

**Assessment methods for the subjective evaluation of the quality of
sound programme material**

Supplement 1

- Multichannel



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Chapter 1 Scope

1.1. General

The technical and production quality of sound programme material has to be monitored by subjective assessment, which means, in practice, by listening to the material in controlled conditions. This document gives details of the method recommended by the EBU for the evaluation of the quality of sound programme material. The recommended listening conditions are given in EBU Recommendation R22 [1] and EBU Tech. 3276: Listening conditions for the assessment of sound programme material [2] and in the Supplement 1 to EBU Tech 3276: Listening conditions for the assessment of sound programme material: multichannel sound.[3].

This document is a supplement to the main part of EBU Tech 3286, "Assessment methods for the subjective evaluation of the quality of sound programme material – Music" [4]. The main part is limited to recommendations for sound systems or programme material using two channels. The purpose of this supplement is to add requirements that relate specifically to the assessment of audio material with multiple channels. In this context, 'multichannel' means more reproduction channels than the two used by the well-established, two-channel stereophony system.

This supplement concentrates on the multichannel audio system described in ITU-R Recommendation BS.775-1 [5] which uses five, full-bandwidth main loudspeakers usually arranged on the perimeter of a circle centred on the main listening position (5.0), with an optional 'low frequency extension' channel (5.1). In BS.775-1, the code "3/2" (three front channels / two surround channels) is used for this loudspeaker arrangement. The method may also be used for other similar multichannel systems.

The recommendations given in this supplement should be taken as additional or alternative to those in the main part of EBU Tech. 3286. For clarity, and in order to make this supplement more readable without a great deal of cross-referencing, some parts of the text of the main part of EBU Tech. 3286 have been repeated or summarised.

For ease of cross-referencing, this supplement is arranged with the same layout and section headings as the main document, even though in many cases there are no additional or altered requirements.

1.2. Programme material

The method described in this supplement was developed for the assessment of the quality of surround sound material without pictures. The requirements are in addition to those given in EBU Tech 3286 [4] section 1.2.

1.3. EBU international listening evaluations

This supplement covers the additional requirements to be used at national and international listening evaluation meetings of EBU Members.

Chapter 2 Basic requirements for the subjective evaluation of the quality of sound programme material

2.1. General

Successful subjective evaluation of the quality of sound programme material requires prior agreement on:

- the composition of the listening panel;
- the listening conditions;
- the parameters to be evaluated;
- the evaluation grading scale;
- the method of reporting and analyzing the results.

Each of these requirements is described in detail below.

2.2. Listening panel

The panel should be composed of expert listeners, that is people who understand and have been trained in the agreed method of subjective quality evaluation. These expert listeners should:

- work daily in the production of sound programmes of the subject genre chosen for the evaluations or have extensive experience in listening to sound in a professional way,
- have ontologically normal hearing: ISO Standard 389 [6] should be used as a guideline,
- be reasonably fluent in the working language of the evaluations, because verbal expression is an important part of the method,
- have experience in listening to multichannel sound.

2.3. Listening room and listening equipment

2.3.1. Listening room

The listening room used for the evaluations should be a reference listening room according to EBU Tech. 3276: Listening conditions for the assessment of sound programme material [2] and Tech 3276 Supplement 1: Listening conditions for the assessment of sound programme material: multichannel sound [3].

Fig. 1 shows the recommended layout for listening to 5 channel audio signals

2.3.2. Measurements of listening conditions

Before the listening evaluations, objective acoustical measurements should be made of the listening conditions (reverberation time and frequency response of the loudspeaker and room combination) according to EBU Tech. 3276 (Section 2) [2] and Tech 3276 Supplement 1 [3].

