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TRANSMISSION STANDARDS

SPECIFICATION FOR AN INTERMEDIATE REFERENCE SYSTEM

ITU-T Recommendation P.48

(Extract from the *Blue Book*)

NOTES

1   ITU-T Recommendation P.48 was published in Volume V of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2   In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation P.48

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SPECIFICATION FOR AN INTERMEDIATE REFERENCE SYSTEM

(Geneva, 1976; amended at Geneva, 1980,
Malaga-Torremolinos, 1984, Melbourne, 1988)

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Summary

This Recommendation intends to specify the intermediate reference system (IRS) to be used for defining loudness ratings. The description should be sufficient to enable equipment having the required characteristics to be reproduced in different laboratories and maintained to standardized performance.

1   Design objectives

The chief requirements to be satisfied for an intermediate reference system to be used for tests carried out on handset telephones[1] are as follows:

a)   the circuit must be stable and specifiable in its electrical and electro-acoustic performance. The calibration of the equipment should be traceable to national standards;

b)   the circuit components that are seen and touched by the subjects should be similar in appearance and "feel" to normal types of subscribers' equipment;

c)   the sending and receiving parts should have frequency bandwidths and response shapes standardized to represent commercial telephone circuits;

d)   the system should include a junction which should provide facilities for the insertion of loss, and other circuit elements such as filters or equalizers;

e)   the system should be capable of being set up and maintained with relatively simple test equipment.

Note – The requirements of a) to d) have been met in the initial design of the IRS by basing the sending and receiving frequency responses on the mean characteristics of a large number of commercial telephone circuits and confining the bandwidths to the nominal range 300-3400 Hz.

Since the detailed design of an IRS may vary between different Administrations, the following specification defines only those essential characteristics required to ensure standardization of the performance of the IRS.

The principles of the IRS are described and its nominal sensitivities are given in §§ 2, 3, 4 and 5 below; requirements concerning stability, tolerances, noise limits, crosstalk and distortion are dealt with in §§ 6 to 9 below. Some information concerning secondary characteristics is given in § 10 below.

Certain information concerning installation and maintenance are given in [1].

2   Use of the IRS

The basic elements of the IRS comprise:

a)   the sending part,

b)   the receiving part,

c)   the junction.

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[1]   For other types of telephone, e.g. headset or loudspeaking telephone, a different IRS will be required. The IRS is specified for the range 100-5000 Hz. The nominal range 300-3400 Hz specified is intended to be consistent with the nominal 4 kHz spacing of FDM systems, and should not be interpreted as restricting improvements in transmission quality which might be obtained by extending the transmitted frequency bandwidth.

When one example each of a), b) and c) are assembled, calibrated and interconnected, a reference (unidirectional) speech path is formed, as shown in Figure 1/P.48. For performing loudness rating determinations, suitable switching facilities are also required to allow the reference sending and receiving parts to be interchanged with their commercial counterparts.
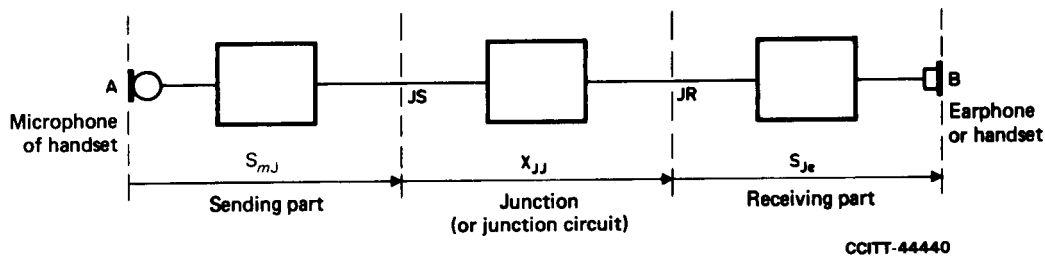

FIGURE 1/P.48

Composition of the complete intermediate reference system

3   Physical characteristics of handsets

The sending and receiving parts of an IRS shall each include a handset symmetrical about its longitudinal place and the profile produced by a section through this plane should, for the sake of standardization, conform to the dimensions indicated in Figure 1/P.35. In practice, any convenient form may be considered use being made, for example, of handsets of the same type as those used by an Administration in its own network. The general shape of the complete handset shall be such that, in normal use, the position of the earcap on the ear shall be as definite as possible, and not subject to excessive variation.

The microphone capsule, when placed in the handset, shall be capable of calibration in accordance with the method described in Recommendation P.64. The earcap shall be such that it can be sealed on the circular knife-edge of the IEC/CCITT artificial ear for calibration in accordance with IEC 318, and the contour of the earcap shall be suitable for defining the ear reference point as described in Annex A to Recommendation P.64.

Transducers shall be stable and linear, and their physical design shall be such that they can be fitted in the handset chosen. A handset shall always contain both microphone and earphone capsules, irrespective of whether either is inactive during tests. The weight of a handset, so equipped, shall not exceed 350 g.

4   Subdivision of the complete IRS and impedances at the interfaces

Figure 1/P.48 shows the composition of the complete IRS, subdivided as specified in § 2 above. The principal features of the separate parts are considered below.

4.1   *Sending part*

The sending part of the IRS is defined as the portion A-JS extending from the handset microphone A to the interface with the junction at JS. The sending part shall include such amplification and equalization as necessary to ensure that the requirements of §§ 5.1 and 7 below are satisfied.

The return loss of the impedance at JS, towards A, against $600 \, \underline{/0°}$ ohms, when the sending part is correctly set up and calibrated, shall be not less than 20 dB over a frequency range 200-4000 Hz, and not less than 15 dB over a frequency range 125-6300 Hz.

4.2   *Receiving part*

The receiving part of the IRS is defined as the portion JR-B extending from the interface with the junction at JR to the handset earphone at B. The receiving part shall include such amplification and equalization as necessary to ensure that the requirements of §§ 5.2 and 7 below are satisfied.

The return loss of the impedance at JR, towards B, against $600 \, \underline{/0°}$ ohms, when the receiving part is correctly set up and calibrated, shall be not less than 20 dB over a frequency range 200-4000 Hz, and not less than 15 dB over a frequency range 125-6300 Hz.

4.3   *Junction*

For loudness balance and sidetone tests, the junction of the IRS shall comprise means of introducing known values of attenuation between the sending and receiving parts, and shall consist of a calibrated 600 ohm attenuator having a maximum value of not less than 100 dB

(e.g. 10×10 dB + 10×1 dB + 10×0.1 dB)

and having a tolerance, when permanently fitted and wired in position in the equipment, of not more than $\pm$ 1% of the dial reading or 0.1 dB, whichever is numerically greater. Provision shall be made for the inclusion of additional circuit elements (e.g. attenuation/frequency distortion) in the junction. The circuit configuration of such additional elements shall be compatible both with that of the attenuator and the junction interfaces. The return loss of the junction against 600 $\underline{/\,0°}$ ohms, both with and without any additional circuit elements, shall be not less than 20 dB over a frequency range 200-4000 Hz, and not less than 15 dB over a frequency range 125-6300 Hz. For these tests, the port other than that being measured shall be closed with 600 $\underline{/\,0°}$ ohms.

5   Nominal sensitivities of sending and receiving parts

The absolute values given below are provisional and may require changes to some extent as a result of the study of Question 19/XII [2].

5.1   *Sending part*

The sending sensitivity, S_{mJ} is given in Table 1/P.48, column (2) (see [3]).

5.2   *Receiving part*

The receiving sensitivity, S_{Je}, on a CCITT/IEC measured artificial ear (see Recommendation P.64) is given in Table 1/P.48, column (3) (see [3]).

TABLE 1/P.48

Nominal sending sensitivities and receiving sensitivities of the IRS

(These values were adopted provisionally)

Frequency (Hz)	S_{mJ}	S_{Je}
	dB V/Pa	dB Pa/V
(1)	(2)	(3)
100	–45.8	–27.5
125	–36.1	–18.8
160	–25.6	–10.8
200	–19.2	–2.7
250	–14.3	2.7
300	–11.3	6.4
315	–10.8	7.2
400	–8.4	9.9
500	–6.9	11.3
600	–6.3	11.8
630	–6.1	11.9
800	–4.9	12.3
1000	–3.7	12.6
1250	–2.3	12.5
1600	–0.6	13.0
2000	0.3	13.1
2500	1.8	13.1
3000	1.5	12.5
3150	1.8	12.6
3500	–7.3	3.9
4000	–37.2	–31.6
5000	–52.2	–54.9
6300	–73.6	–67.5
8000	–90.0	–90.0

6 Stability

The stability should be maintained, under reasonable ranges of ambient temperature and humidity, at least during the period between routine recalibrations. (See also [1].)

7 Shapes and tolerances on sensitivities of sending and receiving parts

The shape of the sensitivity/frequency characteristics of the sending and receiving parts of the IRS shall lie within the limits of masks formed by Table 2/P.48 and plotted in Figures 2/P.48 and 3/P.48. The sending and receiving loudness ratings shall both be set to 0 ± 0.2 dB when calculated in accordance with the principles laid down in Recommendation P.79.

Note – One excursion above or one excursion below the limits is permitted provided that:

a) the excursion is no greater than 2 dB above the upper or below the lower limit;

b) the width of the excursion as it breaks the appropriate limit is no greater than 1/10th of the frequency at the maximum or minimum of the excursion.

TABLE 2/P.48

Coordinates of sending and receiving sensitivity limit curves

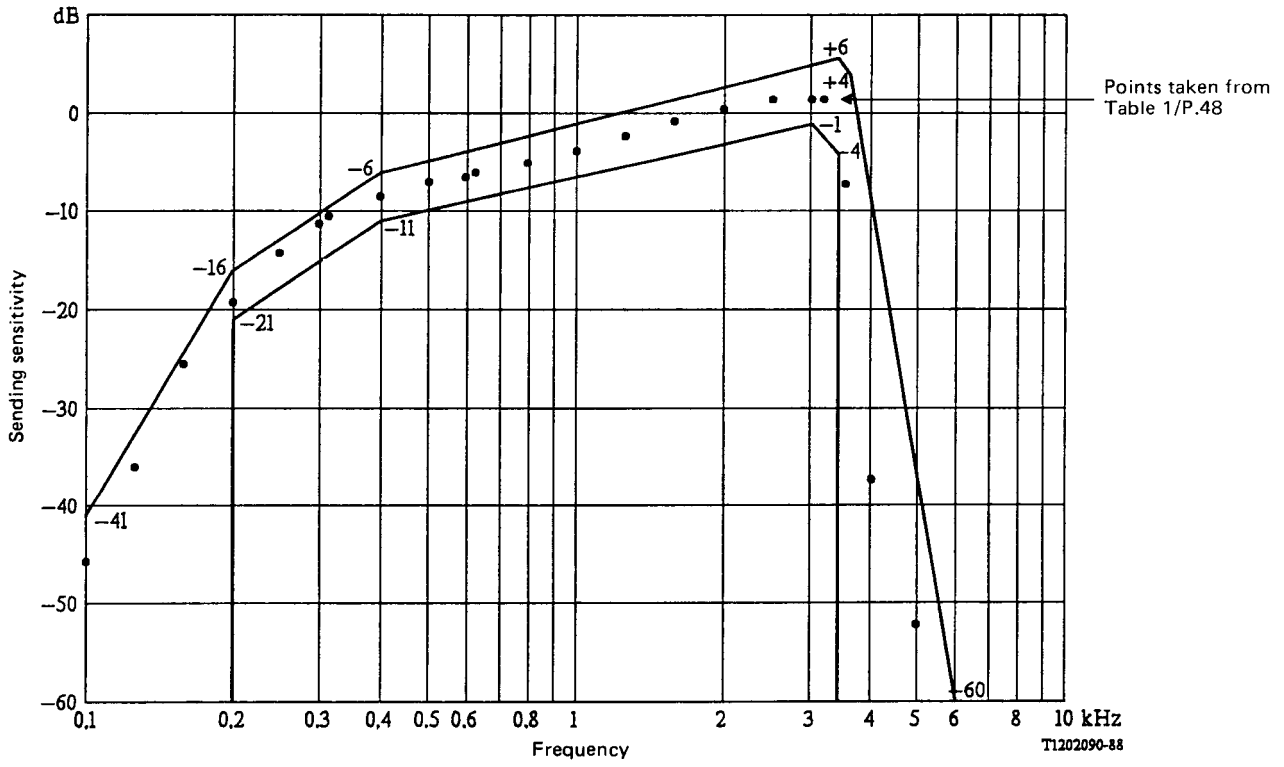| Limite curve	Frequency (Hz)	Sending sensitivity (dB with respect to an arbitrary level)	Frequency (Hz)	Receiving sensitivity (dB with respect to an arbitrary level)
Upper limit	100	−41	100	−24
	200	−16	200	0
			300	+9
	400	−6		
			500	+14
	3400	+6	3400	+16
	3600	+4	3600	+13
			4500	−40
	6000	−60		
Lower limit	Under 200	− ∞	Under 200	− ∞
	200	−21	200	−20
			300	+4
	400	−11		
			500	+9
	3000	−1		
			3200	+10
	3400	−4	3400	+4
	Over 3400	− ∞	Over 3400	− ∞

