType | Table 49 lists the possible values for effectType |
| Initialization | MetadataLibraryEffects | readLibraryEffect | semanticKeywords | As defined in subclause 5.8 |
| Initialization | MetadataLibraryEffects | readLibraryEffect | baseSignal | Table 48 lists the possible values for baseSignal |
| Initialization | MetadataLibraryEffects | readLibraryEffect | compositeEffectCount | Non-zero only if effectType is Composite |
| Initialization | CRC16, GlobalCRC16, CRC32, GlobalCRC32 | mpegiHapticPacket | MIHSPacketType | An initialization unit is a sync unit and shall have the following constraints: Zero or more packets of the following types: PACTYPE\_CRC16, ACTYPE\_CRC32, PACTYPE\_GlobalCRC16, PACTYPE\_GlobalCRC32 |
| Initialization | Data | mpegiHapticPacket | MIHSPacketType | An initialization unit shall have the following constraints: No MIHS packet of the following types: PACTYPE\_DATA |
| Temporal | - | mpegiHapticUnit | - | A temporal unit shall contain one or more MIHS packets |
| Temporal | - | mpegiHapticUnit | MIHSUnitDuration | The duration of a temporal unit shall be a positive number |
| Temporal | Data | mpegiHapticPacket | MIHSPacketType | Temporal units shall have the following additional constraint: Only data for the following perception modalities: Pressure, Acceleration, Velocity, Position, Temperature, Vibrotactile, Water, Wind, Force, Other |
| Temporal, Spatial | Data | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: One or more packets of the following types: PACTYPE\_DATA |
| Temporal, Spatial | Data | readData | perceptionId | ID of the perception associated with the packet |
| Temporal, Spatial | Data | readData | channelId | ID of the channel associated with the packet |
| Temporal, Spatial | Data | readData | bandId | ID of the band associated with the packet |
| Temporal, Spatial | Data | readEffect | id | If effectType is Reference, ID of the effect in the effect library |
| Temporal, Spatial | Data | readEffect | effectType | Table 52 lists the possible values for effectType. |
| Temporal, Spatial | Data | readEffect | semanticKeywords | The bits code of the default semantic keyword scheme is given in Table 53 |
| Temporal, Spatial | CRC16, GlobalCRC16, CRC32, GlobalCRC32 | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: Zero or more packets of the following types: PACTYPE\_CRC16, ACTYPE\_CRC32, PACTYPE\_GlobalCRC16, PACTYPE\_GlobalCRC32 |
| Temporal, Spatial | Timing | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: No packets of following type: PACTYPE\_TIMING |
| Temporal, Spatial | MetadataExperience | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: No packets of following type: PACTYPE\_METADATAEXPERIENCE |
| Temporal, Spatial | MetadataPerception | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: No packets of following type: PACTYPE\_METADATAPERCEPTION |
| Temporal, Spatial | MetadataChannel | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: No packets of following type: PACTYPE\_METADATACHANNEL |
| Temporal, Spatial | MetadataBand | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: No packets of following type: PACTYPE\_METADATABAND |
| Temporal, Spatial | MetadataLibraryEffects | mpegiHapticPacket | MIHSPacketType | Temporal and spatial units shall have the following constraints: No packets of following type: PACTYPE\_METADATALIBRARYEFFECTS |
| Temporal | Data | readEffect | effectPosition | Shall be smaller than the value of MIHSUnitDuration of the mpegiHapticUnit() that contains this effect |
| Temporal | Data | readEffect | effectPosition | If negative, the MIHSUnitSync and the mpegiHapticPacket() packetDependency values shall be set to 1 |
| Temporal | Data | readEffectBasis | baseSignal | The possible values for baseSignal are listed in Table 55 |
| Temporal | Data | readWaveletEffect | id | If effectType is Reference, ID of the effect in the effect library |
| Temporal | Data | readWaveletEffect | effectType | Table 52 lists the possible values for effectType. |
| Temporal | Data | readWaveletEffect | semanticKeywords | Semantic keyword as defined in subclause 5.8 |
| Spatial | - | mpegiHapticUnit | - | A spatial unit shall contain one or more MIHS packets |