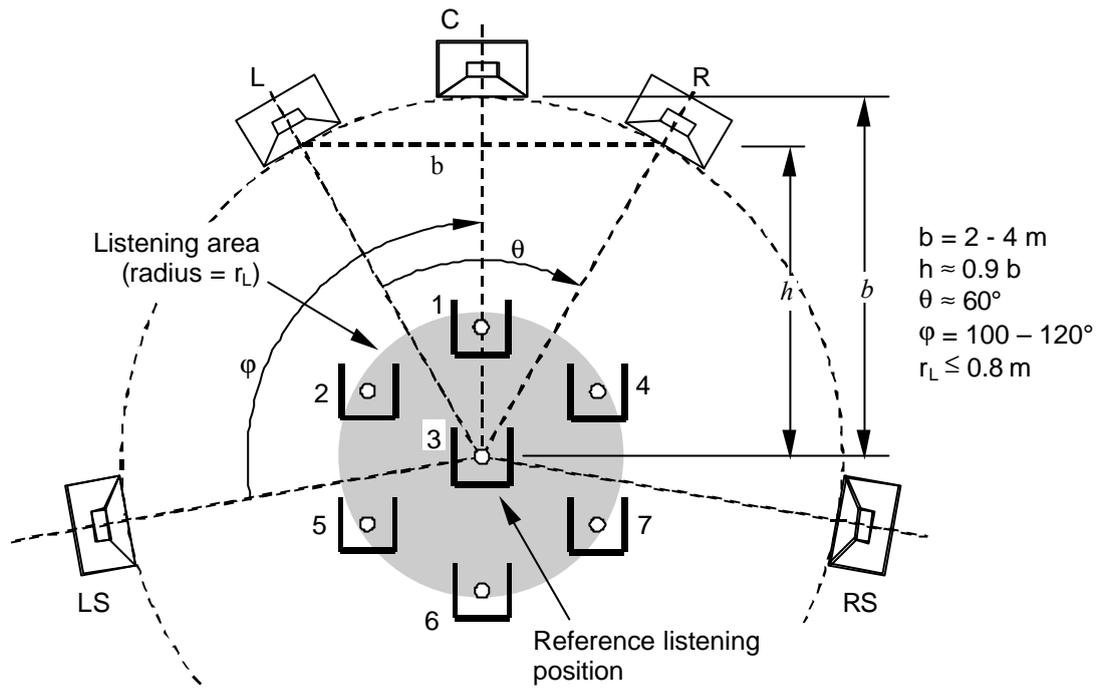


Fig 1. Typical layout of five channel listening arrangement
 (from EBU Tech. 3276 Supplement 1, Appendix 1.)

2.4. Listening level

The reference listening level should be set following the guidelines given in EBU Tech. 3276 Supplement 1 [2] (Section 2.5).

2.5. Evaluation method

2.5.1. Evaluation scale

Listeners should use the same six-point evaluation scale¹ as used in the main document, EBU Tech 3286 [4] This is shown in *Appendix A*.

When evaluating the parameter *main impression*, each listener should decide on a subjectively-weighted mean value of the other seven values. This should not be an arithmetic mean of these values.

2.5.2. Subjective parameters

For each evaluation item, the listeners should evaluate a number of main parameters and sub-parameters. A list of these parameters, with definitions and examples of common terms used to describe them, is given in *Appendix B*.

A glossary, which gives an alphabetical list of all the parameters and their definitions, is given in *Appendix C*.

2.5.3. Evaluation score forms

Each listener should complete an evaluation score form for each item during the listening sessions. An example of a suitable score form is given in *Appendix D*

¹. A six-point scale is chosen rather than a five-point scale as it forces the choice of a positive or negative rank.

Chapter 3 Organisation of listening evaluations

3.1. General

No additional or altered requirements

3.2. Preparation of listening evaluations

3.2.1. The organiser

No additional or altered requirements

3.2.2. Programme material

The organiser should choose the genre or genres of programme material to be evaluated. However, experience has shown that it is difficult to assess widely different genres of programme material in a single listening session.

The programme material to be assessed should preferably be presented as digital recordings. The organiser should specify the recording format(s) for the material. Multichannel recordings should be made according to EBU Recommendation R91 [7]

The originators of each item or sequence of material submitted for assessment should prepare information on the content. A suitable form for presentation is given in *Appendix E*.

3.3. Execution of listening evaluations

3.3.1. Time schedule

No additional or altered requirements

3.3.2. Training session

The training session for EBU international evaluations is described in *Appendix G* of document EBU Tech. 3286 [4]. A special 2-channel stereo training recording has been prepared by the EBU for this purpose [8]. The contents of this recording are listed in *Appendix H* of the EBU Tech. 3286.

The EBU intends to produce an additional demonstration recording [9] of multichannel excerpts, described in *Appendix H* of this Supplement*.

3.3.3. Running the evaluation

No additional or altered requirements

3.4. Evaluation of evaluation results

3.4.1. Statistical evaluation

No additional or altered requirements

3.5. Discussion and report

No additional or altered requirements

* If available.

Chapter 4 Special requirements for EBU international evaluations

4.1. EBU listening groups

In addition to the requirements of EBU Tech. 3286 [4] section 4.1, the tape format should be according to EBU Recommendation R91 [7]

4.2. EBU international listening evaluations

No additional or altered requirements

4.2.1. The organising group

No additional or altered requirements

4.2.2. Responsibilities

No additional or altered requirements

4.3. Preparation

In addition to the requirements of EBU Tech. 3286 [4], section 4.3, the recordings should normally be five channel (5.0), with an optional “low frequency extension” channel (5.1). The recordings should be supplied on tapes conforming to EBU Recommendation R91 [7]. Full information should be supplied on each item in a form similar to that shown in *Appendix E*.

4.4. Results and reporting

No additional or altered requirements

4.5. Distribution of results and copies of the evaluation material

No additional or altered requirements

Appendix A Evaluation scale for subjective assessments

No additional or altered requirements

Appendix B Main parameters, sub-parameters and examples of common descriptive terms

These parameters are developed for the classical music, but they may be suitable for any live acoustical performance taking place in a real space.

Main parameter	Sub-parameters	Examples of common descriptive terms
1. Front image quality The front sound images appear to have the correct and appropriate directional distribution.	Directional balance. Directional stability. Sound image width. Location accuracy.	Wide / narrow. Precise / imprecise. Stable / unstable Localizable/ unlocalizable
2. Side and rear sound quality The side and rear sounds appear to have the correct and appropriate balance.	Directional balance Directional stability. Location accuracy. Homogeneity of spatial sound.	Stable/ unstable Localizable/ unlocalizable
3. Spatial impression The performance appears to take place in an appropriate space.	Spatial reality Reverberation Acoustical balance Apparent room size Depth perspective Envelopment	Room reverberate / dry Direct / indirect Large room / small room
4. Transparency The details of the performance can be clearly perceived.	Sound source definition. Time definition. Intelligibility	Clear / muddy
5. Balance The individual sound sources and the ambience appear to be properly balanced in the general sound image.	Front/Rear loudness balance Direct/indirect loudness balance. Dynamic range.	Sound source too loud / too weak Sound compressed / natural
6. Sound colour The accurate representation of the characteristic sound of the sources.	Timbre Sound colour (front / side & rear) Sound colour of reverberation Sound build-up	Boomy/ sharp Neutral/ dull/ bright Dark/ light Warm / cold
7. Freedom from noise and distortions Absence of various perceptible disturbances	Noise Distortion Surround decoder artefacts	bit errors electrical noise, acoustical noise, public noise, distortions, coding artefacts surround decoding artefacts
8. Main impression A subjectively weighted average of the other parameters.		

Appendix C Definitions of main parameters and sub-parameters

In this list of definitions, the main parameters are shown in capitals.

Acoustical balance	The relationship between the direct and indirect (reflected) sounds
Acoustical noise,	Unwanted sounds in the room of origination, caused by, for example, air-conditioning equipment, lighting, movement of chairs; or noises carried by the structure of the building, such as impacts from outside, traffic noise, etc.
Apparent room size	The subjective impression of the size, real or artificial of origination space.
Artefact	A disturbance of the quality or position of the source
BALANCE	The loudness of the individual sound sources and ambience appear to have appropriate relationships
Bit errors	Discrete noises or distortions originating in a digital system.
Depth perspective	The subjective impression that the sound image has an appropriate front to back depth. (Listeners should be aware when assessing this sub-parameter that it may be an artefact of the listening conditions rather than a characteristic of the recording.)
Direct/indirect loudness balance	Subjective impression that the relationship between the loudness of the direct and indirect sounds is appropriate for the type of programme.
Directional balance	The subjective impression that the sound sources within the sound image are appropriately placed for the type of programme.
Directional stability	The subjective impression that all sound sources stay in their intended positions
Distortions	Deterioration of the sound quality which may be due to defects or non-linearity in the recording or reproducing systems.
Dynamic range	The subjective impression of the range between the strongest and weakest levels during reproduction, relative to the expectation of the listener for programme material of the type.
Electrical noise and distortions	Unwanted signal components caused by the transmission channel or signal processing, such as: noise, clicks, non-linear distortions and fading
Envelopment	Subjective impression of being present at the original performance
FREEDOM FROM NOISE AND DISTORTIONS	Absence of various perceptible disturbances
FRONT IMAGE QUALITY	The front sound images appear to have the correct and appropriate directional distribution.
Front/Rear loudness balance	Subjective impression that the relationship between the loudness of the front and rear sounds is appropriate for the type of programme.
Homogeneity of spatial	The subjective impression that the sound spaces is an integrated whole.

sound

Intelligibility

The possibility to distinguish the words in spoken and sung text.

Location accuracy

The subjective impression that sound sources have well defined positions in the sound image.

MAIN IMPRESSION

A subjectively weighted average of the other parameters.

Noise

Unwanted sounds

Public noise

Disturbances caused by an audience

Reverberation

The subjective impression that the duration of natural or artificial indirect sounds is appropriate for the type of programme.

**SIDE AND REAR
SOUND QUALITY**

The side and rear sounds appear to have the correct and appropriate balance.

Sound build-up

The way in which sounds begin; a combination of the rate at which sounds increase over a very short period, the duration of that period and the changes in colour during that period

SOUND COLOUR

The accurate representation of the characteristics sound of the sources.

**Sound colour of
reverberation**

The subjective impression of the sound colour in the acoustics of the venue including any artificial reverberation

Sound image width.

The subjective impression of the appropriate width of the sound stage in the front sound field

Sound source definition.

The subjective impression that different instruments or voices sounding simultaneously can be identified and distinguished

SPATIAL IMPRESSION

The performance appears to take place in an appropriate space.

**Surround decoding
artefacts**

Disturbances produced by a decoding system used to derive artificial surround signals.

Timbre

The quality of a sound that distinguishes it from other sounds of the same pitch and volume. The distinctive tone of an instrument or singing voice.

Time definition.

The subjective impression that individual short sounds in rapid succession can be identified and differentiated

TRANSPARENCY

The details of the performance can be clearly perceived.

Appendix D Evaluation form for assessment of the quality of sound programme material

This Appendix shows an example of a suitable form to be used during listening sessions.

Assessment methods for the subjective evaluation of the quality of sound programme material
 Supplement 1

- Multichannel

Name:		Group:		Seat:		Date:			
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		Bad	Poor	Fair	Good	Very good	Excel-lent
Comments	Parameter	1	2	3	4	5	6
	Front image quality						
	Side and rear sound quality						
	Spatial impression						
	Transparency						
	Balance						
	Sound colour						
	Freedom from noise and distortions						
	Main Impression						

Appendix E Information to be supplied about the recordings used

This Appendix shows an example of a form to be used to identify the recordings used in the evaluation.

All recordings should be accompanied by the essential metadata necessary to reproduce the recording.

Examples of essential Metadata are given below:

Essential metadata for multichannel sound material

1. Recording Format

1.1 Analogue

- track configuration
- track allocation
- magnetic reference level
- peak programme level relative to the reference level
- noise reduction scheme

1.2 Digital

- sampling frequency
- digital sample word length
- track allocation
- peak operating level
- pre-emphasis

2 History

2.1 Original production format:

- AAA, AAD, ADD, DDD

2.2. Quantization history

- word length of original recording
- truncated, rounded
- TPD,RPD no dither
- use of noise shaping

2.3. Digital coding history

- encoding paradigm used (i.e. MPEG, AC, other)
- type (i.e. MPEG-BC, MPEG-NBC, Matrix compatible)
- Bitrate

2.4. Analogue coding history

- matrix encoding type

Example of a form to be used to production information on recordings for evaluation

ID: Time-code: Duration:

Genre:
Symphonic Chamber Opera Other

Work:
Composer:

Title:

Recording Conditions:
Studio Live Other

Production Techniques:
Microphone technique:

Mixdown:

Post production:

Reproduction format:
3/2 3/1 2/2 other: LFE channel:

Coding format:
Uncoded MPEG-2 II AC-3 Dolby Surround Other

Accompanying picture: No Yes Details

Originator:
Organisation: Archive no.:

REMARKS:

Essential metadata necessary to reproduce the recording should be supplied with the recording.

Appendix F Time schedule for EBU international evaluation meetings

No additional or altered requirements

Appendix G Training session for EBU international evaluations

No additional or altered requirements

Appendix H EBU demonstration recording

The EBU intends to produce a demonstration recording for multichannel sound. This is not available at the moment.

Appendix I Presentation of results

This Appendix shows the two recommended form of presentation, A and B, of the results of an evaluation.

Form A: Final report listing scores for main parameters

Form B: Graphical Presentation of median values of main values

The forms will normally be printed from the spreadsheet described in Appendix L

Listening evaluation - Final report form (A)		
Date 2 October 1996	Place EBU, Geneva	Number of listeners 21
Result of subjective evaluation of Item no: 1		
Title Euroradio theme		
Organization: European Broadcasting Union		
Comments	Distribution of votes	
	Bad Poor Fair Good Very good Excel lent	
Front images quality <i>Good, very stable image.</i>		
Side & rear sound quality <i>Good, but some coughing too close</i>		
Spatial impression <i>Good, but impression of too large a room</i>		
Transparency <i>Good, but strings and woodwind unclear and covered.</i>		
Balance <i>Good, but sometimes instruments covered by rest of orchestra. Balance sometimes variable.</i>		
Sound colour <i>Good. Some instruments too bright.</i>		
Freedom from noise and distortion <i>Good, but too much audience noise.</i>		
Main impression <i>Good. A little heavy.</i>		
	1 2 3 4 5 6	