FIGURE 2/P.48

Suggested IRS sending mask

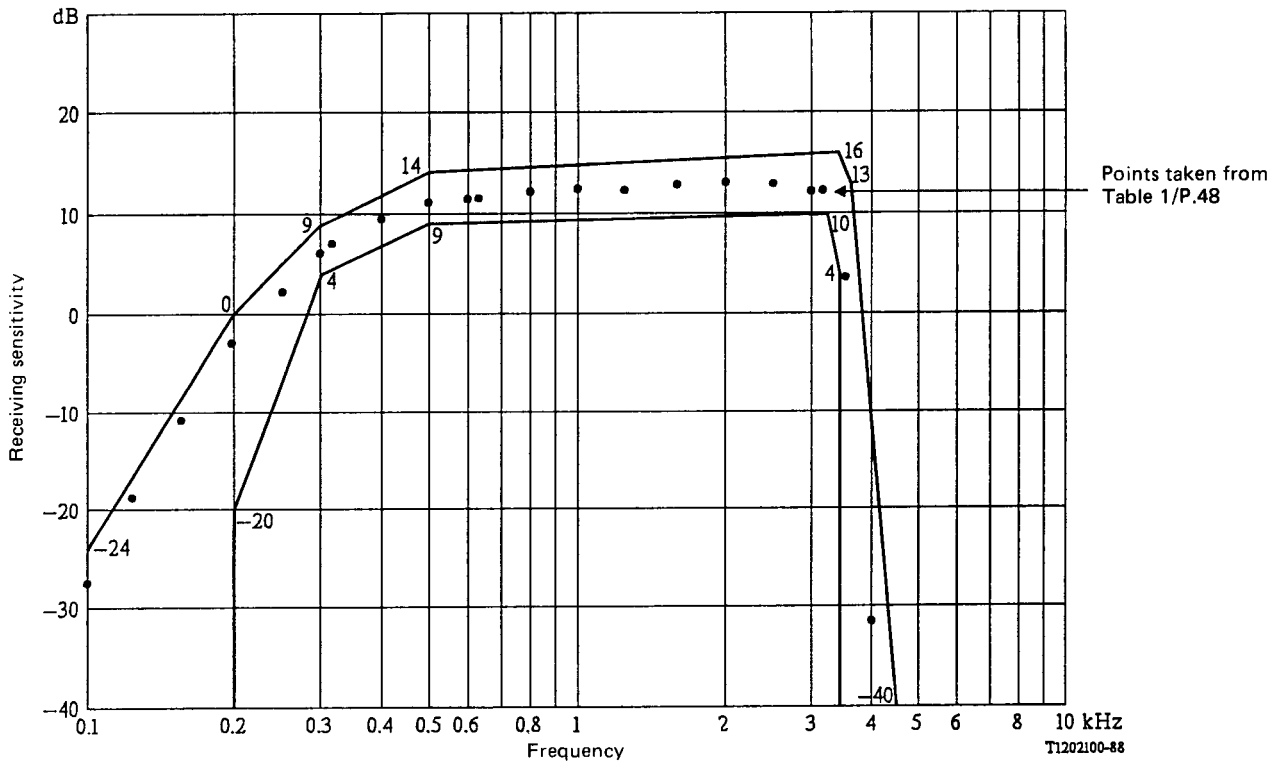FIGURE 3/P.48

Suggested IRS receiving mask

8   Noise limits

It is important that the noise level in the system be well controlled. See [4].

9   Nonlinear distortion

In order to ensure that nonlinear distortion will be negligible with the vocal levels normally used for loudness rating, requirements in respect of distortion shall be met.

10   Complete specifications

Certain secondary characteristics of an IRS may be included in Administrations' specifications. Particularly, special care must be given to adjustable components, stability and tolerances, crosstalk, installation and maintenance operations, etc. Reference [1] gives some guidance on these points.

References

[1]   *Precautions to be taken for correct installation and maintenance of an IRS*, Orange Book, Vol. V, Supplement No. 1, ITU, Geneva, 1977.

[2]   CCITT – Question 19/XII, Contribution COM XII-No. 1, Study Period 1985-1988, ITU, Geneva, 1985.

[3]   *Precautions to be taken for correct installation and maintenance of an IRS*, Orange Book, Vol. V, Supplement No. 1, § 9.2, ITU, Geneva, 1977.

[4]   *Ibid*., § 5.