| Spatial | - | mpegiHapticUnit | MIHSUnitDuration | The duration of a spatial unit shall be zero |
| Spatial | Data | mpegiHapticPacket | MIHSPacketType | Spatial units shall have the following additional constraint: Only data for the following perception modalities: Vibrotactile texture, Stiffness, Friction |
| Spatial | - | mpegiHapticUnit | MIHSUnitSync | [A spatial unit] is a sync unit by definition. |
| Silent | - | mpegiHapticUnit | MIHSUnitDuration | The duration of a silent unit shall be a positive number |
| Silent | \* | - | - | A silent unit shall not include any MIHS packets |
| Timing | Timing | readMetadataTiming | timestamp | The value can not be smaller than previous values, i.e. ascending (Do we need to add this to the spec?) |

1. **List of HJIF constraints to ensure compatibility with HMPG  
   (Informative)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Structure** | **Property** | **Required** | **HMPG compatibility constraints** | **Clause** |
| Experience | description | Yes | The size of the string should be lower or equal to 255 characters. | 6.2.1 |
| timescale | No | The value should be lower or equal to 4294967295. | 6.2.1 |
| avatars | Yes | The array should contain at most 255 elements | 6.2.2 |
| perceptions | Yes | The array should contain at most 255 elements | 6.2.2 |
| Avatars | id | Yes | The value should be lower or equal to 255. | 6.2.2 |
| mesh | No | The size of the string should be lower or equal to 255 characters. | 6.2.2 |
| Perception | id | Yes | The value should be lower or equal to 255. | 6.2.3 |
| description | Yes | The size of the string should be lower or equal to 255 characters. | 6.2.3 |
| avatar id | Yes | The value should be lower or equal to 255. | 6.2.3 |
| effect library | Yes | The array should contain at most 65635 elements | 6.2.3 |
| semantic scheme | No | The size of the string should be lower or equal to 255 characters. | 6.2.3 |
| reference devices | No | The array should contain at most 255 elements | 6.2.3 |
| channels | Yes | The array should contain at most 255 elements | 6.2.3 |
| unit exponent | No | The value should be in the range [-127,127] | 6.2.3 |
| perception unit exponent | No | The value should be in the range [-127,127] | 6.2.3 |
| Sync | timestamp | Yes | The value should be lower or equal to 4294967295. | 6.2.4 |
| timescale | No | The value should be lower or equal to 4294967295. | 6.2.4 |
| Haptic device properties | id | Yes | The value should be lower or equal to 255. | 6.2.5 |
| name | Yes | The size of the string should be lower or equal to 255 characters. | 6.2.5 |
| body part mask | No | The value should be lower or equal to 4294967295. | 6.2.5 |
| maximum frequency | No | The value should be lower or equal to 10000. | 6.2.5 |
| minimum frequency | No | The value should be lower or equal to 10000. | 6.2.5 |
| resonance frequency | No | The value should be lower or equal to 10000. | 6.2.5 |
| maximum amplitude | No | The value should be lower or equal to 10000. | 6.2.5 |
| impedance | No | The value should be lower or equal to 10000. | 6.2.5 |
| maximum voltage | No | The value should be lower or equal to 10000. | 6.2.5 |
| maximum current | No | The value should be lower or equal to 10000. | 6.2.5 |
| maximum displacement | No | The value should be lower or equal to 10000. |  |
| weight | No | The value should be lower or equal to 10000. | 6.2.5 |
| size | No | The value should be lower or equal to 10000. | 6.2.5 |
| custom | No | The value should be in the range [-10000,10000] | 6.2.5 |
| Haptic channel | id | Yes | The value should be lower or equal to 65535. | 6.2.6 |
| description | Yes | The size of the string should be lower or equal to 255 characters. | 6.2.6 |
| reference device id | No | The value should be lower or equal to 255. | 6.2.6 |
| gain | Yes | The value should be in the range [-10000,10000] | 6.2.6 |
| mixing weight | Yes | The value should be lower or equal to 10000. | 6.2.6 |
| body part mask | No | The value should be lower or equal to 4294967295. | 6.2.6 |
| frequency sampling | No | The value should be lower or equal to 4294967295. | 6.2.6 |