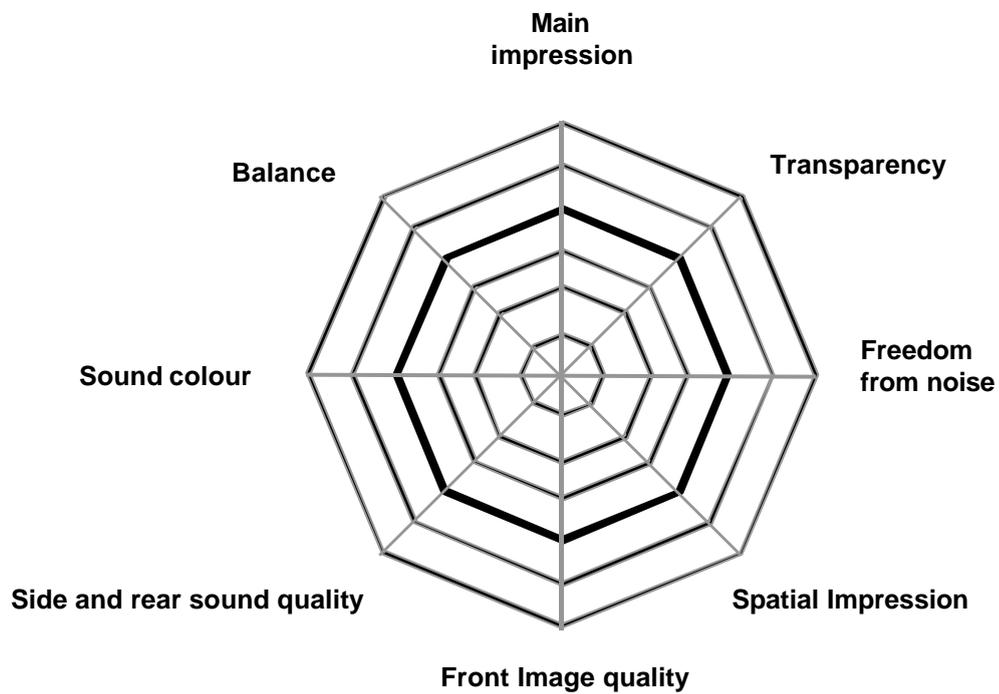
Listening Evaluation Final Report

(B)

Median values of main parameters

Item no: 1

Title: *Euroradio theme*



Appendix J EBU international evaluation sessions: Technical and organisational requirements

In addition to the requirements given in EBU Tech. 3286 [4], the *host organisation* is responsible for providing:

- a listening room conforming to the listening conditions and measurements set out in EBU Tech. 3276 and its Supplement 1.[2][3];
- a control room equipped with replay facilities with the agreed format; preferably according to EBU Recommendations R 91[7] and R96[10].

Appendix K Explanation of the statistical analysis

No additional or altered requirements

Appendix L Analysis of listening test scores

Description of the Excel Spreadsheet application

(Application developed by Mr. Gerhard Spikowski, Institut für Rundfunktechnik.)

The description and guide to the spreadsheet application will be supplied with the application
Contact EBU Technical Department

Bibliography

- [1] EBU Technical Recommendation R22 (1999): **Listening conditions for the assessment of sound programme material**
- [2] EBU document Tech. 3276 (Second edition - 1997): **Listening conditions for the assessment of sound programme material: monophonic and two-channel stereophonic**
- [3] EBU document Tech. 3276 Supplement 1 (1999): Listening conditions for the assessment of sound programme material: multichannel sound.
- [4] EBU document Tech. 3286 (1997): **Assessment methods for subjective evaluation of the quality of sound programme material - Music**
- [5] ITU-R Recommendation BS.775-1 (1997): **Multichannel stereophonic sound system with and without accompanying picture**
- [6] ISO Standard 389 (1985): **Acoustics - Standard reference zero for the calibration of pure air tone conduction audiometers**
- [7] EBU Technical Recommendation R 91 (1998): **Track allocations and recording levels for the exchange of multichannel audio signals**
- [8] EBU document Tech. 3287 (1998): **Parameters for the subjective Evaluation of the Quality of Sound programme material- Music (PEQS). (CD)**
- [9] EBU document Tech. 32xx (2000): Demonstration Recording of multichannel audio material (to be produced)
- [10] EBU Technical Recommendation R 96 (1999): **Formats for production and delivery of multichannel audio programmes**

See also

- ITU-R Recommendation BS.1116-1 (1998): **Methods for the subjective assessment of small impairments in audio systems including multichannel sound systems**
- ITU-R Recommendation BS.1284 (1997): **Methods for subjective assessment of sound quality – General requirements**
- ITU-R Recommendation BS.1286 (1997): **Methods for the subjective assessment of audio systems with accompanying picture**
- EBU Document BPN 021 (1999): **Multichannel audio: Report on different reproduction and delivery formats available on the market**
- EBU Technical Recommendation R68-1995: **Alignment level in digital audio production equipment and in digital audio recorders**
- EBU document Tech. 3282 (1995): **Digital audio alignment levels. Handbook for the EBU R-DAT Levels tape**