

RECOMMENDATION 644-1*

**AUDIO QUALITY PARAMETERS FOR THE PERFORMANCE OF A
HIGH-QUALITY SOUND-PROGRAMME TRANSMISSION CHAIN**

(1986-1990)

The CCIR,

CONSIDERING

- (a) that the performance characteristics of international sound-programme circuits used for programme exchange are based on a hypothetical reference circuit (HRC) defined in Recommendation 502;
- (b) that the performance of a realistic international sound-programme circuit shorter or longer than the HRC can be derived by calculation according to rules given in Recommendation 605;
- (c) that the performance of the sound-programme transmission chain from the broadcasting house to the output of the receiver should therefore be based on a reference chain;
- (d) that sound-programme signals intended for international exchange are conveyed from the broadcasting house to the international sound-programme centre (ISPC) on national circuits which are either the same as, or similar to, the national circuits which form part of the sound-programme transmission chain;
- (e) that the performance of the sound-programme transmission chain should be described by a number of parameters;
- (f) that for reasons of comparison, clearly defined parameters measured using test signals, should be used;
- (g) that these parameters and their target values should be based on the perceptibility of the impairments by the human ear,

UNANIMOUSLY RECOMMENDS

1. that the performance characteristics of a high-quality sound-programme transmission chain should be based on the reference chain described in Annex I;
2. that the performance of the reference transmission chain from the output of the broadcasting house to the output of the receiver should be described by the parameters listed in Annex II;
3. that the limits given in Annex III be used as realistic target values for these parameters;
4. that for the purposes of planning the entire broadcasting chain from the microphone output to the receiver output, the subjective threshold values for quality parameters given in Annex IV should be taken for guidance.

ANNEX I

REFERENCE SOUND-PROGRAMME TRANSMISSION CHAIN

The reference sound-programme transmission chain is represented, for the purpose of this Recommendation, by Fig. 1 in which A, B, and C are 0 dBrs audio signal interface points, permitting performance comparison:

- A : interface between the programme source (broadcasting house) and the sound-programme circuit system;
- A-B : sound-programme circuit system comprising a single cable, radio, communication satellite or optical-fibre section;
- B : interface between the sound-programme circuit and emission-reception systems;
- B-C : emission-reception system, comprising a single broadcasting emitter or a single cable network and a high-quality monitoring receiver under optimum conditions;
- C : audio signal interface at the output of the receiver.

* This Recommendation, derived from Report 293 which has been cancelled, should be brought to the attention of the CMTT.

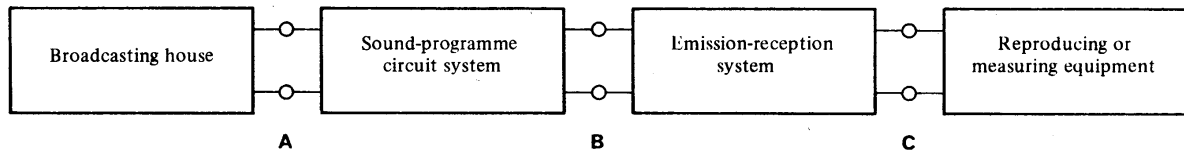


FIGURE 1 – Reference sound-programme transmission chain

D01-sc

The EBU [CCIR, 1986-90] has published Recommendation R.50 to define the polarity of acoustic signals, electrical audio signals, audio signals at connectors, magnetic signals on audio and video tapes, digital audio signals and acoustic pressure signals for loudspeakers.

REFERENCES

CCIR Documents

[1986-90]: 10/313 (EBU).

ANNEX II

LIST OF AUDIO QUALITY PARAMETERS

The audio quality parameters listed below are those which are considered to be the most important in the analogue environment. Some parameters are also appropriate for connections incorporating digital systems, but some further parameters need to be specified for testing these digital systems.*

All test signals should be at the measurement level (see Recommendation 645) unless otherwise stated. For stereo, measurements should be made in both A and B channels.

1. Nominal bandwidth

The effective transmitted frequency band (for both A and B channels, in the case of stereo).

2. Amplitude/frequency response

The response should be expressed relative to the level at the reference frequency of 1 kHz.

3. Group-delay variation

The results of measurements throughout the nominal bandwidth should be expressed relative to the minimum group delay.

4. Non-linear distortion**

Total harmonic distortion (THD) may be measured using a single-tone test signal at +9 dBu0s, at frequencies in the range from 40 Hz to 1 kHz, and the result expressed as a “separation” value (i.e. the difference in level between the test signal and the harmonics, expressed in dB).

* Administrations are requested to study quality parameters and testing methods for digital systems, and contribute to the work of the CCIR under Study Programme 51B/10. Report 1070 is also relevant.

** Administrations are requested to consider these and other suitable distortion measurement methods, and contribute their conclusions to the CCIR under Study Programme 50E/10.

Distortion may, alternatively, be measured using the total difference frequency (TDFD) method [Thiele, 1975]. This is an intermodulation test in which the test signal comprises two tones at frequencies chosen so that second-order and third-order intermodulation products (i.e. one of each) occur close in frequency, and may be measured together by a meter with a selective filter. Tests in the UK [CCIR, 1986-90a] have shown that the TDFD method is less sensitive to noise than THD, and is not restricted to the use of test signals at frequencies below 5 kHz. This could be important when testing pre-emphasised connections, although care must be taken to avoid the possibility of overloading resulting from the pre-emphasis.

The TDFD method is described in Annex V.

The duration for which the test signals are transmitted should be restricted in accordance with the appropriate CCITT Recommendations of the N series.

5. Error in reconstituted frequency

The error in reconstituted frequency should not exceed the values in Annex III, for individual channels.

For stereo, any differential frequency shift between A and B channels is unacceptable.

A sensitive measuring method is described in [Thiele and Bonner, 1985].

6. Error in amplitude/amplitude response

A 1 kHz tone is applied to the input of the transmission chain at +9 dBu0s and at -31 dBu0s alternatively. The output levels should be measured selectively, and the difference should be within the limits specified in Annex III.

The duration for which the test signal is transmitted should be restricted in accordance with the appropriate CCITT Recommendations of N series.

7. Level stability

The difference in the level of a constant reference signal, at the measurement level, applied to the input of the transmission chain, from its nominal level should be determined for a 24 h period. This difference may vary over the 24 h period, and include a fixed adjustment error.

For stereo, the level stability should be determined concurrently for both A and B channels.

8. Noise (and single-tone interference)

Weighted noise voltage level (and, where appropriate, single-tone interference voltage level) is measured in accordance with Recommendation 468. The permitted maximum signal-to-(weighted) noise ratio (PMS/N, expressed in dB) is determined as the difference between the permitted maximum signal (PMS) and the weighted noise levels.

- Idle-channel noise.
- Programme-modulated noise, measured with a 60 Hz sinusoidal test signal applied to the input of the transmission chain at +9 dBu0s and -31 dBu0s. The fundamental and low-order harmonics are suppressed at the input to the measuring instrument by a high-pass filter with a cut-off frequency between 200 Hz and 400 Hz. The insertion loss of the filter should be at least 56 dB at 60 Hz, taking into account the attenuation of the weighting filter (24 dB at this frequency).

The duration for which the test signal is transmitted should be restricted in accordance with the CCITT Recommendations of the N series.

- If necessary, steady single-tone interference should be measured selectively at the frequencies at which tones are detected or may be expected. The measurement should be made using a bandpass filter (having effectively 0 dB insertion loss in the passband) in conjunction with the noise measuring apparatus described in Recommendation 468, or using a spectrum analyzer and correcting the measured level by the corresponding weighting factor.

9. Disturbing modulation by power supply

This is the ratio of a 1 kHz sinusoidal test signal to the highest level unwanted side-component resulting from modulation of that test signal caused by interference from conventional a.c. (50/60 Hz) line power supply sources.

10. Stereo: level difference between A and B channels

The difference in level between the A and B outputs of the transmission chain should be measured with the same sinusoidal test signal applied to both channel inputs simultaneously.

11. Stereo: phase difference between A and B channels

The difference in phase between the A and B outputs of the transmission chain should be measured with the same sinusoidal test signal applied to both channel inputs simultaneously.

Conservation of the polarity [CCIR, 1986-90b] of audio signals is recommended.

12. Stereo: crosstalk between A and B channels– *Linear cross-talk*

A sinusoidal test signal is applied to each channel in turn, and the level of the signal in the other channel is measured selectively. The cross-talk attenuation (expressed in dB) is the difference between the levels of the signal in the two channels.

– *Non-linear cross-talk*

The conventional test signal for simulating sound-programme signals specified in Recommendation 571 is applied to each channel in turn. If the other channel is influenced by non-linear cross-talk, an increase in the weighted noise level may be observed.

The increased noise voltage N_s formed by the sum of two noise contributions: the idle-channel noise N_0 and the non-linear cross-talk noise N_{cT} . The latter voltage can be calculated using the following formula:

$$N_{cT} = \sqrt{(N_s)^2 - (N_0)^2}$$

The non-linear cross-talk is expressed as the ratio of the permitted maximum signal to this level of non-linear cross-talk noise (i.e. PMS/N_{cT}).

REFERENCES

- THIELE, A. N. [September, 1975] Measurement of non-linear distortion in a band-limited system. IREECON International Convention Digest, 480-482, Sydney, Australia.
- THIELE, A. N. and BONNER, D. J. [September-October, 1985] Measuring reconstituted frequency error in f.d.m. sound-programme circuits. IREECON International Convention Digest, 684-686, Melbourne, Australia.

CCIR Documents

[1982-86]: **a.** 10/213 (Sweden); **b.** 10/224 (France).

[1986-90]: **a.** 10/236 (United Kingdom); **b.** 10/313 (EBU).