| sample count | No | The value should be lower or equal to 4294967295. | 6.2.6 |
| vertices | No | The array should contain at most 65635 elements. | 6.2.6 |
| bands | Yes | The array should contain at most 65635 elements. | Annex D |
| Haptic band | effects | Yes | The array should contain at most 65635 elements. | 6.2.8 |
| Haptic effect | Id | No | The value should be lower or equal to 65535. | 6.2.9 |
| Position | Yes | The value should be in the range [-16777215,16777215] | 6.2.9 |
| composition | No | The array should contain at most 65635 elements | 6.2.9 |
| Keyframes | No | The array should contain at most 65635 elements | 6.2.9 |
| Haptic keyframe | amplitude modulation | No |  | 6.2.10 |
| frequency modulation | No |  | 6.2.10 |
| relative position | No | The value should be lower or equal to 65535. | 6.2.10 |

1. **List of input reference files  
   (Informative)**

|  |  |  |
| --- | --- | --- |
| **Test set** | **Type** | **OHM File** |
| Test1\_1 | AHAP | APPL-vib-boing-nopad.ahap |
| Test1\_1 | IVS | IMMR-vib-DoubleTick.ivs |
| Test1\_1 | IVS | IMMR-vib-Explosion1.ivs |
| Test1\_1 | IVS | IMMR-vib-FastPulse1.ivs |
| Test1\_1 | IVS | IMMR-vib-Fill1.ivs |
| Test1\_1 | IVS | IMMR-vib-Grain1.ivs |
| Test1\_1 | IVS | IMMR-vib-Sweep1.ivs |
| Test1\_1 | IVS | IMMR-vib-Tick1.ivs |
| Training1\_1 | IVS | IMMR-vib-Explosion3.ivs |
| Training1\_1 | IVS | IMMR-vib-FastPulse2.ivs |
| Training1\_1 | IVS | IMMR-vib-FastPulse3.ivs |
| Training1\_1 | IVS | IMMR-vib-Fill2.ivs |
| Training1\_1 | IVS | IMMR-vib-Grain2.ivs |
| Training1\_1 | IVS | IMMR-vib-RepeatTicks.ivs |
| Training1\_1 | IVS | IMMR-vib-Sweep2.ivs |
| Training1\_1 | IVS | IMMR-vib-Tick2.ivs |
| Evaluation1\_1 | IVS | ERM\_010\_Bounce100.ivs |
| Evaluation1\_1 | IVS | ERM\_074\_Explosion1.ivs |
| Evaluation1\_1 | IVS | LRA\_014\_DoubleSharpClick66.ivs |
| Evaluation1\_1 | IVS | LRA\_079\_Explosion6.ivs |
| Evaluation1\_1 | IVS | Piezo\_010\_Bounce100.ivs |
| Test1\_2 | WAV | ACTK-vib-pantheongrandstarfall-8kHz-16-nopad.wav |
| Test1\_2 | AHAP | APPL-vib-heartbeats-nopad.ahap |
| Test1\_2 | AHAP | APPL-vib-inflate-nopad.ahap |
| Test1\_2 | AHAP | APPL-vib-oscillate-nopad.ahap |
| Test1\_2 | AHAP | APPL-vib-rumble-nopad.ahap |
| Test1\_2 | WAV | IDCC-vib-Rain-8kHz-16-nopad.wav |
| Test1\_2 | WAV | IDCC-vib-Rain\_chan2-8kHz-16-nopad.wav |
| Test1\_2 | WAV | IDCC-vib-Towel-8kHz-16-nopad.wav |
| Test1\_2 | IVS | IMMR-vib-Content1.ivs |
| Test1\_2 | IVS | IMMR-vib-PersTexture1.ivs |
| Test1\_2 | IVS | IMMR-vib-Ringtone1.ivs |
| Test1\_2 | IVS | IMMR-vib-Weapon1.ivs |
| Training1\_2 | AHAP | APPL-vib-drums-nopad.ahap |
| Training1\_2 | AHAP | APPL-vib-gravel-nopad.ahap |
| Training1\_2 | AHAP | APPL-vib-sparkle-nopad.ahap |
| Training1\_2 | WAV | IDCC-vib-Carpet-8kHz-16-nopad.wav |
| Training1\_2 | WAV | IDCC-vib-HeartBeat-8kHz-16-nopad.wav |
| Training1\_2 | WAV | IDCC-vib-Paper-8kHz-16-nopad.wav |
| Training1\_2 | IVS | IMMR-vib-Content2.ivs |
| Training1\_2 | IVS | IMMR-vib-RandTexture1.ivs |
| Training1\_2 | IVS | IMMR-vib-Ringtone2.ivs |
| Training1\_2 | IVS | IMMR-vib-Weapon2.ivs |
| Evaluation1\_2 | IVS | a1.ivs |
| Evaluation1\_2 | IVS | a2.ivs |
| Evaluation1\_2 | IVS | a3.ivs |
| Evaluation1\_2 | IVS | ERM\_068\_Alert5.ivs |
| Evaluation1\_2 | IVS | LRA\_066\_Alert3.ivs |
| Evaluation1\_2 | IVS | Piezo\_073\_Alert10.ivs |
| Evaluation1\_2 | IVS | Piezo\_091\_Weapon8.ivs |
| Test1\_3 | WAV | IDCC-kin-BigBuckBunny-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-BikeRiding-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-ForceXFast-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-ForceXSlow-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-ForceYFast-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-ForceYSlow-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-ForceZFast-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-ForceZSlow-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-HorseRiding-8kHz-16-nopad.wav |
| Test1\_3 | WAV | IDCC-kin-Rollercoaster-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-BigBuckBunny-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-BikeRiding2-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-BikeRiding-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-ForceXY-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-ForceXYZ-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-ForceXZ-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-ForceYZ-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-HorseRiding2-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-HorseRiding-training-8kHz-16-nopad.wav |
| Training1\_3 | WAV | IDCC-kin-Rollercoaster-training-8kHz-16-nopad.wav |
| Evaluation1\_3 | WAV | rollercoaster.wav |

1. **List of Schema Conformance testing files  
   (Informative)**

|  |  |  |
| --- | --- | --- |
| Object | Test | File |
| Haptic | version year as number | haptic-version-year\_as\_number.hjif |
| Haptic | version invalid | haptic-version-invalid\_version.hjif |
| Haptic | version invalid amendment | haptic-version-invalid\_amendment.hjif |
| Haptic | version invalid year | haptic-version-invalid\_year.hjif |
| Haptic | timescale negative | haptic-timescale-negative.hjif |
| Haptic | timescale zero | haptic-timescale-zero.hjif |
| Haptic | no perceptions | haptic-perceptions-no\_perception.hjif |
| Avatar | id negative | avatar-id-negative.hjif |
| Avatar | id equals zero | avatar-id-zero.hjif |
| Avatar | lod negative | avatar-lod-negative.hjif |
| Avatar | type invalid | avatar-type-invalid.hjif |
| Perception | id negative | perception-id-negative.hjif |
| Perception | invalid perception modality | perception-perception\_modality-invalid\_perception\_modality.hjif |
| Perception | priority negative | perception-priority-negative.hjif |
| Perception | avatar id negative | perception-avatar-id-negative.hjif |
| Perception | no channel | perception-channels-no\_channels.hjif |
| Sync | timestamp negative | sync-timestamp-negative.hjif |
| Sync | timescale negative | sync-timescale-negative.hjif |
| Sync | timescale zero | sync-timescale-zero.hjif |
| Reference Device | id negative | refDevice-id-negative.hjif |
| Reference Device | id equals zero | refDevice-id-zero.hjif |
| Reference Device | body\_part\_mask negative | refDevice-body\_part\_mask-negative.hjif |
| Reference Device | body\_part\_mask too large | refDevice-body\_part\_mask-too\_large.hjif |
| Reference Device | minimum\_frequency negative | refDevice-minimum\_frequency-negative.hjif |
| Reference Device | maximum\_frequency negative | refDevice-maximum\_frequency-negative.hjif |
| Reference Device | resonance\_frequency negative | refDevice-resonance\_frequency-negative.hjif |
| Reference Device | maximum\_amplitude negative | refDevice-maximum\_amplitude-negative.hjif |
| Reference Device | impedance negative | refDevice-impedance-negative.hjif |
| Reference Device | maximum\_voltage negative | refDevice-maximum\_voltage-negative.hjif |
| Reference Device | maximum\_current negative | refDevice-maximum\_current-negative.hjif |
| Reference Device | maximum\_displacement negative | refDevice-maximum\_displacement-negative.hjif |
| Reference Device | weight negative | refDevice-weight-negative.hjif |
| Reference Device | size negative | refDevice-size-negative.hjif |
| Reference Device | invalid type | refDevice-type-invalid.hjif |
| Channel | id negative | channel-id-negative.hjif |
| Channel | priority negative | channel-priority-negative.hjif |
| Channel | reference\_device\_id negative | channel-reference\_device\_id-negative.hjif |
| Channel | gain too\_small | channel-gain-too\_small.hjif |
| Channel | mixing\_weight negative | channel-mixing\_weight-negative.hjif |
| Channel | body\_part\_mask negative | channel-body\_part\_mask-negative.hjif |
| Channel | body\_part\_mask too large | channel-body\_part\_mask-too\_large.hjif |
| Channel | invalid body\_part\_target | channel-body\_part\_target-invalid\_body\_part\_target.hjif |
| Channel | frequency\_sampling negative | channel-frequency\_sampling-negative.hjif |
| Channel | sample\_count negative | channel-sample\_count-negative.hjif |
| Vector | X value out of range | vector-X-out\_of\_range.hjif |
| Vector | Y value out of range | vector-Y-out\_of\_range.hjif |
| Vector | Z value out of range | vector-Z-out\_of\_range.hjif |
| Band | invalid band\_type | band-band\_type-invalid\_band\_type.hjif |
| Band | priority negative | band-priority-negative.hjif |
| Band | invalid curve\_type | band-curve\_type-invalid\_curve\_type.hjif |
| Band | block\_length too small |  |
| Band | lower\_frequency\_limit negative | band-lower\_frequency\_limit-negative.hjif |
| Band | lower\_frequency\_limit too large | band-lower\_frequency\_limit-too\_large.hjif |
| Band | upper\_frequency\_limit negative | band-upper\_frequency\_limit-negative.hjif |
| Band | upper\_frequency\_limit too large | band-upper\_frequency\_limit-too\_large.hjif |
| Effect | id negative | effect-id-negative.hjif |
| Effect | invalid effect\_type | effect-effect\_type-invalid\_effect\_type.hjif |
| Effect | position negative | effect-position-negative.hjif |
| Effect | phase too\_small | effect-phase-too\_small.hjif |
| Effect | phase too large | effect-phase-too\_large.hjif |
| Effect | invalid base\_signal | effect-base\_signal-invalid\_base\_signal |
| Keyframe | amplitude\_modulation too\_small | keyframe-amplitude\_modulation-too\_small.hjif |
| Keyframe | amplitude\_modulation too large | keyframe-amplitude\_modulation-too\_large.hjif |
| Keyframe | frequency\_modulation negative | keyframe-frequency\_modulation-negative.hjif |
| Keyframe | frequency\_modulation too large | keyframe-frequency\_modulation-too\_large.hjif |
| Keyframe | relative\_position negative | keyframe-relative\_position-negative.hjif |

1. **List of Semantic Conformance testing files  
   (Informative)**

|  |  |  |
| --- | --- | --- |
| **Object** | **Test** | **File** |
| Haptic | version year too small | haptic-version-year\_too\_small.hjif |
| Haptic | version amendement equals zero | haptic-version-amendement\_equals\_zero.hjif |
| Haptic | invalid profile | haptic-profile-invalid\_profile.hjif |
| Haptic | invalid level | haptic-level-invalid\_level.hjif |
| Haptic | invalid date | haptic-date-invalid\_date.hjif |
| Haptic | invalid timescale | haptic-timescale-invalid\_timescale.hjif |
| Avatar | duplicate id | avatar-id-duplicate\_id.hjif |
| Avatar | invalid uri | avatar-mesh-invalid\_uri.hjif |
| Perception | id duplicate | perception-id-duplicate\_id.hjif |
| Perception | non supported perception\_modality | perception-modality-non\_supported\_perception\_modality.hjif |
| Perception | avatar id non existant | perception-avatar\_id-non\_existant\_id.hjif |
| Perception | too many channels | perception-channels-too\_many\_channels.hjif |
| Reference Device | id duplicate | refDevice-id-duplicate.hjif |
| Reference Device | maximum\_frequency less than minimum\_frequency | refDevice-maximum\_frequency-maxi\_freq\_smaller\_than\_min\_freq,hjif |
| Reference Device | resonance\_frequency less than minimum\_frequency | refDevice-resonance\_frequency-res\_freq\_smaller\_than\_min\_freq.hjif |
| Reference Device | resonance\_frequency greater\_than\_maximum\_frequency | refDevice-resonance\_frequency-res\_freq\_greater\_than\_max\_freq.hjif |
| Channel | id duplicate | channel-channel\_id-duplicate.hjif |
| Channel | reference\_device\_id non\_existent | channel-reference\_device-non\_existent.hjif |
| Channel | actuator\_resolution negative | channel-actuator\_resolution-contains\_negative\_value.hjif |
| Channel | actuator\_target out of resolution range | channel-actuator\_target-out\_of\_resolution\_range.hjif |
| Channel | too many bands | channel-bands-too\_many\_bands.hjif |
| Channel | direction non unit\_vector | channel-direction-non\_unit\_vector.hjif |
| Band | band\_type not supported |  |
| Band | block\_length not power of 2 | band-block\_length-not\_power\_of\_2.hjif |
| Band | upper\_frequency\_limit less than lower\_frequency\_limit | band-upper\_frequency\_limit-less\_than\_lower\_frequency\_limit.hjif |
| Effect | id duplicate | effect-id-duplicate.hjif |
| Effect | id non existent | effect-id-non\_existent.hjif |
| Effet | effect\_type not supported | effect-effect\_type-effect\_type\_not\_supported.hjif |
| Effect | invalid sematic\_keywords | effect-semantic-invalid\_semantic\_keyword.hjif |
| Effect | Keyframes defined in wavelet bands |  |