

TECHNICAL REPORT

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2005-05

**Household high-fidelity audio
equipment and systems–
Methods of measuring and specifying
the performance –**

Part 6:
**Listening tests on loudspeakers –
Single stimulus ratings and
paired comparisons**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HOUSEHOLD HIGH-FIDELITY AUDIO EQUIPMENT AND SYSTEMS –
METHODS OF MEASURING AND SPECIFYING THE PERFORMANCE –****Part 6: Listening tests on loudspeakers –
Single stimulus ratings and paired comparisons**

FOREWORD

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IEC 61305-6, which is a technical report, has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
100/855/DTR	100/905/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

This technical report gives recommendations for establishing, conducting and evaluating listening tests.

The tests described in this report are to be performed in a room, the size and acoustical properties are similar to those of an average living room. Specific recommendations about the room size, acoustical properties, arrangement of loudspeakers and listeners, and environmental conditions are given.

This technical report describes experimental procedures, including recommendations on the choice of programme material and the processing and presentation of the final data. It may be useful to consider some of the recommendations in AES 20. It should be understood that the topics of experimental design, execution and statistical analysis are complex, and that only the most general guidelines can be given. It is recommended that professionals with expertise of experimental design and statistics should be consulted.

The use of multichannel formats, principally for domestic presentation of surround audio and cinema is becoming more usual. The procedures described in this report are applicable to any number of channels.

If the number of loudspeakers to be tested is high, the paired comparison listening test is lengthy because each loudspeaker has to be compared with the other. A shorter method is the single stimulus rating. With this method, each object is judged once. The rating is almost independent of the loudspeaker range in test. Each object is rated absolutely, whereas a paired comparison provides a relative ranking of the order of the loudspeakers in test.

Another technical report for listening test has been published as IEC 60268-13 and it is expected that the two technical reports should be combined in the maintenance work

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HOUSEHOLD HIGH-FIDELITY AUDIO EQUIPMENT AND SYSTEMS – METHODS OF MEASURING AND SPECIFYING THE PERFORMANCE –

Part 6: Listening tests on loudspeakers – Single stimulus ratings and paired comparisons

1 Scope

This technical report applies to loudspeakers conforming to IEC 61305-5 and intended for home use.

The purpose of this report is, in addition to objective testing according to IEC 60268-5, to establish standards for comparison of the sound characteristics of various loudspeakers with each other.

Two test procedures are described:

- single stimulus ratings;
- paired comparisons.

The procedures described in this report are applicable to any number of channels.

NOTE The test procedures are specified for stereo systems. They can be applied to multichannel systems accordingly.

2 Normative references

[IEC TR 61305-6:2005](https://standards.iteh.ai/catalog/standards/sist/1fa8b2f6-3000-43a4-9be0-f59a56015802/iec-tr-61305-6-2005)

<https://standards.iteh.ai/catalog/standards/sist/1fa8b2f6-3000-43a4-9be0-f59a56015802/iec-tr-61305-6-2005>

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61305-5, *High fidelity audio equipment and systems; Minimum performance requirements – Part 5: Loudspeakers.*

IEC 60268-5, *Sound system equipment – Part 5: Loudspeakers.*

ISO 3382, *Acoustics – Measurement of the reverberation time of rooms with reference to other acoustical parameters.*

3 Test preparation

3.1 Characteristics of the listening room

The volume of the listening room shall be $80 \text{ m}^3 \pm 20 \text{ m}^3$ with a room height of $2,75 \text{ m} \pm 0,25 \text{ m}$. The room should have a rectangular floor plan, whereby the ratio of the sides to each other should not exceed 2:1. A square floor plan is not permitted.

