Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A Manual

Upon publication of "Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A"

The Institute of Image Information and Television Engineers (ITE) conducts its activities with the goal of advancing image information media in Japan, to advance science and technology related to image information media. As part of this, it publishes various standard test video materials, standard digital images, and high-definition and 3D standard images that have played a major role in R&D on video systems, new services, and in maintaining quality.

Recently, R&D on 4K and 8K broadcasting with high-definition video and 3D sound has advanced, as a medium that can realize a highly realistic sense of presence. Trial broadcasts began in August 2016 and regular broadcasts are scheduled to start in 2018. Work toward practical implementation is advancing rapidly, to expand to a full service in time for the opening of the Tokyo Olympics in 2020. As part of this, ITE and the Association of Radio Industries and Businesses (ARIB) have collaborated to create and publish ultra-high definition, wide-color-gamut standard test images and standard test videos conforming to the Rec. ITU-R BT.2020 video format, which is an international standard for 4K and 8K video. These standard test images and videos have been well received and used in the development and evaluation of various devices.

On the other hand, there have been no standard test materials for 3D sound conforming to Rec. ITU-R BS.2051 and ARIB STD-B59, and there has been strong demand from broadcasters and broadcasting equipment vendors within and outside of Japan, for standard test materials for sound, to go with the standard video test materials.

As such, our institute has collaborated with ARIB to create standard test materials for three-dimensional multichannel sound. At this time, we are publishing the results of this effort: the "Standard test materials for three-dimensional multichannel sound – Series A," which are standard test materials for 22.2 multichannel sound. We would like to express our deep gratitude to all those involved for their extraordinary efforts. We strongly hope that this will facilitate still more active R&D on next generation image information media, and the expansion of stable broadcasting services brimming with realism and vibrancy. We will continue our efforts to create standard test materials, and to produce the "Standard test materials for three-dimensional multichannel sound, Series B."

July 2017

Yasuto Hamada, President

The Institute of Image Information and Television Engineers

Regarding selection and production of "Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A"

The Association of Radio Industries and Businesses (ARIB), R&D Group on Program Production Systems conducts R&D related to program production, editing and transmission systems used by broadcasters and on methods for evaluating the quality of video and sound in program content production, transmission and reception. In the past, the Institute of Image Information and Television Engineers has selected, created and distributed video test materials required for evaluating image quality and performance of devices, including standard images and video test materials, and ultra-high-definition wide color gamut images and video test materials used for evaluating Hi-Vision systems. This standard video data is included in the Report ITU-R BT.2245 titled "HDTV and UHDTV test materials for assessment of picture quality," and is used widely within and outside of Japan.

In addition to conventional stereo and 5.1 surround sound, 4K and 8K broadcasts are able to use 7.1 multichannel sound and 22.2 multichannel sound conforming to the ARIB STD-B59 "three-dimensional multichannel stereophonic sound system for programme production", so there is increasing demand for sound test materials to evaluate these sound devices and systems. Preparation continues for full 4K and 8K broadcast services. We are anticipating that broadcast services will use sound operations such as processing monaural sound sources with a 22.2 multichannel sound mixing table, and recording new resources using a 22.2 multichannel sound one-point microphone. As such, we have selected and created standard test materials suitable for evaluating functions such as positioning sound sources, audio encoding, and conversion among numbers of channels. These standard test materials were recently published under supervision from the Institute of Image Information and Television Engineers as "Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A." We would like to offer our sincere thanks to all involved in this work.

We hope that these standard test materials will be used widely, together with ultra-high definition, wide-color-gamut test images and video, for the development and deployment of 4K and 8K broadcasting.

July 2017

Tsutomu Shimizu, Chairman

R&D Group on Program Production Systems

Association of Radio Industries and Businesses

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- Unauthorized copying of these standard test materials, this manual and appendices is a violation of copyright and is strictly prohibited. However, appearance in academic publications and scientific journals will not be contested.

- Use of these standard test materials is limited to the following purposes.
  (1)　Technical evaluation
  　　・Device and system R&D
  　　・Testing and inspection in device manufacturing processes
  　　・Transmission path evaluation for broadcasting and telecommunications
  　　・Equipment maintenance
  (2)　Exhibition use
  　　・Presentation/Exhibition at Academic/Research conferences
  　　・Exhibition of equipment performance and functionality at trade shows[1]
  　　　(Use in promotion of sales is excluded)

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[1] Please contact the Institute of Image Information and Television Engineers before using these materials for this purpose (Exhibiting equipment at a trade show)

The following people and organizations were involved in production of these standard test materials.

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Manual of
"Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A"
Contents

1. Overview of "Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A"

In the past, the Institute of Image Information and Television Engineers has published various standard test materials to facilitate accurate evaluation of performance and image quality in video equipment, systems and methods. For the new 4K and 8K television broadcasting formats which began trial broadcasts in August 2016, the "Ultra-high definition/wide-color-gamut standard test sequences – Series A"[1] was also published in December 2015 to facilitate R&D and deployment.

However, there have been no standard test materials for the 3D multichannel sound formats being used with 4K and 8K broadcasts. These are attracting much attention, and we have received many requests for sound test materials corresponding to the available test images, from research facilities, broadcasters, and manufacturers within and outside Japan. To meet this demand and promote R&D and deployment of 22.2 multichannel sound, we have published, "Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A."

The 22.2 multichannel sound used with 8K broadcasts is a 3D multichannel sound format that conforms to recommendation ITU-R BS.2051[2], from the International Telecommunication Union - Radiocommunication Sector (ITU-R), and the ARIB STD-B59[3] standard, from the Association of Radio Industries and Businesses (ARIB). Channel allocations for 22.2 multichannel sound are shown in Table 1-1. To quickly provide 22.2 multichannel sound data suitable mainly for listening tests and system evaluation, test materials recorded at this time were compiled from samples created by the Sound Quality Evaluation WG of the ARIB R&D Group on Program Production Systems. "Series A" was added to the name because it is our intention to create further series in the future, with a wide range of test materials, according to requests from users.

These test materials include noise and other mono sound signals processed using a 22.2 multichannel sound mixing board as well as 22.2 multichannel sound materials recorded and produced using microphones. Most of the processed mono sound test materials are mono sound signals with directional information applied, such as assigning the signal to a specific channel or panning it between multiple channels. They are suitable for testing channel identification or motion in a system.

On the other hand, the microphone-recorded test materials include sounds recorded using a one-point microphone, which is composed of 22 directional microphones at one location and oriented in the 22 principle directions of 22.2 multichannel sound, and those recorded by placing omni-directional microphones at each of the locations of the 22 loudspeakers used in 22.2 multichannel sound systems. These latter are suitable for evaluating spatial impressions given by the reproduced sound. Some of the test materials recorded using microphones include materials recorded using both methods simultaneously, so that the two kinds of spatial impression can be evaluated.

The test materials are provided in two file formats, a multi-mono format with signals for the 24

channels in 24 individual files, and an interleaved format with the signals for all 24 channels stored in a single file. This was done to support a wide range of playback equipment and software that users may have. In addition to these two audio formats, distribution in the BW64[5] 64-bit broadcasting file format has also been provided, with additional metadata such as playback position, channel check and other audio definition model (ADM)[4] data.

Table 1-1 Sound channel allocations for 22.2 multichannel sound[2]

Channel No.	Channel label	Channel names	Loudspeaker label	Range of Loudspeaker position			
				Azimuth		Elevation	
1	FL	Front Left	M+060	+45°	+60°	0°	+5°
2	FR	Front Right	M-060	-45°	-60°	0°	+5°
3	FC	Front Center	M+000	0°		0°	+5°
4	LFE1	Low Frequency Effects -1	LFE1	+30°	+90°	-15°	-30°
5	BL	Back Left	M+135	+110°	+135°	0°	+15°
6	BR	Back Right	M-135	-110°	-135°	0°	+15°
7	FLc	Front Left Center	M+030	+22.5°	+30°	0°	+5°
8	FRc	Front Right Center	M-030	-22.5°	-30°	0°	+5°
9	BC	Back Center	M+180	+180°		0°	+15°
10	LFE2	Low Frequency Effects -2	LFE2	-30°	-90°	-15°	-30°
11	SiL	Side Left	M+090	+90°		0°	+15°
12	SiR	Side Right	M-090	-90°		0°	+15°
13	TpFL	Top Front Left	U+045	+45°	+60°	+30°	+45°
14	TpFR	Top Front Right	U-045	-45°	-60°	+30°	+45°
15	TpFC	Top Front Center	U+000	0°		+30°	+45°
16	TpC	Top Center	T+000	0°		+90°	
17	TpBL	Top Back Left	U+135	+110°	+135°	+30°	+45°
18	TpBR	Top Back Right	U-135	-110°	-135°	+30°	+45°
19	TpSiL	Top Side Left	U+090	+90°		+30°	+45°
20	TpSiR	Top Side Right	U-090	-90°		+30°	+45°
21	TpBC	Top Back Center	U+180	+180°		+30°	+45°
22	BtFC	Bottom Front Center	B+000	0°		-15°	-30°
23	BtFL	Bottom Front Left	B+045	+45°	+60°	-15°	-30°
24	BtFR	Bottom Front Right	B-045	-45°	-60°	-15°	-30°

[References]

[1] "Ultra-high definition/wide-color-gamut standard test sequences – Series A Manual," The Institute of Image Information and Television Engineers, December 2015.

[2] Rec. ITU-R BS.2051: "Advanced sound system for programme production" (2014).

[3] ARIB STD-B59 Ver. 2.0: "Three-dimensional Multichannel Stereophonic Sound System for Programme Production," (2016).

[4] Rec. ITU-R BS.2076: "Audio Definition Model" (2015).

[5] Rec. ITU-R BS.2088: "Long-form file format for the international exchange of audio programme materials with metadata" (2015).
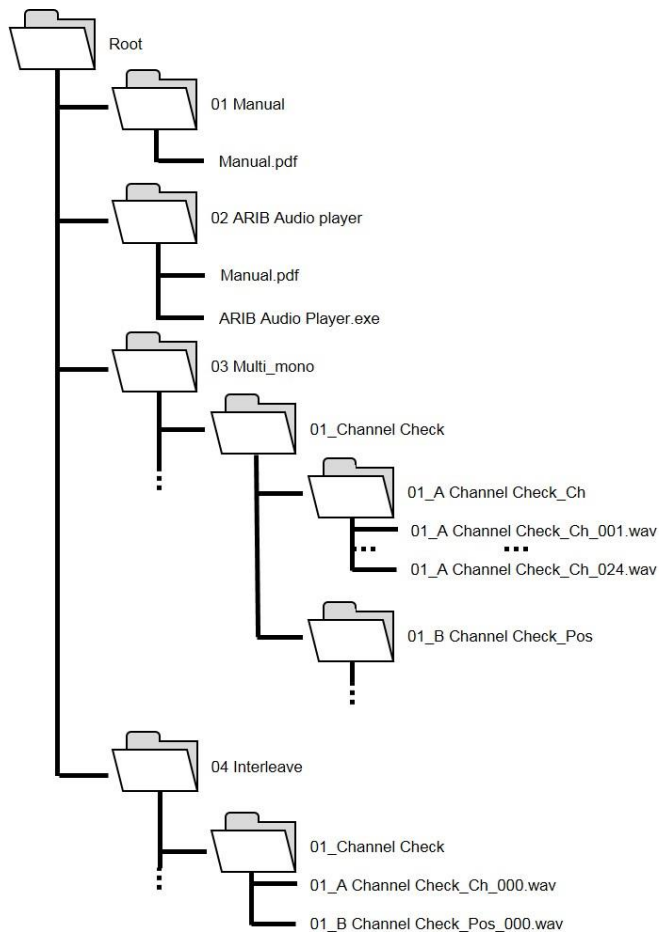
2. Recording Format

The USB memory folder structure and file formats for distribution of "Standard test materials for three-dimensional multichannel stereophonic sound systems – Series A," are described below.

2.1. Folder Structure

These standard test materials are distributed on USB memory. The root directory contains the "01 Manual" folder, containing this manual, the "02 ARIB Audio player" folder, containing software able to read and play back the test material files and accompanying manuals, the "03 Multi_mono" folder and the "04 Interleave" folder. "03 Multi_mono" contains folders for each test sound, each of which contains 24 mono-signal files, while "04 Interleave" contains test sound folders with sounds stored in single files.

Each of the test materials is given a number from 1 to 10, and a name indicating the signal type. A combination of these was used for the folder name (e.g. the channel connection check signal is in 01_ChannelCheck/). Inside that folder there are folders further partitioning according to recording or production method (e.g. 01_A Channel Check_Ch/, etc.), and files are recorded with the same name as the partition folder names.

```
Root
├── 01 Manual
│       └── Manual.pdf
├── 02 ARIB Audio player
│       ├── Manual.pdf
│       └── ARIB Audio Player.exe
├── 03 Multi_mono
│   ┊   └── 01_Channel Check
│   ┊           ├── 01_A Channel Check_Ch
│   ┊           │       ├── 01_A Channel Check_Ch_001.wav
│   ┊           │   ┊   ···
│   ┊           │       └── 01_A Channel Check_Ch_024.wav
│   ┊           └── 01_B Channel Check_Pos
│   ┊                   ┊
└── 04 Interleave
    ┊   └── 01_Channel Check
    ┊           ├── 01_A Channel Check_Ch_000.wav
    ┊           └── 01_B Channel Check_Pos_000.wav
```

2.2. File Formats

The file formats for these standard test materials are as follows.

・Signal format:　　　Linear PCM

・Sampling frequency: 48 kHz

・Quantization bits:　24 bits

・No. of channels:　　24

　　　　Multi-mono:　1 channel (24 files)

　　　　Interleave:　24 channels (1 file)

・　File names

Multi-mono:　　Composed of 24 files, with 1 audio channel per file.

　　　　　　　File names are in the form Filename_<number>.wav. Filename represents the test material name, and the numbers following Filename_ are the channel number, with "001" representing the FL channel, "002" the FR channel and so on.

　　　　　　　(e.g.: Filename_001.wav, …, Filename_024.wav etc.).

　　　　　　　The channel numbers for 22.2 channel sound are given in Table 1-1.

Interleave:　　Composed of a single file containing 24 audio channels.

　　　　　　　File names are of the form Filename_000.wav. Filename represents the test material name.

　　　　　　　The channel order for 22.2 channel sounds in these test materials is given in Table 1-1.

・LFE channels:　Signals recorded for LFE channels have had a 3D low pass filter with 120 Hz cutoff frequency applied.

3. Organization of Standard Test Materials

3.1. Organization of Materials based on Recording and Production Methods

These "Standard test materials for three-dimensional multichannel stereophonic sound systems - Series A" are organized into two sets of sound files by type: multi-mono and interleave. With multi-mono, the 22.2 multichannel sound (sound mode: Multichannel stereo 3/3/3-5/2/3-3/0/0.2) is stored in 24 files containing mono sound signals, and with interleave all 24 channels are stored in a single audio file. Each of the test materials has been given a name and a number from 1 to 10, and the same names are used for Multi-mono and Interleave formats. The numbers "_001" to "_024" appended to sound file names indicate multichannel sound channels 1 to 24, and "_000" indicates the interleaved sound file. There are also several sound files for each test number, so there are 41 sound files in total.

For example, test material No. 1, "Channel check" (01_Channel Check/) is the test material for checking whether the loudspeakers are connected correctly, but four types of this test material have been recorded. They are "Channel order check" (01_A Channel Check_Ch), with a woman's voice reading out the channel names in channel order, the same content read out in English, in "Channel order check (English version)" (01_C Channel Check_Ch_En) , "Speaker position check" (01_B Channel Check_Pos), with a man's voice reading out loudspeaker positions in a clockwise order," and the same content read out in English in "Speaker position check (English version)" (01_D Channel Check_Pos_En).

Another example is No. 3, "Soundscape (Amusement park)" (03_Amusement/), which has both a single-point recording, "Amusement park 1 point (short)" (03_1A Amusement_One_Short), and a multi-point recording, "Amusement park multi-point (short)" (03_2A Amusement_Multi_Short). Single-point and multi-point recordings use different recording methods, simultaneously recording the same content. Single-point recorded materials are recorded using a one-point microphone, which consists of 22 directional microphones arranged radially, facing the directions of each of the 22 loudspeakers used for 22.2 multichannel sound. Multi-point recorded materials are recorded using omni-directional microphones placed at the positions of each of the 22 loudspeakers used for 22.2 multichannel sound. The separation between the microphones used for multi-point recording is generally from 3 m to 5 m but also depends on the recording location. Note also that the same signal recorded for the LFE channel is used for both single-point and multi-point recordings.

3.2.   Test Items Suited to each Test Material

As an example, for test material No. 2, "Sound image localization" (02_Localization/), five types of test materials were recorded for both 45 degree and 60 degree systems. 45 and 60 express the positions of the front, middle layer loudspeakers on the right and left sides. In a 45 degree system the middle layer front five loudspeakers are assumed to be at 0, ±22.5, and ±45 degrees, while in a 60 degree system, they are at 0, ±30, and ±60 degrees. For both the "Left-Right motion 45 deg. system" (02_1A Localization_45_L-R) and the "Left-Right motion 60 deg. system" (02_2A Localization_60_L-R), the signals have been adjusted so that the sound image moves in a range of ±45 degrees from the front direction if the loudspeakers are placed in the specified locations. To perform a sound image localization test, the sound image position must be distinguished accurately, and it is preferable to use sound files that are closer to the positions of the loudspeakers actually connected.

Lists of the main evaluation terms and attributes corresponding to each of the test materials are summarized in Tables 3-1 and 3-2.

Table 3-1 Evaluation terms and associated attributes

Overall quality (Basic audio quality)	Overall impressions such as loudness, timbre, and localization
Gradation	Level changes, dynamic range
Timbre	Tonal quality, reproduction of timbre, clarity
Signal processing degradation	Quantization distortion, signal processing distortion, effects of audio coding distortion
Sound image localization	Sound image position, auditory source width, sense of motion, sense of direction
Stereo image	Sound image localization in front, spaciousness, connection to left/right sound
Surround sense	Sense of front/back, movement toward the back, listener envelopment, connection to horizontal plane sounds
Vertical sense	Up and down motion, listener envelopment, sense of depth, connection to sound in all directions
Sense of presence	Impact, atmosphere

Table 3-2 Main evaluation terms for each standard material

Standard materials		Evaluation terms								
No.	Name	Overall quality	Gradation	Timbre	Signal processing degradation	Sound image localization	Stereo image	Surround sense	Vertical sense	Sense of presence
1	Channel check			○	○	◎				
2	Sound image localization					◎	◎	◎	◎	
3	Soundscape (Amusement park)	◎			○	◎	○	○	◎	◎
4	Soundscape (Train)	◎	○			○	◎			◎
5	Soundscape (Volleyball)				◎	○		○	◎	○
6	Octet	◎	○	◎	◎	○	◎	◎		◎
7	Song (Kagome)			○		○		◎		
8	Drama	◎				○	○	○		
9	Tempura			○	◎					
10	Sound resources				◎	○		○	◎	

◎ Especially suitable

○ Suitable

3.3. **22.2 Multichannel Sound Standard Materials**

Table 3-3 22.2 multichannel sound standard material list

No.	Name	Name	Length	Folder
1	Channel check[*1]			01_Channel Check/..
		Channel check (in Japanese)	125 s	../01_A Channel Check_Ch/
		Speaker position check (in Japanese)	125 s	../01_B Channel Check_Pos/
		Channel check (in English)	124 s	../01_C Channel Check_Ch_En/
		Speaker position (in English)	155 s	../01_D Channel Check_Pos_En/
2	Sound localization[*2]			02_Localization/..
	For 45 degree system			../01_45/..
		L-R motion 45 degrees	90 s	../02_1A Localization_45_L-R/
		U-D motion 45 degrees	120 s	../02_1B Localization_45_U-D/
		Horiz. Rotation 45 degrees	30 s	../02_1C Localization_45_Rot/
		Flying overhead 45 degrees	129 s	../02_1D Localization_45_Over/
		Vertical helix 45 degrees	30 s	../02_1E Localization_45_Helix/
	For 60 degree system			../02_60/..
		L-R motion 60 degrees	90 s	../02_2A Localization_60_L-R/
		U-D motion 60 degrees	120 s	../02_2B Localization_60_U-D/
		Horiz. Rotation 60 degrees	30 s	../02_2C Localization_60_Rot/
		Flying overhead 60 degrees	129 s	../02_2D Localization_60_Over/
		Vertical helix 60 degrees	30 s	../02_2E Localization_60_Helix/
3	Soundscape (Amusement park)			03_Amusement/
	Single-point recording			../01_One_Point/..
		Amusement park short 1 point	15 s	../03_1A Amusement_One_Short/
		Amusement park long 1 point	31 s	../03_1B Amusement_One_Long/
	Multi-point recording			../02_Multiple_Points/..
		Amusement park short multi-point	15 s	../03_2A Amusement_Multi_Short/
		Amusement park long multi-point	31 s	../03_2B Amusement_Multi_Long/

No.	Name	Name	Length	Folder
4	Soundscape (Train)			04_Train/
	Single-point recording			../01_One_Point/..
		Train passing once 1 point	22 s	../04_1A Train_One_Short/
		Train passing multiple 1 point	44 s	../04_1B Train_One_Long/
	Multi-point recording			../02_Multiple_Points/..
		Train passing multi-point	22 s	../04_2A Train_Multi_Short/
		Train passing multiple multi-point	44 s	../04_2B Train_Multi_Long/
5	Soundscape (Volleyball)			05_Volleyball/
	Single-point recording			../01_One_Point/..
		Volleyball Facing sideline 1 point	15 s	../05_1A Volleyball_One_Facing Side line/
		Volleyball Facing end line 1 point	15 s	../05_1B Volleyball_One_Facing End line/
	Multi-point recording			../02_Multiple_Points/..
		Volleyball Facing sideline multi-point	15 s	../05_2A Volleyball_Multi_Facing Side line/
		Volleyball Facing end line multi-point	15 s	../05_2B Volleyball_Multi_Facing End line/
6	Octet			06_Music Octet/
		Octet Strings	16 s	../06_A Octet_String/
		Octet Winds	13 s	../06_B Octet_Wind/
		Octet Short	13 s	../06_C Octet_Short/
		Octet Medium	70 s	../06_D Octet_Middle/
		Octet Long	291 s	../06_E Octet_Long/
		Octet Original	291 s	../06_F Octet_Original/
7	Song (Kagome)[*2]			07_Music KAGOME/
		Kagome at rest	26 s	../07_A KAGOME_at Rest/
		Kagome in motion	26 s	../07_B KAGOME_Locomotion/
8	Drama [*2]			08_Drama/
		Drama (meeting)	13 s	../08_A Drama_Meeting/
		Drama (rehearsal)	12 s	../08_B Drama_Rehearsal/

No.	Name	Name	Length	Folder
9	Tempura [*2]			09_Tempura/
		Tempura Vegetables	22 s	../09_A Tempura_Vegetables/
		Tempura Prawns	34 s	../09_B Tempura_Prawns/
10	Sound resources			10_Resources/
		Dishes dropping	9 s	../10_A Resources_Tableware/
		Tree chime[*2]	6 s	../10_B Resources_Tree Chime/
		Frogs in rain[*2]	15 s	../10_C Resources_Frogs in Rain/

*1 For the LFE Channel the full bandwidth signal is recorded.

*2 For the LFE Channel no signal was recorded.

No. 1 Channel check (01_Channel Check/)

A. Channel check (in Japanese)
File names: 01_A Channel Check_Ch/01_A Channel Check_Ch_001.wav - _024.wav

            01_A Channel Check_Ch_000.wav

Length: 125 s

B. Speaker position check (in Japanese)
File names:

            01_B Channel Check_Pos/01_B Channel Check_Pos_001.wav - _024.wav

            01_B Channel Check_Pos_000.wav

Length: 125 s

C. Channel check (in English)
File names:

     01_C Channel Check_Ch_En/01_C Channel Check_Ch_En_001.wav - _024.wav

     01_C Channel Check_Ch_En_000.wav

Length: 124 s

D. Speaker position check (in English)
File names:

     01_D Channel Check_Pos_En/01_D Channel Check_Pos_En_001.wav - _024.wav

     01_D Channel Check_Pos_En_000.wav

Length: 155 s

Description:

In "A. Channel check (in Japanese)" (01_A Channel Check_Ch), the loudspeaker positions are read out by a female voice in the recorded channel order. In "B. Speaker position check (in Japanese)" (01_B Channel Check_Pos), the loudspeaker positions are read out by a male voice, clockwise starting from the front left for the middle layer, then the top layer, the top center, and the bottom layer. "C. Channel check (in English)" (01_C Channel Check_Ch_En) and "D. Speaker position check (in English)" (01_D Channel Check_Pos_En) each contain the same content read in English.

These test materials are for checking that loudspeakers are connected to the playback equipment correctly. To actually adjust acoustics from loudspeakers requires playing pink noise from each loudspeaker, and adjusting so that they each yield the same levels, arrival times, and frequency

characteristics (flat response over a broad range is preferred) at the listening position. They are also suitable for checking sound quality, such as whether female and male voices can be heard naturally, and can be used to evaluate the accuracy of sound image localization when converting the number of channels or using pseudo surround sound.

Recording data:

Recording location:	Soundproof room
Microphone:	Omni-directional microphone
Notes:	A. Channels are read out at 5 s intervals. B. Between each channel is 2 s of silence.
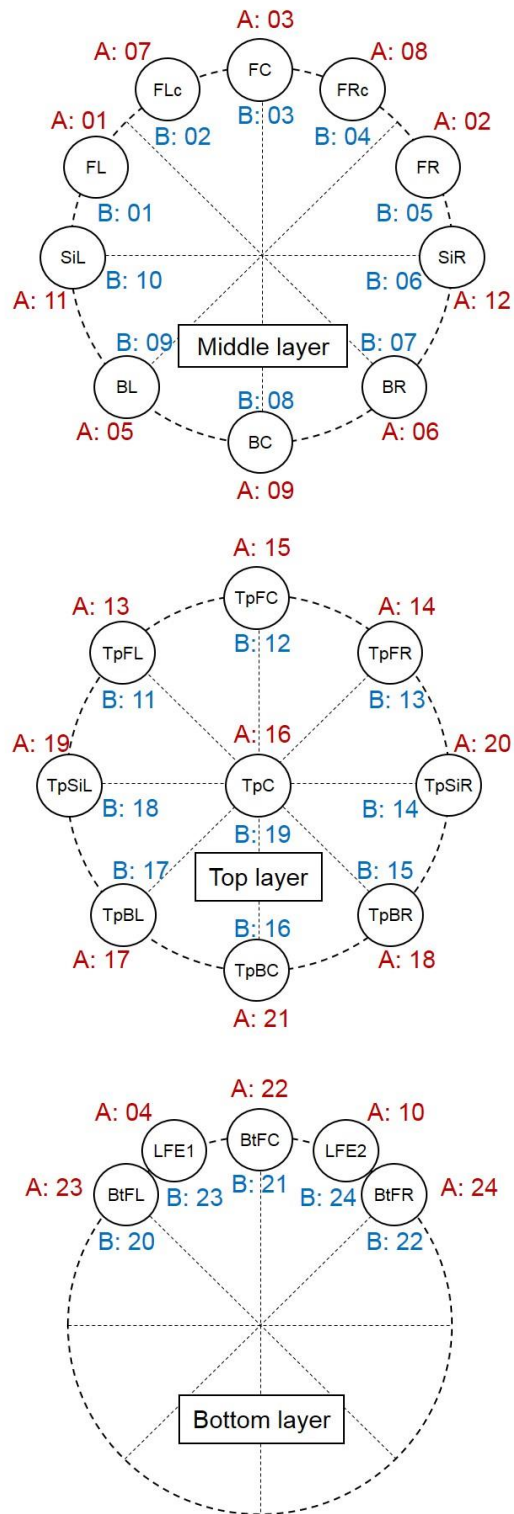
Figure 3-1. Reading order for channel check (A, red) and loudspeaker position check (B, blue)

No. 2 Sound image localization (02_Localization/)

A．L-R motion 45 degrees (01_45/) and L-R motion 60 degrees (02_60/)

File names:

・**45 degrees (01_45/)**

    02_1A Localization_45_L-R/02_1A Localization_45_L-R_001.wav - _024.wav

    02_1A Localization_45_L-R_000.wav

・**60 degrees (02_60/)**

    02_2A Localization_60_L-R/02_2A Localization_60_L-R_001.wav - _024.wav

    02_2A Localization_60_L-R_000.wav

Length: 90 s

Description:

    This test material facilitates evaluation of sound image localization accuracy, by listening to white noise (sound image positions are indicated by the red circles in the diagram). The white noise makes two round trips, starting from 45 degrees to the left, above and to the front, and moving to 45 degrees to the right, above and to the front, and returning. This motion is repeated five times while changing the height, maintaining uniform speed. In the 45-degree system middle layer (the third repetition), and when the sound image is at the end of the sweep, the sound only plays from the loudspeaker at that position. However, in a 60-degree system when the sound image is at the ends of the sweep in the middle layer, the same level is output from the inner and outer left or right loudspeakers. This is so that, assuming there is accompanying video, the sound image moves through the same range of ±45 degrees in the front direction, whether on a 45-degree or a 60-degree system.

    This is suitable for evaluating the sense of motion of the sound image on the screen, particularly in the horizontal direction.
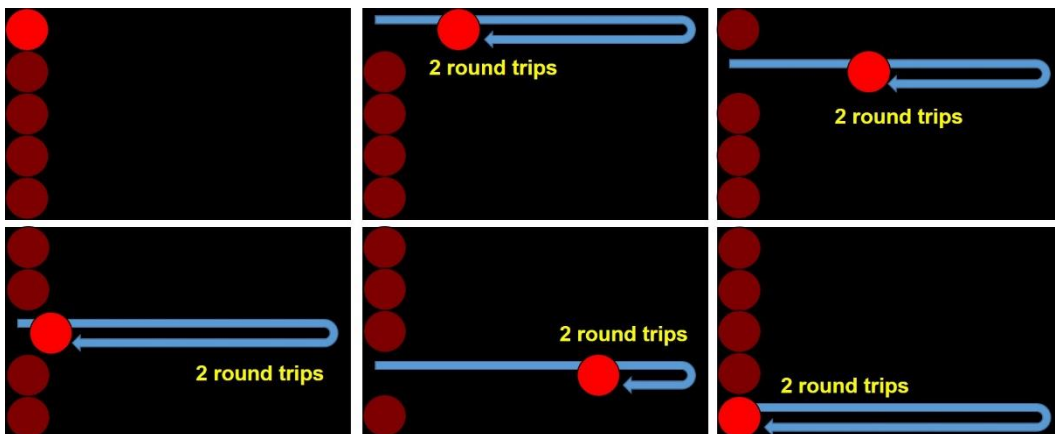
B. U-D motion 45 degrees (01_45/) and U-D motion 60 degrees (02_60/)

File names:

・**45 degrees (01_45/)**

    02_1B Localization_45_U-D/02_1B Localization_45_U-D_001.wav - _024.wav

    02_1B Localization_45_U-D_000.wav

・**60 degrees (02_60/)**

    02_2B Localization_60_U-D/02_2B Localization_60_U-D_001.wav - _024.wav

    02_2B Localization_60_U-D_000.wav

Length: 120 s

Description:

White noise (sound image positions indicated by the red circles in the diagram) makes two round trips, starting from 45 degrees to the left, above and to the front, and moving to 45 degrees to the left, below and to the front, and returns. This motion is repeated nine times while changing the left-right position, maintaining uniform speed. In the 45-degree system at middle layer and when the sound image is at the left (1st sweep) and right (9th sweep), the sound only plays from the loudspeaker at that position. However, in a 60-degree system when the sound image is at the left or right at middle layer, the same level is output from the inner and outer left or right loudspeakers. This is so that, assuming there is accompanying video, the sound image moves through the same range of ±45 degrees in the front direction, whether on a 45-degree or a 60-degree system.

This is suitable for evaluating the sense of motion of the sound image on the screen, particularly in the vertical direction.
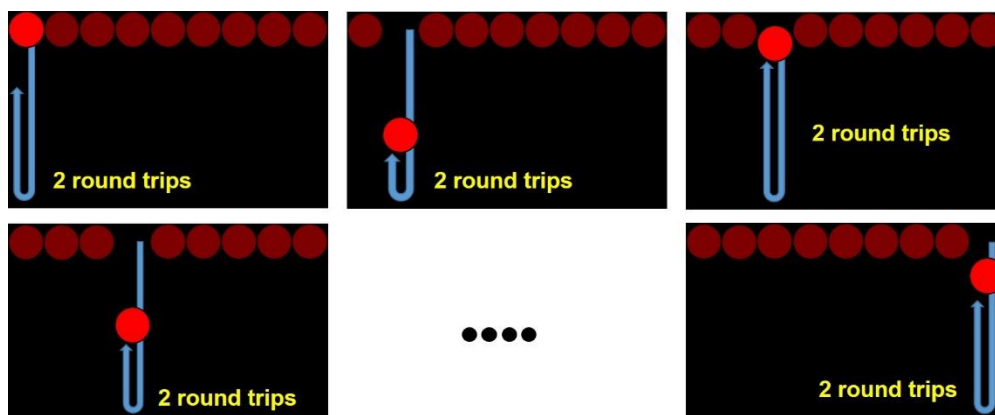

Figure 3-3 U-D motion sound image positions

C. Horizontal rotation 45 degrees (01_45/) and Horizontal rotation 60 degrees (02_60/)

File names:

・**45 degrees (01_45/)**

　　02_1C Localization_45_Rot/02_1C Localization_45_Rot_001.wav - _024.wav

　　02_1C Localization_45_Rot_000.wav

・**60 degrees (02_60/)**

　　02_2C Localization_60_Rot/02_2C Localization_60_Rot_001.wav - _024.wav

　　02_2C Localization_60_Rot_000.wav

Length: 30 s

Description:

White noise (sound image positions indicated by the red circles in the diagram) circles counter-clockwise from the front in the middle layer, once around the listener, and then returns in the clockwise direction. The sound image is adjusted to move at a uniform speed.

The sound circles the listener, so it is suitable for evaluating the sense of motion of the sound image in the horizontal plane.
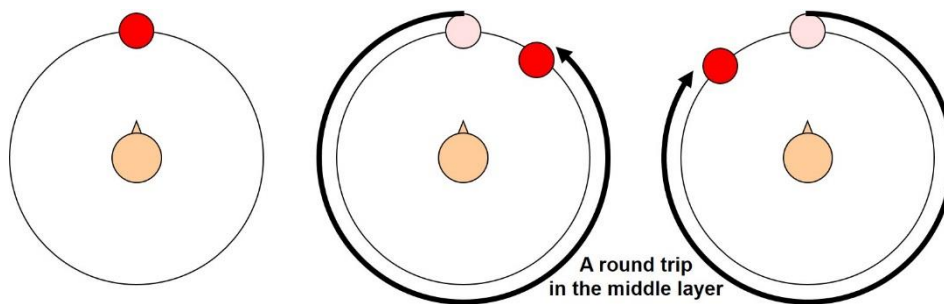

Figure 3-4 Horizontal rotation sound image positions

D. Flying overhead 45 degrees (01_45/) and Flying overhead 60 degrees (02_60/)

File names:

・**45 degrees (01_45/)**

02_1D Localization_45_Over/02_1D Localization_45_Over_001.wav - _024.wav

02_1D Localization_45_Over_000.wav

・**60 degrees (02_60/)**

02_2D Localization_60_Over/02_2D Localization_60_Over_001.wav - _024.wav

02_2D Localization_60_Over_000.wav

Length: 129 s

Description:

White noise (sound image positions indicated by the red circles in the diagram) moves from center-front in the middle layer to the rear, through the top-center position, and then returns to the front over the same path. This is repeated. Similarly it makes return trips from left to right through the top-center position, from the front-left to the back-right, and from the front-right to the back-left.

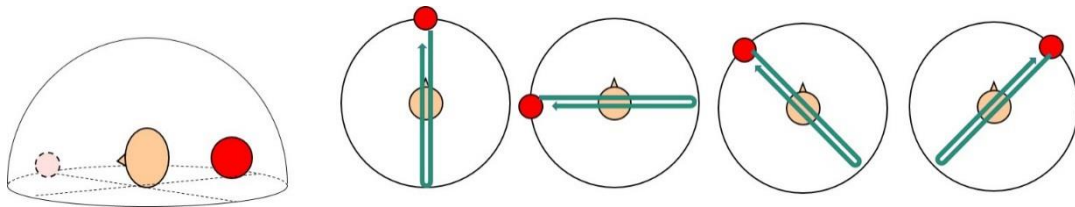It is suitable for evaluating motion of the sound image in vertical planes (front, cross-section planes).

Figure 3-5 Flying overhead sound image positions

E. Vertical helix 45 degrees (01_45/) and Vertical helix 60 degrees (02_60/)

File names:

・45 degrees (01_45/)

02_1E Localization_45_Helix/02_1E Localization_45_Helix_001.wav - _024.wav

02_1E Localization_45_Helix_000.wav

・60 degrees (02_60/)

02_2E Localization_60_Helix/02_2E Localization_60_Helix_001.wav - _024.wav

02_2E Localization_60_Helix_000.wav

Length: 30 s

Description:

White noise (sound image positions indicated by the red circles in the diagram) spirals down in the counter-clockwise direction from the top-front position in the top layer to center-front position in the middle layer, and then the other white noise also spirals down in the clockwise direction from the top-front position in the top layer to center-front position in the middle layer. The sound image is adjusted to move at uniform speed.

This material is suitable for evaluating motion of the sound image in the horizontal plane while moving up and down.
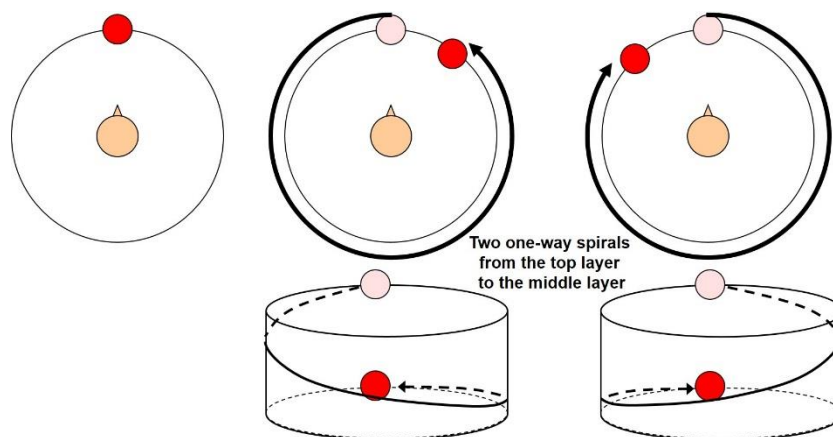

Figure 3-6 Vertical helix sound image positions

No. 3 Soundscape (Amusement park) (03_Amusement/)

A. Amusement park short 1 point (01_One_Point/) and Amusement park short multi-point (02_Multiple_Points/)

File names:

・**Single-point recording (01_One_Point/)**

03_1A Amusement_One_Short/03_1A Amusement_One_Short_001.wav - _024.wav

03_1A Amusement_One_Short_000.wav

・**Multi-point recording (02_Multiple_Points/)**

03_2A Amusement_Multi_Short/03_2A Amusement_Multi_Short_001.wav - _024.wav

03_2A Amusement_Multi_Short_000.wav

Length: 15 s

B. Amusement park long 1 point (01_One_Point/) and Amusement park long multi-point (02_Multiple_Points/)

File names:

・**Single-point recording (01_One_Point/)**

03_1B Amusement_One_Long/03_1B Amusement_One_Long_001.wav - _024.wav

03_1B Amusement_One_Long_000.wav

・**Multi-point recording (02_Multiple_Points/)**

03_2B Amusement_Multi_Long/03_2B Amusement_Multi_Long_001.wav - _024.wav

03_2B Amusement_Multi_Long_000.wav

Length: 31 s

Description:

This test material is a soundscape from an amusement park recorded using a one-point microphone consisting of 22 directional microphones, and 24 omni-directional microphones placed at possible loudspeaker positions of the 22.2 multichannel sound system. It includes sounds of a roller coaster overhead and an empty drink can rolling below. There are two test materials of lengths 15 s and 31 s, and each was recorded as single-point and multi-point recordings at the same time and was picked up from the same recoded tracks.

It is suitable for evaluating motion of sound images, including the movement of the roller coaster and screams overhead, and the empty can below. Since the sound signals from the directional and omni-directional microphone recording devices are different, it is also useful for evaluating degradation due to signal processing.

Recording data:

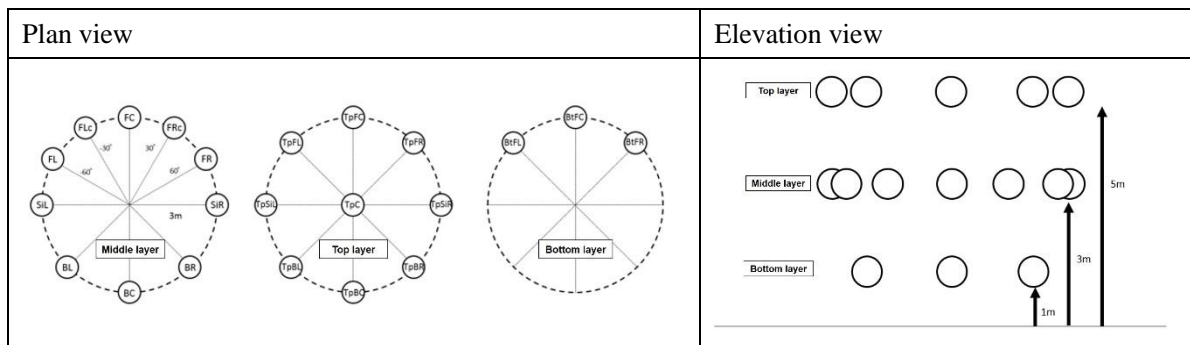| Recording location:	Urban amusement park	
Recording equipment:	Single-point recording	
	Microphone Sanken CSR-2 (highly directional)	
	Microphone amp. DirectOut Technologies Andiamo.MC	
	Multi-point recording	
	Microphones Schoeps MK2H (Omni-directional) Schoeps CMC6xt (Preamp)	
	Microphone amp. StageTec NEXUS	
Edit history:		

Recording scenes

Figure 3-7 Multi-point recording microphone positions for Soundscape (Amusement park)

No. 4 Soundscape (Train) (04_Train/)

A. Train passing 1 point (01_One_Point/) and Train passing multi-point (02_Multiple_Points/)

File names:

・**Single-point recording (01_One_Point/)**

04_1A Train_One_Short/04_1A Train_One_Short_001.wav - _024.wav

04_1A Train_One_Short_000.wav

・**Multi-point recording (02_Multiple_Points/)**

04_2A Train_Multi_Short/04_2A Train_Multi_Short_001.wav - _024.wav

04_2A Train_Multi_Short_000.wav

Length: 22 s

B. Train round trip 1 point (01_One_Point/) and Train round-trip multi-point (02_Multiple_Points/)

File names:

・**Single-point recording (01_One_Point/)**

04_1B Train_One_Long/04_1B Train_One_Long_001.wav - _024.wav

04_1B Train_One_Long_000.wav

・**Multi-point recording (02_Multiple_Points/)**

04_2B Train_Multi_Long/04_2B Train_Multi_Long_001.wav - _024.wav

04_2B Train_Multi_Long_000.wav

Length: 44 s

Description:

This is a scenario with a railway toward the front and overhead, and on the rail a train passes from left to right. In the short, 22 s test material, the train passes once, and in the longer, 44s test material, trains pass in both directions. Recordings were made with both single-point and multi-point recording at the same time.

This is suitable for evaluating sound image localization effects with multiple microphones, which is different than with panning. It is also useful for evaluating the natural sense of distance from the train sound as it gradually approaches and the volume changes.

Recording data:

Recording location:	Tama river, riverbed
Recording equipment:	Single-point recording
	Microphone: Sanken CSR-2 (highly directional)
	Microphone amp.: DirectOut Technologies Andiamo.MC
	Multi-point recording
	Microphone: Schoeps MK2H (Omni-directional) Schoeps CMC6xt (Preamp)
	Microphone amp.: StageTec NEXUS
Edit history:	

Recording scenes

Multi-point recording microphone arrangement

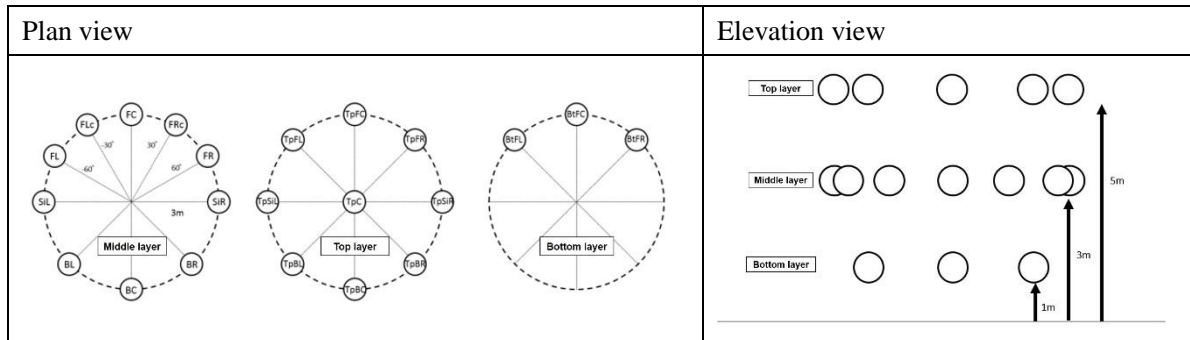| Plan view	Elevation view

Figure 3-8 Multi-point recording microphone arrangement for Soundscape (Train)

No. 5 Soundscape (Volleyball) (05_Volleyball/)

A. Volleyball facing sideline 1 point (01_One_Point/)
and Volleyball facing sideline multi-point (02_Multiple_Points/)

File names:

・**Single-point recording (01_One_Point/)**

    05_1A Volleyball_One_Facing Side line/

            05_1A Volleyball_One_Facing Side line_001.wav - _024.wav

    05_1A Volleyball_One_Facing_Side line_000.wav

・**Multi-point recording (02_Multiple_Points/)**

    05_2A Volleyball_Multi_Facing Side line/

            05_2A Volleyball_Multi_Facing Side line_001.wav - _024.wav

    05_2A Volleyball_Multi_Facing Side line_000.wav

Length: 15 s

B. Volleyball facing end line (01_One_Point/)
and Volleyball facing end line multi-point (02_Multiple_Points/)

File names:

・**Single-point recording (01_One_Point/)**

    05_1B Volleyball_One_Facing End line/

            05_1B Volleyball_One_Facing End line_001.wav - _024.wav

    05_1B Volleyball_One_Facing_End line_000.wav

・**Multi-point recording (02_Multiple_Points/)**

    05_2B Volleyball_Multi_Facing End line/

            05_2B Volleyball_Multi_Facing End line_001.wav - _024.wav

    05_2B Volleyball_Multi_Facing End line_000.wav

Length: 15 s

Description:

This test material is a recording of a volleyball practice scenario. Recordings were made using both single-point and multi-point recording at the same time. The one-point microphone was positioned directly under the net for single-point recording, and the 24 omni-directional microphones were positioned in a rectangle around the perimeter of the court. Two types of test material were recorded, one with the front of 22.2 multichannel sound facing the sideline (spectator view), and one facing the end line (player view), for a total of four test materials.

These materials are useful for evaluating localization of the overhead sound image of a spike, and

also signal processing degradation from using sound coding with distortion. They can also be used to evaluate the listener envelopment and spaciousness from reverberation in the gymnasium, the intensity of the players' movements, and the sense of space.

Recording data:

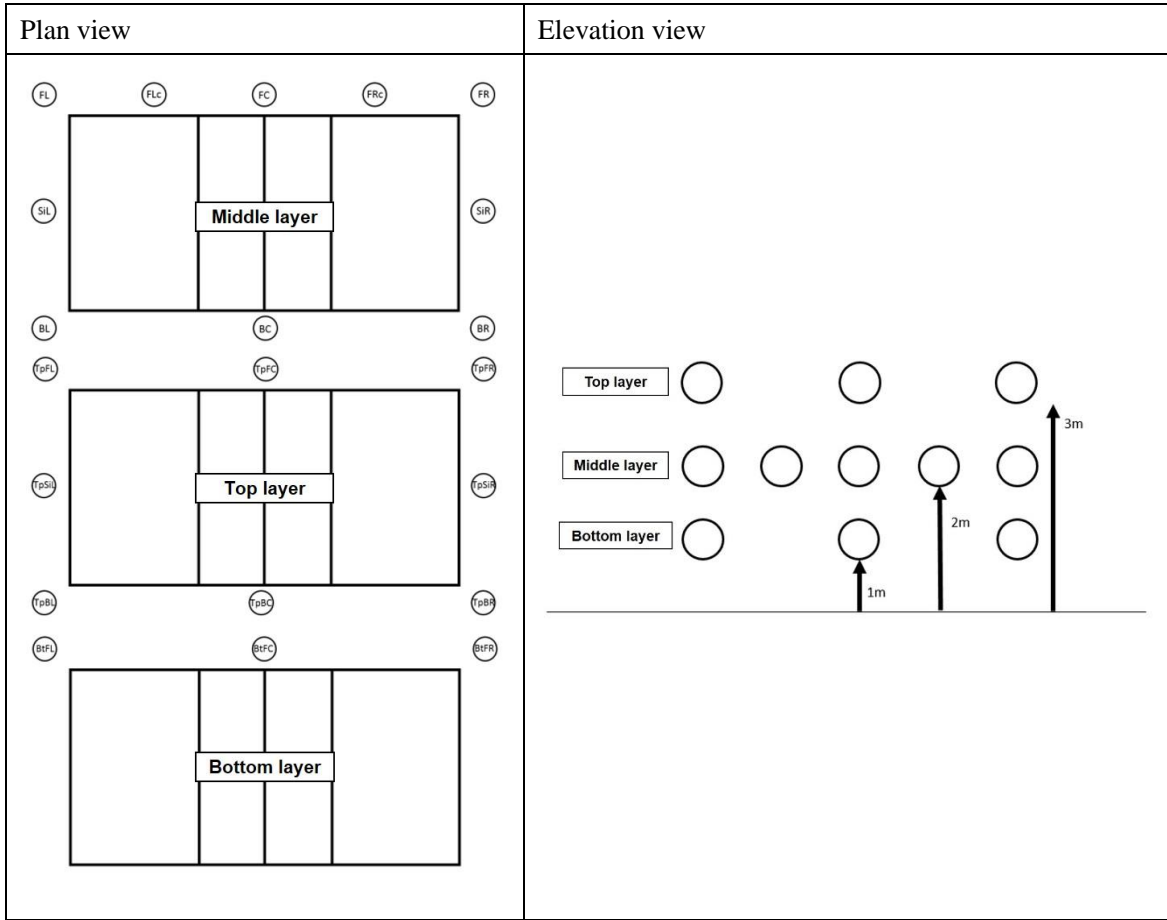|	
Recording location:	Gymnasium in Ibaraki Prefecture
Recording equipment:	Single-point recording
	Microphone Sanken CSR-2 (highly directional)
	Microphone amp. DirectOut Technologies Andiamo.MC
	Multi-point recording
	Microphones Schoeps MK2H (Omni-directional) Schoeps CMC6xt(Preamp)
	Microphone amp. StageTec NEXUS
Edit history:	

Recording scenes

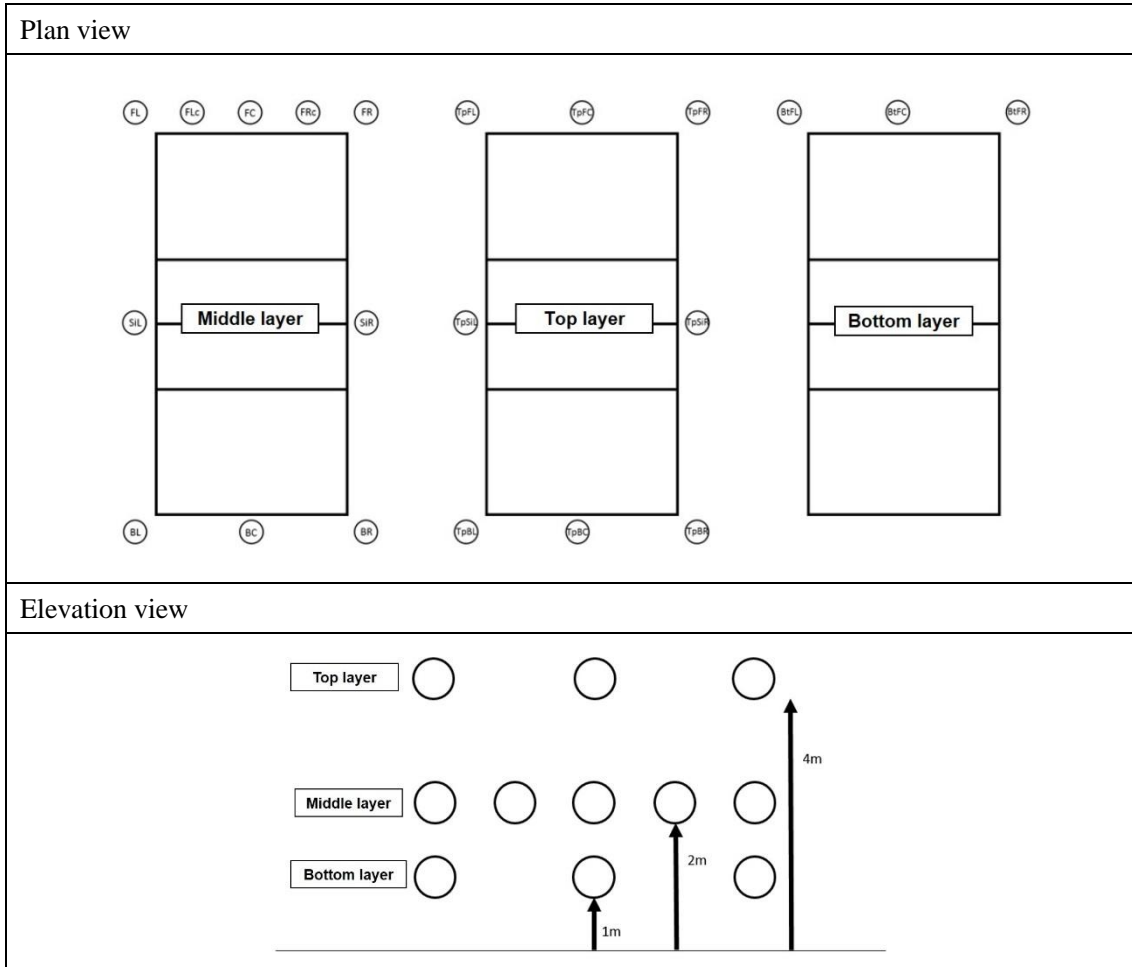**Figure 3-9 Multi-point recording microphone arrangement for Soundscape (Volleyball) (facing sideline)**

Figure 3-10 Multi-point recording microphone arrangement for Soundscape (Volleyball) (facing end line)

No. 6 Octet (06_Music Octet/)

A. Octet Strings

File names: 06_A Octet_String/06_A Octet_String_001.wav - _024.wav

06_A Octet_String_000.wav

Length: 16 s

B. Octet Winds

File names: 06_B Octet_Wind/06_B Octet_Wind_001.wav - _024.wav

06_B Octet_Wind_000.wav

Length: 13 s

C. Octet short

File names: 06_C Octet_Short/06_C Octet_Short_001.wav - _024.wav

06_C Octet_Short_000.wav

Length: 13 s

D. Octet middle

File names: 06_D Octet_Middle/06_D Octet_Middle_001.wav - _024.wav

06_D Octet_Middle_000.wav

Length: 70 s

E. Octet long

File names: 06_E Octet_Long/06_E Octet_Long_001.wav - _024.wav

06_E Octet_Long_000.wav

Length: 291 s

F. Octet unprocessed

File names: 06_F Octet_Original/06_F Octet_Original_001.wav - _024.wav

06_F Octet_Original_000.wav

Length: 291 s

Description:

In this situation, an octet of performers surrounds a one-point microphone. Recording F is the unprocessed recording of the entire performance, and E is the same recording with added reverberation of a large hall. Recording D is a 70 s clip taken from E, while A through C are

approximately 15 s segments featuring, mainly strings, mainly winds, and all instruments respectively.

These test materials are suitable for evaluating the direction of each instrument (position of sound image), tone, and listener envelopment.

These are single-point recordings, but omni-directional microphones were also used for the LFE channels, and signals from all 24 channels were recorded. These can be used for demonstrations or for checking operation over longer periods of time.

Recording data:

Recording location:	Urban auditorium	
Recording equipment:	Single-point recording	
	Microphone Schoeps MK41 (Highly directional) Schoeps CMC6xt (Preamp)	
	Microphone amp. StageTec NEXUS	
	For LFE channel	
	Microphone Sanken CO-100K (Omni-directional)	
	Microphone amp. StageTec NEXUS	
Edit history:	Large-hall reverberation added using 3D reverb equipment.	

Recording scenes

No. 7 Song (Kagome) (07_Music KAGOME)

A. Kagome Kagome at rest

File names: 07_A KAGOME_at Rest/07_A KAGOME_at Rest_001.wav - _024.wav

07_A KAGOME_at Rest_000.wav

Length: 26 s

B. Kagome Kagome moving

File names:

07_B KAGOME_Locomotion/07_B KAGOME_Locomotion_001.wav - _024.wav

07_B KAGOME_Locomotion_000.wav

Length: 26 s

Description:

These are single-point recordings. Participants stand or walk around the one-point microphone singing the song while it is recorded.

Recordings at rest are suitable for evaluating spatial resolution, and those done with participants moving are suitable for comparing spatial resolution, and other aspects such as differences in tone of the voices. Motion of participants is slow, so this can be used for evaluating localization in a different situation than the train or roller coaster signals.

Recording data:

Recording location:	Urban testing studio
Recording equipment:	Single-point recording
	Microphone
	Schoeps MK41 (Highly directional)
	Schoeps CMC6xt (Preamp)
	Microphone amp.
	DirectOut Technologies
	Andiamo.MC

Recording scenes

No. 8 Drama (08_Drama/)

A. Drama (meeting)

File names: 08_A Drama_Meeting/08_A Drama_Meeting_001.wav - _024.wav

08_A Drama_Meeting_000.wav

Length: 13 s

B. Drama (rehearsal)

File names: 08_B Drama_Rehearsal/08_B Drama_Rehearsal_001.wav - _024.wav

08_B Drama_Rehearsal_000.wav

Length: 12 s

Description:

These are single-point recordings. A one-point microphone was positioned in the center of the meeting room. The meeting and drama rehearsal were done in the meeting room.

The voices of participants in various directions are suited to evaluating spatial resolution. The sound of applause and from dishes are useful for evaluating signal processing degradation. After the applause, flutter echo also occurs due to reflections from the walls and glass windows. This effect was also audible in the environment, so we recorded it.

Recording data:

Recording location:	Urban meeting room	
Recording equipment:	Single-point recording	
	Microphone Schoeps MK41 (highly directional) Schoeps CMC6xt (Preamp)	
	Microphone amp. DirectOut Technologies Andiamo.MC	

Recording scene

No. 9 Sound resource (Tempura) (09_Tempura/)

A.   Tempura - Vegetables
File names:

> 09_A Tempura_Vegetables/09_A Tempura_Vegetables_001.wav - _024.wav

> 09_A Tempura_Vegetables_000.wav

Length: 22 s

B.   Tempura - Prawns
File names: 09_B Tempura_Prawns/09_B Tempura_Prawns_001.wav - _024.wav

> 09_B Tempura_Prawns_000.wav

Length: 34 s

Description:

This is the sound of frying tempura. Two types of sound, differing in how the oil is repelled by different types of fried food, were recorded. The overall sound of vegetables frying is more even, while frying prawns includes more violent popping sounds as more water is repelled.

The crackling spatter of oil is suitable for evaluating coding distortion or other degradation due to signal processing.

Recording data:

Recording location:	Urban kitchen studio
Recording equipment:	Two layers (top, middle) of six Omni-directional Microphones One directional stereo microphone (FLc/FRc)
	Microphones Sanken COS-11 (Omni-directional) Sennheiser MKH-418 (directional stereo)
	Microphone amp. SOUND DEVICES 788T-SSD
Edit history:	Sound sources were recorded twice, with two layers of omni-directional microphones placed in six directions around the pan. For the first, the front and back (FC, BC) and the four corners (FL, FR, BL, BR) channels of 22.2 multichannel sound were recorded. The second time, microphones were rotated 90 degrees to record the left and right (SiL, SiR), and the four corner channels, and the directional stereo microphone was used to record the forward channels (FLc, FRc). Some of the middle layer signals were assigned to the bottom layer channels.

Recording scenes

No. 10 Sound resources (10_Resources/)

These sound resources were collected for use in audio dramas and other applications, so the 22.2 multichannel sound signals were created using techniques such as panning with mono and stereo sources. As such, these test materials do not necessarily use all 24 channels.

A. Dishes dropping

File names:

10_A Resources Tableware/10_A Resources Tableware_001.wav - _024.wav

10_A Resources Tableware_000.wav

Length: 9 s

Description:

In this production, dishes fall from a table and scatter in all directions. The dropped dishes fall around the listener.

Sound image localization from panning gives a different impression than that given by single-point or multi-point recording, so this is useful for evaluating clarity and other aspects. It is particularly suitable for evaluating sound images in the bottom layer.

B. Tree chimes

File names:

10_A Resources Tree Chime/10_A Resources Tree Chime_001.wav - _024.wav

10_A Resources Tree Chime_000.wav

Length: 6 s

Description:

This production has a tree chime descending from above. It is suitable for evaluating the impression of vertical motion. It is also useful for evaluating coding distortion in the timbre of the tree chimes, and other degradation due to signal processing.

C. Frogs in rain

File names:

10_A Resources Frogs in Rain/10_A Resources Frogs in Rain_001.wav - _024.wav

10_A Resources Frogs in Rain_000.wav

Length: 15 s

Description:

In this production, thunder sounds, rain begins to fall, and frogs begin to make sounds. It is suitable for evaluating the listener environment, with the spatially homogenous sound of the rain filling the space. The sounds of the frogs in all four directions, but especially behind, are suitable for testing sound image localization.

Standard test materials for three-dimensional multichannel stereophonic sound systems - Series A

Manual