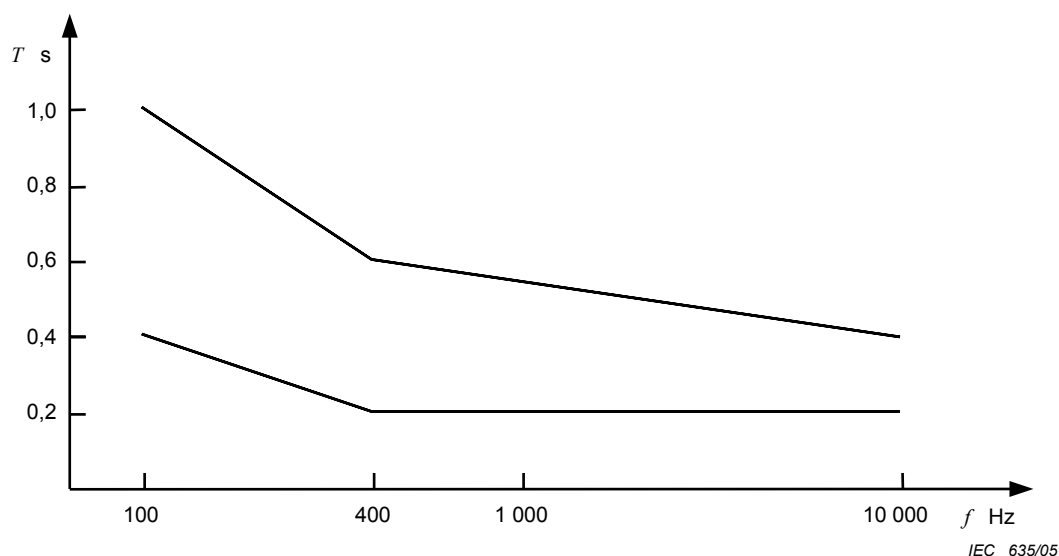


Figure 1 – Range limits for the reverberation time

The reverberation time of the room shall be within the range limits shown in Figure 1. The reverberation time shall not change by more than +25 % or –20 % within one octave in the range from 400 Hz to 8 kHz. The reverberation time is to be measured with noise in 1/3 - octave intervals with listeners present as laid down in ISO 3382. Conversion of the reverberation time measured without listeners to one with listeners is permitted.

Relevant room resonance resulting from furnishings shall be avoided. The distribution of the absorbing material should be as uniform as possible for all frequencies. In particular, parallel walls shall not be allowed to reflect sound to a significantly higher degree than the other walls. This also applies to the floor and the ceiling of the listening room. The AF-rated mean level of noise in the testing room may not exceed a value of $L_{AFm} = 25$ dB.

3.2 Loudspeaker position and seat arrangement

The loudspeaker shall be hidden behind an acoustically transparent screen to avoid influencing the listener by its design.

The loudspeakers shall be located and listened to in the positions in which they are used normally (as recommended of the manufacturer). This means, for example, loudspeakers designed for placement in shelves shall be placed in shelves or in an acoustically equivalent position. The distances from the floor and the ceiling shall correspond to usual positioning. Unless otherwise specified, the distance from the walls shall be at least 0,5 m.

The loudspeakers shall be tested in the stereo mode. The angle between the imaginary lines joining the loudspeakers and the listener should be not less than 45° for each listener. The loudspeakers shall be positioned so that the stereo base is constant in each case. Only the two sets of stereo loudspeaker (paired comparison) or the set of stereo loudspeakers to be tested (single stimulus rating) may be arranged to prevent feedback from other loudspeakers. When the paired comparison procedure is used, the centre and height of the line between the loudspeakers of each set shall not vary more than is necessary.

If several listeners participate simultaneously in one test, the seats should be arranged so that all listeners can see the loudspeakers directly when the screen is taken away.

3.3 Electrical requirements

The loudspeakers shall be fed by equipment with characteristics that do not affect the test results. The system shall consist of a source, level adjustment, and a power amplifier with a low output impedance and sufficient power (that is, clipping may not occur even at the highest signal levels). The tone control is to be set to a flat position both on the equipment as well as on the loudspeakers. Other settings shall be indicated.

Deviations in the flat frequency response shall be less than 0,5 dB in the range from 20 Hz to 20 kHz as measured at the input of the system and at the output of the power amplifier.

3.4 Level setting

The loudspeakers shall be set to provide the same level of volume as measured at an average listener's position with a test signal similar to a programme. It has been proven good practice to feed pink noise to the loudspeakers and set the A-weighted sound level to 75 dB.

NOTE The problem of setting up different loudspeakers by measurement so that reproduction of speech and music is equal in volume for all loudspeakers cannot be solved completely if the loudspeakers have different frequency responses. It is only possible to find a practical compromise using such a test signal.

3.5 Listening levels for programmes

The listening levels shall be adjusted so that the loudness is the same, as far as possible, as the loudness at an average listening position in the original room where the performance was held.

3.6 Programme material

The programme material should include [IEC TR 61305-6:2005](https://standards.iteh.ai/catalog/standards/sist/1fa8b2f6-3000-43a4-9be0-f59a56015802/iec-tr-61305-6-2005)

- a) speech;
- b) chamber music;
- c) orchestra music (tutti passages of a large orchestra);
- d) solo voice and instrumental accompaniment;
- e) entertainment music without significant electro acoustical tampering.

The duration of each unit should be between 60 s and 120 s. The sections should correspond to musical phrases. The programme material used shall be listed in detail.

3.7 Qualification and number of listeners

The hearing loss of the listeners shall be less than 20 dB in the frequency range of 125 Hz to 8 kHz [1]. Moreover, they should have some form of training or be interested in music, shall visit concerts regularly and listen to recorded music. The number of listeners shall be not less than 10.

3.8 Test duration

The duration of one test session should not exceed 1,5 h, whereby a suitable break should be made after about 0,75 h. The total test duration should not exceed 3 h per day and per listener.

4 Single stimulus ratings

4.1 Test procedure

The purpose of a listening test is to obtain an evaluation of the overall quality of the loudspeakers. This overall judgement is formed by the various sound characteristics of a loudspeaker. According to studies made by Gabrielson *et al.* [2], three independent characteristics (evaluation aspects) can be found, which can be designated as follows:

- volume;
- definition;
- transparency.

An overall judgement is obtained by combining the evaluations. Since these characteristics can be judged by comparing with an optimum sound obtained from a comparable original performance, these loudspeakers can be judged with a single stimulus rating. The result of the listening test not only provides a relative rating of individual loudspeakers within a set of loudspeakers but an absolute rating, as well.

Since any loudspeaker has to be tested only once for each sample of music, the single stimulus test is essentially a shorter test, especially for a large number of loudspeakers, compared to paired comparison which requires each loudspeaker to be compared with the other. The repeated judgement of loudspeakers required to check the rating reliability of the listeners increases the time insignificantly.

4.2 Questionnaire

In order to obtain ratings for the three evaluation aspects volume, definition and transparency, it is recommended to use a questionnaire listing pairs of terms with opposite meanings. Since the terms do not describe the sensations felt by every test person in exactly the same way it is recommended that several terms are used for each aspect of evaluation. The following questionnaire has proved to be useful in several studies:

Table 1 – Questionnaire for single stimulus rating

		1	2	3	4	5	6	
1	light	---	--	-	-	--	---	dark
2	distinct	---	--	-	-	--	---	indistinct
3	natural	---	--	-	-	--	---	unnatural
4	diffuse	---	--	-	-	--	---	concentrated
5	emphasized bass	---	--	-	-	--	---	poor bass
6	brilliant	---	--	-	-	--	---	faint
7	unpleasant	---	--	-	-	--	---	pleasant
8	round	---	--	-	-	--	---	sharp
9	narrow	---	--	-	-	--	---	wide
10	slim	---	--	-	-	--	---	voluminous
11	subdued	---	--	-	-	--	---	powerful
12	unbalanced	---	--	-	-	--	---	balanced
13	shrill	---	--	-	-	--	---	hollow
14	soft	---	--	-	-	--	---	hard
15	not transparent	---	--	-	-	--	---	transparent
16	dry	---	--	-	-	--	---	echoic
17	rough	---	--	-	-	--	---	clear
18	coloured	---	--	-	-	--	---	uncoloured
19	sharp	---	--	-	-	--	---	dull

Name:

Date:

Example No.: