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REGULATION

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**Public Switched Telephone Network (PSTN);
Attachment requirements for a terminal equipment incorporating
an analogue handset function capable of supporting
the justified case service when connected
to the analogue interface of the PSTN in Europe**

ETSI

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Foreword

This draft Technical Basis for Regulation (TBR) has been produced by the Analogue Terminals and Access (ATA) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for Public Enquiry.

Introduction

This TBR is written in response to an European Commission standardization mandate requesting a harmonized standard for analogue voice terminals.

The scope of this TBR was laid down by ACTE and the requirements are based on I-ETS 300 677 (Public Switched Telephone Network (PSTN); Requirements for handset telephony, and on I-ETS 300 480 (Public Switched Telephone Network (PSTN); Testing specification for analogue handset telephony.

This TBR specifies only the technical characteristics for handset telephony and shall be used in conjunction with an appropriate access standard.

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1 Scope

This Technical Basis for Regulation (TBR) specifies the technical characteristics (electrical and acoustic requirements) under Article 4(g) of Directive 91/263/EEC [1] to be provided by a single, handset telephony, terminal equipment which is intended:

- (a) for pan-European approval; and
- (b) for connection by 2 wires to an analogue interface of a PSTN. This interface is characterised by a d.c. loop to indicate seizure and clearing, low frequency a.c. ringing signals below the speech passband to indicate an incoming call and the transmission phase having an approximate bandwidth of 3 kHz at the network terminating point; and
- (c) for supporting the voice telephony justified case service.

The objective of this TBR is to ensure minimum speech quality when interworking via the public network between two single items of equipment.

This TBR only applies to terminal equipment supporting handset telephony.

This TBR is applicable to handset telephony function. In the case of multiple functions provided in the same terminal equipment, this TBR does not apply when those other functions are active in conjunction with handset telephony.

This TBR specifies the functions necessary to provide 2-way real-time speech conversation. Where a function is indicated as optional, it need not be provided, but, where such a function is provided, the terminal needs to conform to the requirements and test specified in this TBR.

A test is given for each requirement in this TBR including measurement methods. The terminal equipment may be stimulated to perform the tests by additional equipment if necessary.

The application of this TBR is not mandatory for:

- a) a handset telephony function with speech transmission performance specially designed for the disabled (e.g. with amplification of received speech as an aid for the hard of hearing);
- b) a handset telephony function employing a radio link (e.g. cordless telephones);
- c) a handset telephony function with speech transmission performance specifically designed to cater for hostile environments;
- d) any handsfree or loudspeaking voice telephony function;
- e) a handset telephony function employing non-linear or time variant techniques for the processing of the signal.

NOTE: The terminal equipment may provide additional functions or facilities to that of handset telephony.

2 Normative references

This TBR incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this TBR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] 91/263/EEC: "Council Directive on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity".

- [2] ITU-T Recommendation G.122 (03/93): "Influence of national systems on stability and talker echo in international connections".
- [3] I-ETS 300 677: "Public Switched Telephone Network (PSTN); Requirements for handset telephony".
- [4] I-ETS 300 480: "Public Switched Telephone Network (PSTN); Testing specification for analogue handset telephony".
- [5] ITU-T Recommendation P.64 (03/93): "Determination of sensitivity/frequency characteristics of local telephone systems".
- [6] ITU-T Recommendation P.51 (03/93): "Artificial mouth".
- [7] ITU-T Recommendation P.57 (03/93): "Artificial ears".
- [8] IEC 651: "Sound level meters".
- [9] ISO 3 (1973): "Preferred numbers - Series of preferred numbers".
- [10] ITU-T Recommendation P.79 (1993): "Calculation of loudness ratings for telephone sets".
- [11] ITU-T Recommendation O.41 (10/94): "Psophometer for use on telephone-type circuits".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of this TBR, the following definitions apply:

artificial ear: A device for the calibration of earphones incorporating an acoustic coupler and a calibrated microphone for the measurement of sound pressure and having an overall acoustic impedance similar to that of the average human ear over a given frequency band.

Echo Return Loss (ERL): Return loss averaged with 1/f power weighting over the telephone band (300 Hz - 3 400 Hz), in accordance with clause 4 of ITU-T Recommendation G.122 [2].

handset: A combination of telephone microphone and receiver in a form convenient for holding simultaneously to mouth and ear, which, when in use, retains the microphone in a position fixed in relation to the receiver.

handset telephony: A function provided by terminal equipment whereby two-way real-time speech is supported by means of a handset that forms an integral part of the terminal equipment. The term "live speech" is also frequently used to describe "real-time speech". For the purposes of this TBR, they should be considered as having the same meaning.

handsfree function: A function whereby telephony transmission and reception is facilitated by the use of microphone(s) and loudspeaker(s) placed at a distance from the user. No handset is required to be used and normally the handset is not active.

loop state: The state where the TE draws sufficient DC current to activate the exchange.

loop steady state: A loop state excluding the transitions from and to quiescent state.

loudness rating: A measure, expressed in decibels, for characterising the loudness performance of complete telephone connections or of parts thereof such as sending system, line, receiving system.

loudspeaking function: A function of a handset telephone using a loudspeaker associated with an amplifier as a telephone receiver.

Mouth Reference Point (MRP): A point 25 mm in front of and on the axis of the lip position of a typical human mouth (or artificial mouth).

nominal setting: A setting of the volume control where the RLR is as close as possible to -8 dB.

3.2 Symbols

For the purposes of this TBR, the following symbols apply:

| | |
|----------|--|
| Ω | Ohm |
| dB | decibel |
| dbPa | sound pressure level with respect to 1 Pa, expressed in decibels |
| dBPa(A) | "A" weighted sound pressure level with respect to 1 Pa, expressed in decibels |
| dBV | voltage level with respect to 1 V, expressed in decibels |
| dBVp | psophometrically weighted sound pressure level with respect to 1 Pa, expressed in decibels |
| Pa | Pascal |
| SPL | Sound Pressure Level |
| V | Volt |

3.3 Abbreviations

For the purposes of this TBR, the following abbreviations apply:

| | |
|--------|---|
| ERL | Echo Return Loss |
| ITU-T | International Telecommunications Union -Telecommunications sector |
| LRGP | Loudness Rating Guard-ring Position |
| MRP | Mouth Reference Point |
| PSTN | Public Switched Telephone Network |
| RL | Return Loss |
| RLR | Receiving Loudness Rating |
| r.m.s. | root mean square |
| SLR | Sending Loudness Rating |
| STMR | SideTone Masking Rating |
| TBR | Technical Basis for Regulation |
| TBR-RT | Technical Basis for Regulation - Requirements Table |
| TE | Terminal Equipment |

4 Speech transmission aspects

4.1 General

4.1.1 Polarity independence

Reference: [I-ETS 300 677] [3], subclause 4.1.1.

Requirement: The TE shall conform to the requirements of this TBR for both polarities of line feeding voltage.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to provide adequate speech performance with both feed polarities, since a fixed polarity is not guaranteed by the PSTN.

Test: Compliance shall be demonstrated by reversal of the d.c. voltage applied to the line terminals from test to test or between changes of test configuration when performing the tests of annex A.

4.1.2 Feed conditions

Reference: [I-ETS 300 677] [3], subclause 4.1.2.

Requirement: The TE shall conform to the requirements of this TBR when tested with a supply voltage of 50 V and with feed resistances ranging from 500 Ω to 2 800 Ω .

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to provide adequate speech performance over the range of feed conditions occurring in the loop steady state when connected to the PSTN.

Test: Compliance shall be demonstrated by performing the tests of annex A with the feed resistances specified in subclause 4.2 which are chosen from those permitted by I-ETS 300 480 [4].

4.1.3 Power supply

Reference: I-ETS 300 677 [3], subclause 4.1.3.

Requirement: Where the terminal requires an additional power supply in order for the handset telephony function to operate, the requirements of this TBR shall be met with the power supply connected and operating within specification.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires any TE which needs a source of external power for its speech functions to have adequate speech performance when its power supply is connected and operative.

Test: Compliance shall be demonstrated by performing the tests of annex A with the power supply connected and operative.

4.1.4 Volume control

Reference: I-ETS 300 677 [3], subclause 4.1.4.

Requirement: For TE with a user-controlled receiving volume control, the speech performance characteristics requirements apply with the user-controlled receiving volume control at the setting where the RLR is as close as possible to -8 dB, unless stated otherwise. This setting is to be taken as the nominal setting of the volume control.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to provide adequate speech performance at least one setting of the volume control.

Test: Compliance tests of annex A. will be carried out at the setting of the volume control where the RLR is as close as possible to -8 dB when measured with the feed resistance R_f set to 1 600 Ω , unless otherwise specified in the appropriate requirement.

NOTE: It is not necessary to strive to achieve values closer than 1 dB.

4.2 Speech performance characteristics

4.2.1 Sensitivity/frequency response

4.2.1.1 Sending

Reference: I-ETS 300 677 [3], subclause 4.2.1.1.

Requirement: The sending sensitivity, as a function of frequency, shall be not greater than the upper limit and not less than the lower limit given in table 1 and shown in figure 1 when measured with the feed resistance R_f set to 1 600 Ω .

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to have a sensitivity/frequency response compatible with the network and with other telephones connected to the network so as to be capable of providing adequate speech performance.

Test: Compliance shall be checked by the test described in annex A.2.1.1.

Table 1: Co-ordinates of sending sensitivity limit curves

| | Frequency (Hz) | dB relative to arbitrary level |
|-------------|----------------|--------------------------------|
| Upper limit | 100 | -9 |
| | 2 000 | +4 |
| | 4 000 | +4 |
| | 8 000 | -16 |
| Lower limit | 300 | -14 |
| | 2 000 | -6 |
| | 3 400 | -11 |

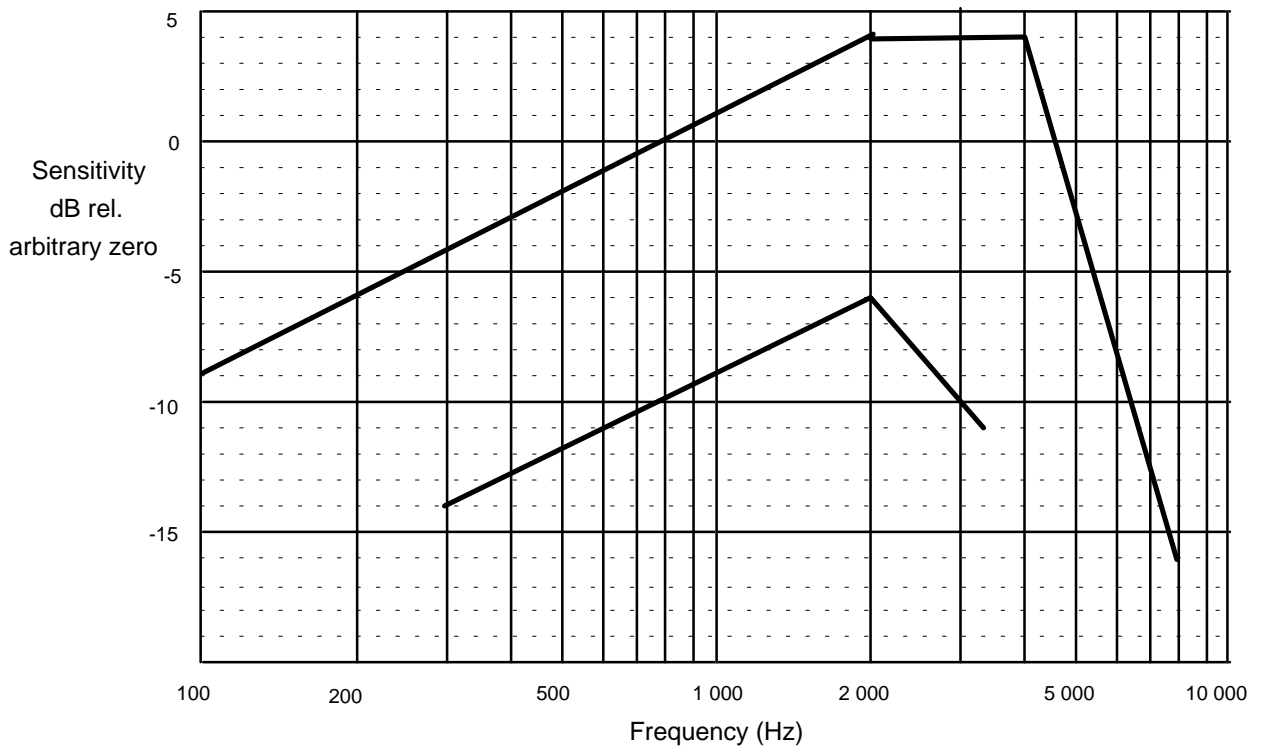


Figure 1: Sending sensitivity/frequency limits

4.2.1.2 Receiving

Reference: I-ETS 300 677 [3], subclause 4.2.1.2.

Requirement: The receiving sensitivity, as a function of frequency, shall be not greater than the upper limit and not less than the lower limit given in table 2 and shown in figure 2 when measured with the feed resistance R_f set to 1 600 Ω .

Additionally, the sensitivity at 8 kHz shall be at least 25 dB below the sensitivity at 1 kHz.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to have a sensitivity/frequency response compatible with the network and with other telephones connected to the network so as to be capable of providing adequate speech performance.

Test: Compliance shall be checked by the test described in annex A.2.1.2.

Table 2: Co-ordinates of receiving sensitivity limit curves

| | Frequency (Hz) | dB relative to arbitrary level |
|-------------|----------------|--------------------------------|
| Upper limit | 100 | -10 |
| | 200 | +2 |
| | 4 000 | +2 |
| Lower limit | 8 000 | -18 |
| | 300 | -9 |
| | 1 000 | -7 |
| | 3 400 | -12 |

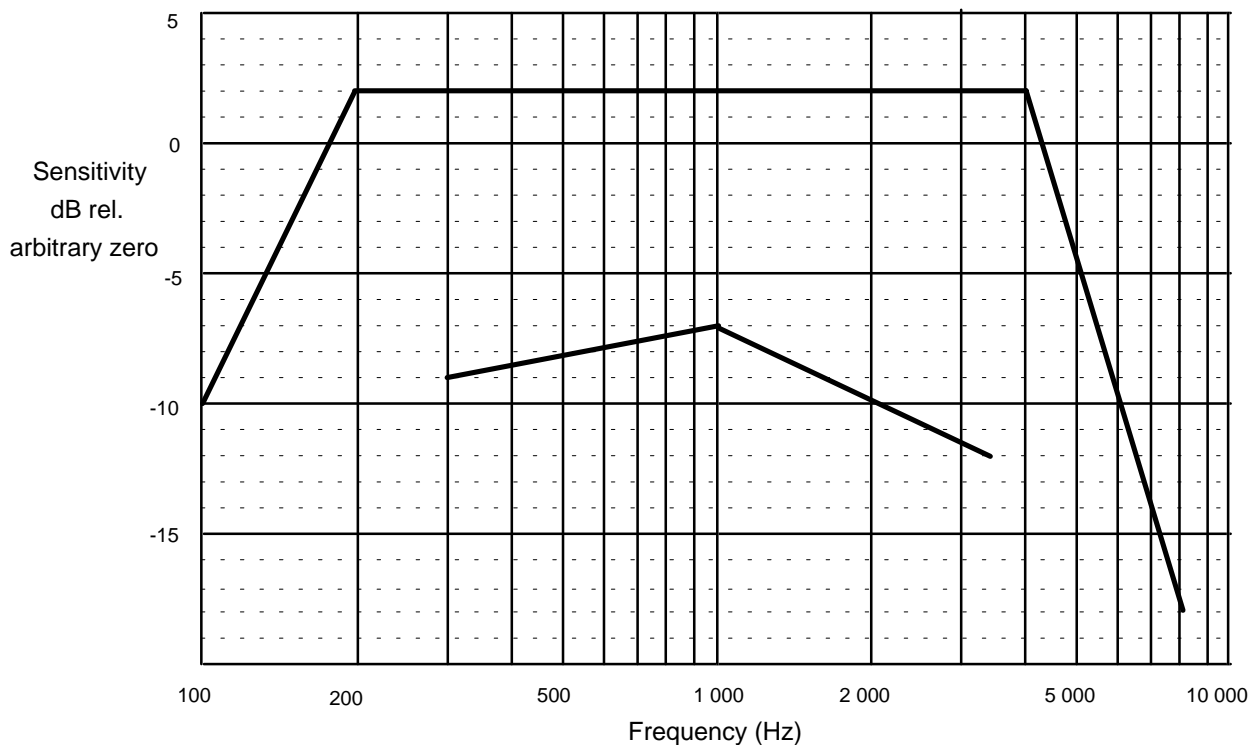


Figure 2: Receiving sensitivity/frequency limits

4.2.2 Sending and Receiving Loudness Ratings (SLR and RLR)

4.2.2.1 Sending Loudness Rating (SLR)

Reference: I-ETS 300 677 [3], subclause 4.2.2.1.

Requirement: The Sending Loudness Rating (SLR) shall be $+3 \text{ dB} \pm 4 \text{ dB}$ when measured with the feed resistance R_f set to $2\ 800 \ \Omega$ and $1\ 600 \ \Omega$ and $+3 \text{ dB} + 7/- 4 \text{ dB}$ when measured with the feed resistance R_f set to $500 \ \Omega$.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to have a SLR compatible with other telephones connected to the network so as to be capable of providing adequate speech performance. It is also essential that the terminal performance permits a network transmission plan capable of meeting ITU-T Recommendations at the international boundary.

Test: Compliance shall be checked by the test described in annex A.2.2.1.

4.2.2.2 Receiving Loudness Rating (RLR)

Reference: I-ETS 300 677 [3], subclause 4.2.2.2.

Requirement: The Receiving Loudness Rating (RLR) shall be $-8 \text{ dB} \pm 4 \text{ dB}$ when measured with the feed resistance R_f set to $2\ 800 \ \Omega$ and $1\ 600 \ \Omega$ and $-8 \text{ dB} + 7/- 4 \text{ dB}$ when measured with the feed resistance R_f set to $500 \ \Omega$.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to have a RLR compatible with other telephones connected to the network so as to be capable of providing adequate speech performance. It is also essential that the terminal performance permits a network transmission plan capable of meeting ITU-T Recommendations at the international boundary.

Test: Compliance shall be checked by the test described in annex A.2.2.2.

4.2.2.3 Volume Control

Reference: I-ETS 300 677 [3], subclause 4.2.2.3.

Requirement: Where a user-controlled receiving volume control is provided, and when the volume control is set to the nominal setting described in subclause 4.1.4, the requirements of subclause 4.2.2.2 shall be met.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to have available a RLR compatible with other telephones connected to the network so as to be capable of providing adequate speech performance. It is also essential that the terminal performance permits a network transmission plan capable of meeting ITU-T Recommendations at the international boundary.

Test: Compliance shall be checked by measurement of the RLR as described in annex A.2.2.2, with the volume control at the nominal setting.

4.2.3 Sidetone

Reference: I-ETS 300 677 [3], subclause 4.2.3.

Requirement: When measured by the test described in annex A.2.3, the SideTone Masking Rating (STMR) shall be not less than the value shown in table 3 for each termination specified in that table.

Where a user-controlled receiving volume control is provided, at its nominal setting the STMR shall be not less than the value shown in table 3 for each termination specified in that table.

Table 3: Sidetone rating

| Value of SideTone Masking Rating (dB) | | |
|---------------------------------------|---------------------------|---------------------------|
| Termination of figure A.6 | Termination of figure A.7 | Termination of figure A.8 |
| STMR | STMR | STMR |
| ≥ +5 | ≥ +10 | ≥ +7 |

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE to have a sidetone performance which neither disturbs the user nor interferes with the speech levels to such an extent as to render the telephone incompatible with adequate speech performance and with ITU-T Recommendations.

Test: Compliance shall be checked by the test described in annex A.2.3.

4.2.4 Distortion

4.2.4.1 Sending distortion

Reference: I-ETS 300 677 [3], subclause 4.2.4.1.

Requirement: The "total" harmonic distortion (summed up to the 5th harmonic) for fundamental frequencies in the range 315 Hz to 1 000 Hz shall be not greater than 7 % with an input of -4,7 dBPa and when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

With a sinusoidal input signal of +5 dBPa at a frequency of 1 000 Hz, the "total" harmonic distortion (summed up to the 5th harmonic) shall be not greater than 10 % when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to produce distortion of the transmitted speech signals sufficient to interfere with adequate speech performance.

Test: Compliance shall be checked by the test described in annex A.2.4.1.

4.2.4.2 Receiving distortion

Reference: I-ETS 300 677 [3], subclause 4.2.4.2.

Requirement: The "total" harmonic distortion (summed up to the 5th harmonic) for fundamental frequencies in the range 315 Hz to 1 000 Hz shall be not greater than 7 %, when measured with an input e.m.f. of -12 dBV supplied by a generator with an impedance of 600 Ω and when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

With a sinusoidal input signal of 0 dBV at a frequency of 1 000 Hz, the "total" harmonic distortion (summed up to the 5th harmonic) shall be not greater than 10 % when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to produce distortion of the received speech signals sufficient to interfere with adequate speech performance.

Test: Compliance shall be checked by the test described in annex A.2.4.2.

4.2.5 Linearity (variation of gain with input level)

4.2.5.1 Sending

Reference: I-ETS 300 677 [3], subclause 4.2.5.1.

Requirement: With the feed resistance R_f set to 1 600 Ω , the sensitivity determined with an input Sound Pressure Level (SPL) of -4,7 dBPa shall not differ by more than ± 2 dB from the sensitivity determined with an input SPL of -19,7 dBPa.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to vary its response to input speech signals sufficient to interfere with adequate speech performance.

Test: Compliance shall be checked by the test described in annex A.2.5.1.

4.2.5.2 Receiving

Reference: I-ETS 300 677 [3], subclause 4.2.5.2.

Requirement: With the feed resistance R_f set to 1 600 Ω , the sensitivity determined with an input signal with an e.m.f. of -12 dBV shall not differ by more than ± 2 dB from the sensitivity determined with an input signal with an e.m.f. of -32 dBV.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to vary its response to received speech signals sufficient to interfere with adequate speech performance.

Test: Compliance shall be checked by the test described in annex A.2.5.2.

4.2.6 Noise

4.2.6.1 Sending noise

Reference: I-ETS 300 677 [3], subclause 4.2.6.1.

Requirement: The psophometrically weighted noise produced by the apparatus in the sending direction shall be not greater than -66 dBVp when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to generate noise levels sufficient to interfere with adequate speech performance or to be incompatible with ITU-T Recommendations.

Test: Compliance shall be checked by the test described in annex A.2.6.1.

4.2.6.2 Receiving noise

Reference: I-ETS 300 677 [3], subclause 4.2.6.2.

Requirement: The A-weighted noise produced by the apparatus in the receiving direction shall be not greater than -49 dBPa(A) when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to generate noise levels sufficient to interfere with adequate speech performance or to be incompatible with ITU-T Recommendations.

Test: Compliance shall be checked by the test described in annex A.2.6.2.

4.2.7 Instability

Reference: I-ETS 300 677 [3], subclause 4.2.8.

Requirement: Instability (sustained audible oscillations), shall not be induced when the volume control is set to give maximum receiving gain and the apparatus is subjected to the conditions specified in the compliance test described in annex A.2.7.

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to be so unstable as to prevent the TE from operating in the normal speech mode or to be incompatible with ITU-T Recommendations.

Test: Compliance shall be checked by the test described in annex A.2.7.

4.2.8 Echo Return Loss (ERL)

Reference: I-ETS 300 677 [3], subclause 4.2.7.

Requirement: The Echo Return Loss (ERL) shall be not less than 14 dB with respect to the impedance shown in figure 3 when the feed resistance R_f is set to 2 800 Ω and 500 Ω .

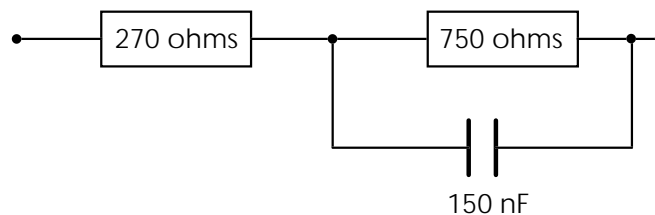


Figure 3: Terminating impedance

Justification: 91/263/EEC [1], Article 4(g).

Interworking of terminal equipment via the public telecommunications network requires the TE not to cause echo of sufficient magnitude as to interfere with adequate speech performance.

Test: Compliance shall be checked by determination of the echo loss as described in annex A.2.8.

Annex A (normative): Speech transmission compliance tests

A.1 General conditions for testing

A.1.1 Environment for tests

The following conditions shall apply for the testing environment:

- a) Ambient temperature: 15°C to 35°C (inclusive);
- b) Relative humidity: 5 % to 85 %;
- c) Air pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar).

A.1.2 Accuracy of measurements and test equipment setting

Unless specified otherwise, the accuracy of measurements made by test equipment shall be equal to or better than:

Table A.1: Accuracy of measurements

| Item | Accuracy |
|-------------------------|--|
| Electrical signal level | ±0,2 dB for levels ≥ -50 dBV ±0,4 dB for levels < -50 dBV |
| Sound pressure | ±0,7 dB |
| Frequency | ±0,2 % |

Unless specified otherwise, the accuracy of the signals generated by the test equipment shall be better than:

Table A.2: Accuracy of signals

| Quantity | Accuracy |
|---|---|
| Sound pressure level at Mouth Reference Point (MRP) | ±3 dB for frequencies from 100 Hz to 200 Hz ±1 dB for frequencies from 200 Hz to 4 000 Hz ±3 dB for frequencies from 4 000 Hz to 8 000 Hz |
| Electrical excitation levels | ±0,4 dB across the whole frequency range. |
| Frequency generation | ±2 % (see note) |
| Specified component values | ±1 % |
| NOTE: | This tolerance may be used to avoid measurements at critical frequencies, e.g. those due to sampling operations within the terminal under test. |

For terminal equipment which is directly powered from the mains supply, all tests shall be carried out within ±5 % of the rated voltage of that supply. If the equipment is powered by other means and those means are not supplied as part of the apparatus, all tests shall be carried out within the power supply limit declared by the supplier. If the power supply is a.c., the test shall be conducted within ±4 % of the rated frequency.

A.1.3 Order of tests

Tests are made in any order except where otherwise specified.

Where testing involves taking measurements using different feeding resistances, measurements shall be made with the largest feed resistance, then at lesser values of resistance, decreasing sequentially to the minimum, in order to avoid a heating effect in the test arrangement.

A.1.4 Acoustic environment

Acoustic tests shall be carried out in an environment where the ambient noise is insufficient to influence the acoustic measurements being made.

Tests for noise and Echo Return Loss (ERL) shall be carried out in an environment where the ambient noise is less than -64 dBPa(A).

A.1.5 Handset mounting

Unless otherwise stated in a particular test, where the mouthpiece of the TE is fixed relative to the earcap, the handset shall be placed in the Loudness Rating Guard-ring Position (LRGP) as described in annex C of ITU-T Recommendation P.64 [5].

In the case of a moveable microphone part, measurements are to be carried out at the setting for normal usage as defined by the manufacturer.

Where the mouthpiece of the TE is separate from the earpiece, the front plane of the mouthpiece shall be mounted 15 mm in front of the lip ring and coaxial with the artificial mouth.

The earcap shall be applied to the artificial ear.

A.1.6 Test levels

A.1.6.1 Sending

Unless otherwise stated in this TBR, a pure tone signal with a sound pressure level of -4,7 dBPa shall be applied at the Mouth Reference Point (MRP) as described in ITU-T Recommendation P.64 [5].

A.1.6.2 Receiving

Unless otherwise stated in this TBR, a pure tone signal with an e.m.f. of -12 dBV from a 600 Ω resistive source shall be connected between the terminals A and B shown in figure A.1.

A.1.6.3 Sidetone

Unless otherwise stated in this TBR, a pure tone signal with a sound pressure level of -4,7 dBPa shall be applied at the Mouth Reference Point (MRP) as described in ITU-T Recommendation P.64 [5].

A.1.7 Volume control

Where a user-controlled volume control is provided, compliance tests shall be carried out at a setting of the volume control as specified in the appropriate requirement.

A.1.8 Test equipment requirements

Artificial mouth: the artificial mouth shall conform to ITU-T Recommendation P.51 [6].

Artificial ear: the ITU-T Recommendation P.57 [7] Type 1 shall normally be used unless another artificial ear described in that Recommendation is requested by the terminal supplier.

Where a Type 1 ear is not used:

- a) the sound pressure measurements shall be referred to the ERP by the correction characteristics specified in ITU-T Recommendation P.57 [7];
- b) no leakage correction shall be made in the calculations of RLR (i.e. $L_E = 0$).

Sound level measuring equipment: the sound level measuring equipment shall conform to IEC 651 [8], Type 1.

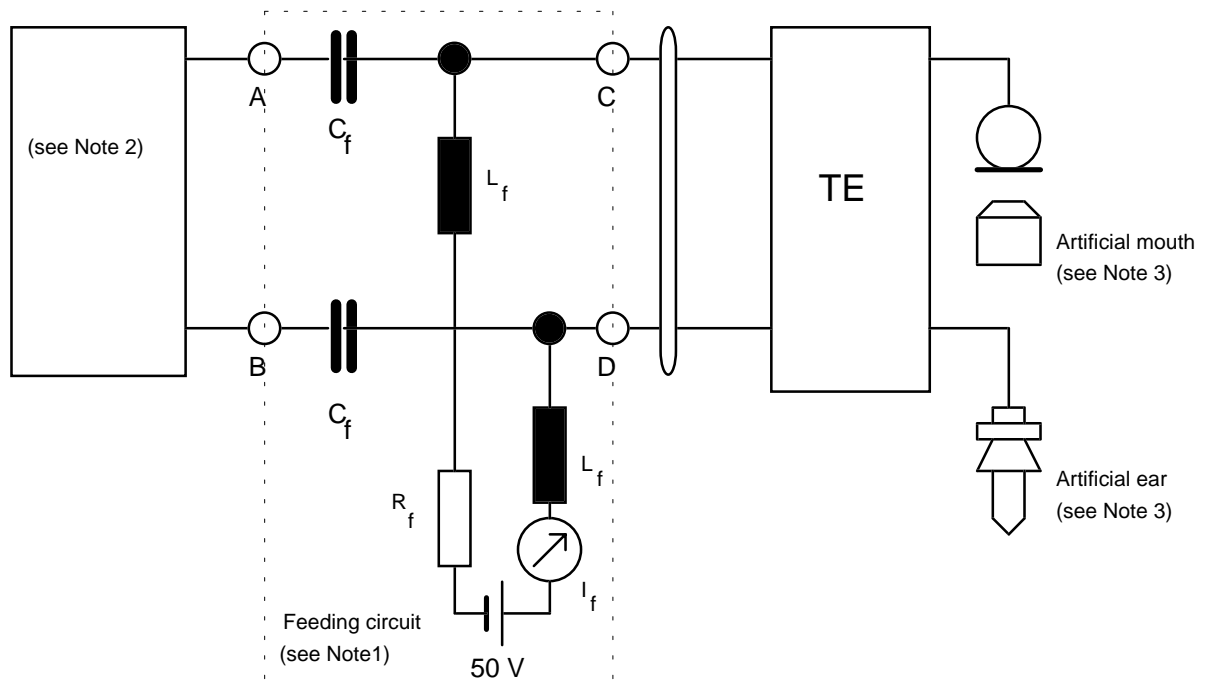
A.1.9 Alternative test methods

The requirements of this test specification were written on the basis of the standard test methods described in this TBR. For some parameters it is recognized that alternative test methods may exist. It is the responsibility of the test house to ensure that any alternative method used is equivalent to that described in this TBR.

For TE with adaptive modification of any transmission parameter dependent on the electrical operating conditions e.g. automatic adjustment of sidetone balance, each of the feed conditions for the compliance tests for the transmission parameters should be treated as a new installation and should be conditioned according to any instructions provided by the supplier.

A.1.10 Testing arrangements

All tests for transmission performance shall be carried out with the TE connected to the test arrangement shown in figure A.1. The values of the feed resistance R_f are chosen appropriate to the requirement under test.



- NOTE 1: The d.c. feeding circuit shown is an idealized arrangement. Performance requirements are given in figures A.3 and A.5.
- NOTE 2: The equipment used for testing is connected between terminals A and B and consists of the following as appropriate: a signal generator, a measuring set, the network either of figure A.6, or figure A.7, or figure A.8 or a 600 Ω resistor.
- NOTE 3: The artificial mouth and ear are described in ITU-T Recommendations P.51 [6] and P.57 [7] respectively. The TE handset is mounted in the LRGP and the earcap is applied to the artificial ear.

Figure A.1: Circuit for measurement of transmission characteristics

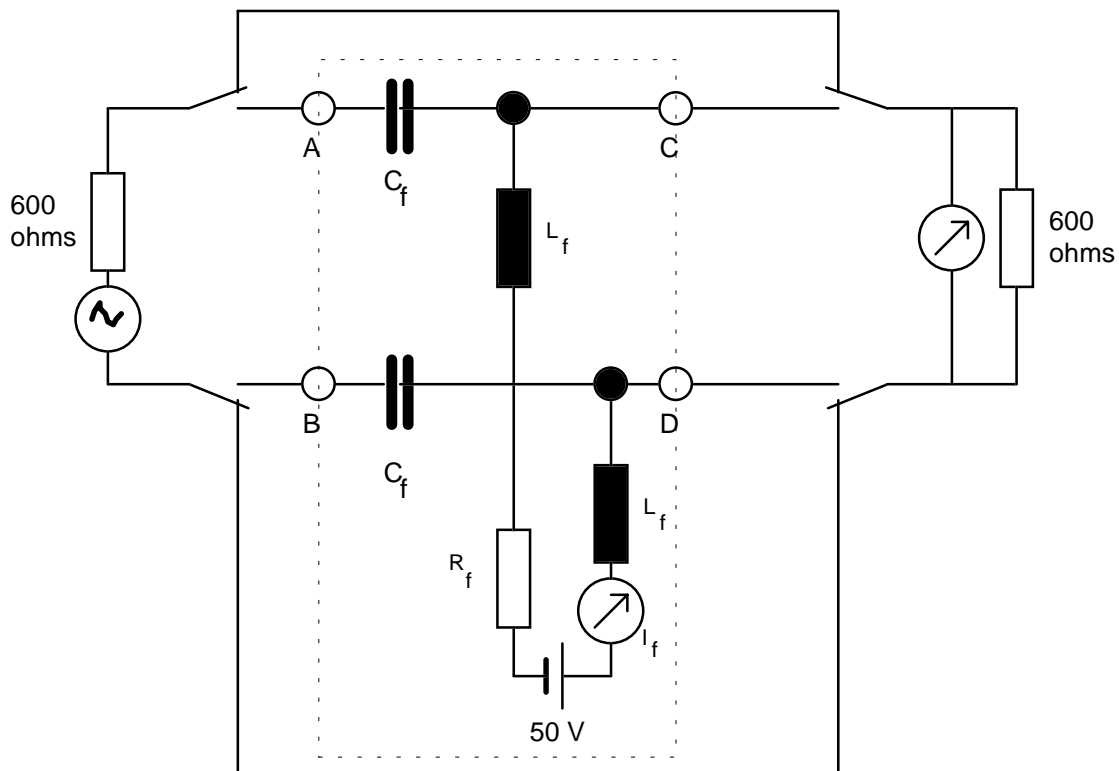


Figure A.2: Insertion loss test arrangement for the d.c. feeding circuit

When measured with the circuit shown in figure A.2, the insertion loss of the d.c. feeding circuit shown in figure A.1 shall have a value less than that given in figure A.3 (below) for all resistances and frequencies at which it is used.

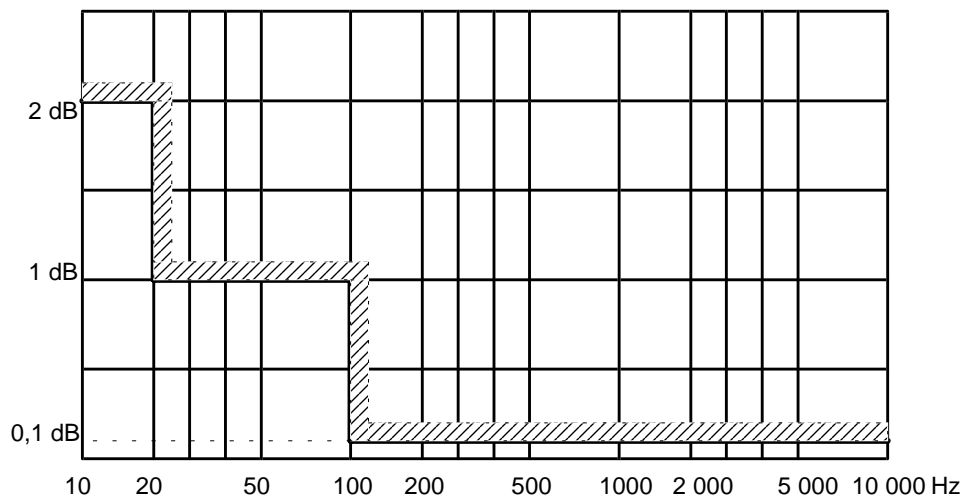
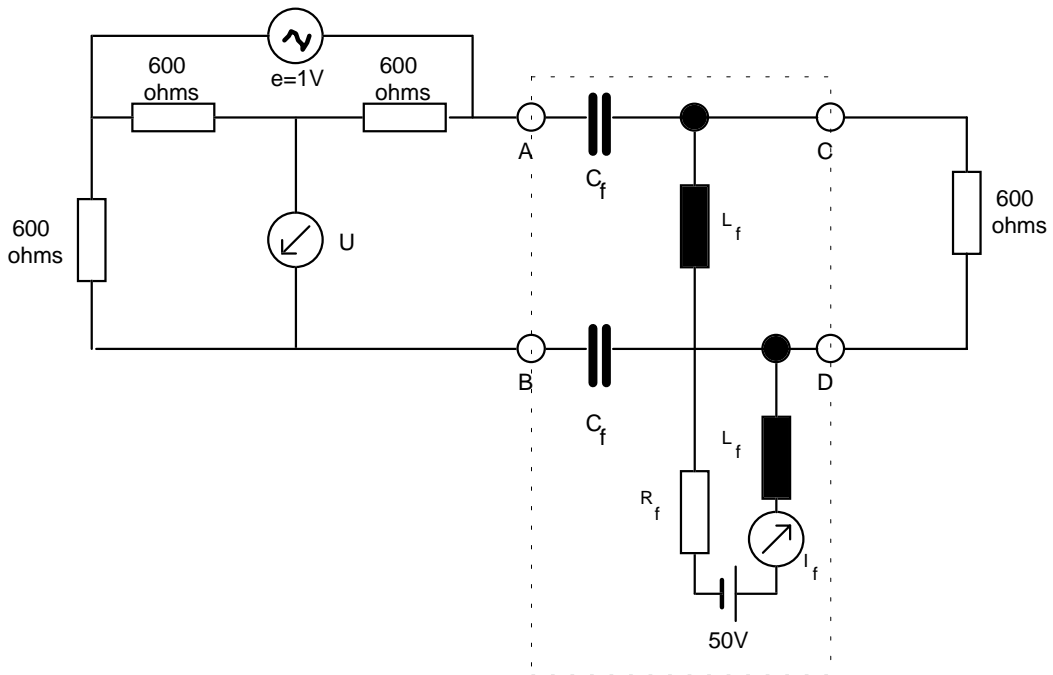


Figure A.3: Maximum limit for insertion loss



NOTE: In the absence of the d.c. feeding circuit, the return loss shall be greater than 40 dB.

Figure A.4: Return loss test arrangement for the d.c. feeding circuit

When measured with the circuit shown in figure A.4, the return loss of the d.c. feeding circuit shown in figure A.1 shall have a value greater than that given in figure A.5 for all values of R_f and at all frequencies at which it is used.

The return loss is calculated from the formula:

$$RL = 20 \log_{10} \left(\frac{e}{2U} \right) \text{ dB}$$

where e is the generator voltage and U is the voltage measured by the measuring set.

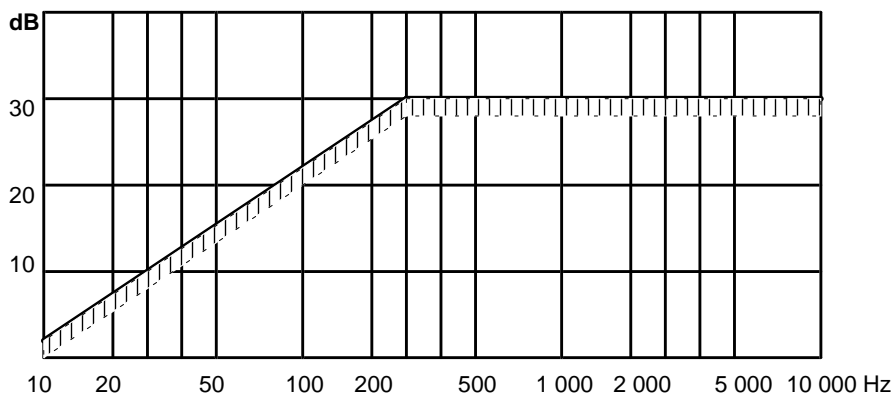


Figure A.5: Minimum limit for return loss

A.2 Speech transmission performance tests

All tests for transmission performance shall be carried out with the TE connected to the test arrangements specified in subclause A.1.10.

Values of R_f are chosen appropriate to the requirement under test.

A.2.1 Sensitivity/frequency response

A.2.1.1 Sending

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.1.1.

Test configuration:

A measuring set calibrated in dBV, with an impedance of 600 Ω shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

The sending sensitivity/frequency response shall be determined as described in clause 6 of ITU-T Recommendation P.64 [5] and by using the procedure described in clause 9 of that Recommendation. The output voltage is measured at the fundamental frequency of the stimulus. The results are expressed in dBV/Pa.

Measurements shall be made for R_f set to 1 600 Ω , at 1/12 octave intervals at the preferred frequencies given by the R40 series of preferred numbers in ISO 3 [9] for frequencies from 100 Hz to 8 kHz.

A.2.1.2 Receiving

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.1.2.

Test configuration:

A signal generator shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

The receiving sensitivity/frequency response shall be determined as described in clause 7 of ITU-T Recommendation P.64 [5] and by using the procedure described in clause 9 of that Recommendation. The sound pressure is measured at the fundamental frequency of the stimulus. The results are expressed in dBPa/V.

Measurements shall be made for R_f set to 1 600 Ω , at 1/12 octave intervals at the preferred frequencies given by the R40 series of preferred numbers in ISO 3 [9] for frequencies from 100 Hz to 8 kHz.

A.2.2 Loudness ratings

A.2.2.1 Sending

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.2.1.

Test configuration:

A measuring set calibrated in dBV, with an impedance of 600 Ω shall be connected between terminals A and B shown in figure A.1. Measurements shall be performed at each of the 14 frequencies given in table 1 of ITU-T Recommendation P.79 [10], bands 4 to 17, to yield values of the sending sensitivity, expressed in dBV/Pa.

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω , 1 600 Ω and 500 Ω .

The Sending Loudness Rating (SLR) (in dB) for each value of R_f specified shall be calculated according to the formula 2-1 of ITU-T Recommendation P.79 [10], over bands 4 to 17, using $m = 0,175$ and the sending weighting factors from table 1 of ITU-T Recommendation P.79 [10].

NOTE: ITU-T Recommendation P.65 allows the use of alternative signal sources for measurement of loudness ratings, e.g. noise rather than sinusoidal signals. These alternative methods are believed to produce the same results.

A.2.2.2 Receiving

Purpose:

To demonstrate compliance with the requirements of subclauses 4.2.2.2 and 4.2.2.3.

Test configuration:

A signal generator shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

Measurements shall be performed at each of the 14 frequencies given in table 1 of ITU-T Recommendation P.79 [10], bands 4 to 17, to yield values of the receiving sensitivity, expressed in dBPa/V.

Measurements shall be made with R_f set to 2 800 Ω , 1 600 Ω and 500 Ω .

The Receiving Loudness Rating (RLR) (in dB) for each value of R_f specified shall be calculated according to the formula 2-1 of ITU-T Recommendation P.79 [10], over bands 4 to 17, using $m = 0,175$ and the receiving weighting factors from table 1 of ITU-T Recommendation P.79 [10].

The Type 1 artificial ear sensitivity shall be corrected using the real ear correction (L_E) of table 2 of ITU-T Recommendation P.79 [10].

NOTE 1: The values of real ear correction of table 2 of ITU-T Recommendation P.79 [10] were derived for one type of handset conforming to the shape defined in CCITT Recommendation P.35.

NOTE 2: ITU-T Recommendation P.65 allows the use of alternative signal sources for measurement of loudness ratings e.g. noise rather than sinusoidal signals. These methods are believed to produce the same results.

A.2.3 SideTone Masking Rating (STMR)

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.3.

Test configuration:

For the first test, the terminating impedance shown in figure A.8 shall be connected to terminals A and B shown in figure A.1 and the feeding resistance R_f shall be set to 2 800 Ω .

For the second test, the terminating impedance shown in figure A.7 shall be connected to terminals A and B shown in figure A.1 and the feeding resistance R_f shall be set to 1 600 Ω .

For the third test, the terminating impedance shown in figure A.6 shall be connected to terminals A and B shown in figure A.1 and the feeding resistance R_f shall be set to 500 Ω .

a) the impedance shown in figure A.6 is intended to represent a short line terminated with 600 Ω;

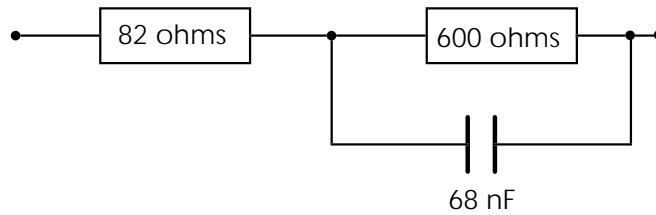


Figure A.6: Terminating impedance - impedance "a"

For impedance "a", the measurement shall be made with the feeding resistance R_f set to 500 Ω.

b) the impedance shown in figure A.7 is the harmonized European impedance;

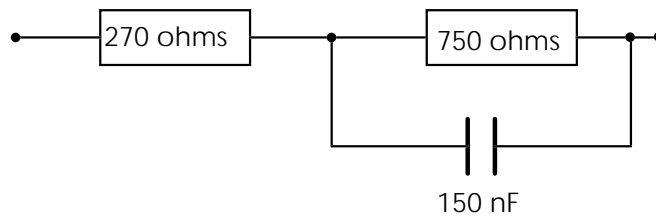


Figure A.7: Terminating impedance - impedance "b"

For impedance "b", the measurement shall be made with the feeding resistance R_f set to 1 600 Ω.

c) The impedance shown in figure A.8 is intended to represent a very long line.

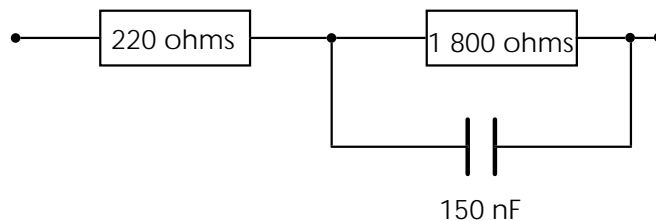


Figure A.8: Terminating impedance - impedance "c"

For impedance "c", the measurement shall be made with the feeding resistance R_f set to 2 800 Ω.

Measurement execution:

The sidetone sensitivity/frequency response shall be determined by the procedure described in clauses 6 and 9 of ITU-T Recommendation P.64 [5]. The sound pressure shall be measured in the artificial ear at the fundamental frequency of the stimulus. The results are expressed in dB.

The SideTone Masking Rating (STMR) (in dB) shall be calculated according to the formula 2-1 of ITU-T Recommendation P.79 [10], over bands 1 to 20, using $m = 0,225$ and the weighting factors of column headed W_{MSi} of table 3 of ITU-T Recommendation P.79 [10] irrespective of which artificial ear is used.

NOTE: ITU-T Recommendation P.65 allows the use of alternative signal sources for measurement of loudness ratings e.g. noise rather than sinusoidal signals. These methods are believed to produce the same results.

A.2.4 Distortion

A.2.4.1 Sending

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.4.1.

Test configuration:

A 600 Ω resistor shall be connected between terminals A and B shown in figure A.1.

A high impedance measuring set, capable of measuring harmonic distortion up to the 5th harmonic of signals with fundamental frequencies in the range 315 Hz to 1 000 Hz, shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

For the test with an input of -4,7 dBPa, pure tones at frequencies of 315 Hz, 500 Hz and 1 000 Hz shall be applied at the MRP.

For the test with an input of +5 dBPa, a frequency of 1 000 Hz shall be used.

The total harmonic distortion, d_t , shall be determined from the equation:

$$d_t = 100 \sqrt{\frac{v_2^2 + v_3^2 + v_4^2 + v_5^2}{v_1^2 + v_2^2 + v_3^2 + v_4^2 + v_5^2}} \%$$

where in each equation v_n is the measured r.m.s. voltage at harmonic n measured for each frequency and with R_f set to 2 800 Ω and 500 Ω .

A.2.4.2 Receiving

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.4.2.

Test configuration:

A signal generator shall be connected between terminals A and B shown in figure A.1.

A measuring set, capable of measuring harmonic distortion up to the 5th harmonic of signals with fundamental frequencies in the range 315 Hz to 1 000 Hz, shall be connected to the artificial ear.

Measurement execution:

For the test with an input of -12 dBV the generator is operated at frequencies of 315 Hz, 500 Hz and 1 000 Hz.

For the test with an input of 0 dBV, a frequency of 1 000 Hz shall be used.

The total harmonic distortion, d_t , shall be determined from the equation:

$$d_t = 100 \sqrt{\frac{p_2^2 + p_3^2 + p_4^2 + p_5^2}{p_1^2 + p_2^2 + p_3^2 + p_4^2 + p_5^2}} \%$$

where in each equation, p_n is the measured r.m.s. sound pressure at harmonic n which is measured for each frequency and with R_f set to 2 800 Ω and 500 Ω .

A.2.5 Linearity (variation of gain with input level)

A.2.5.1 Sending

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.5.1.

Test configuration:

A measuring set calibrated in dBV, with an impedance of 600 Ω shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

Measurements shall be made with R_f set to 1 600 Ω .

The sending sensitivity at a frequency of 1 000 Hz shall be determined as described in clause 6 of ITU-T Recommendation P.64 [5] with the input SPL set to -4,7 dBPa and by using the procedure described in clause 9 of that Recommendation. The output voltage is measured at the fundamental frequency of the stimulus. The results are expressed in dBV/Pa.

The test is repeated with the input SPL set to -19,7 dBPa.

NOTE: Telephones using non-linear and time variant signal processing techniques will require a more complex test procedure.

A.2.5.2 Receiving

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.5.2.

Test configuration:

A signal generator shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

Measurements shall be made with R_f set to 1 600 Ω .

The receiving sensitivity at a frequency of 1 000 Hz shall be determined as described in clause 7 of ITU-T Recommendation P.64 [5] with the input e.m.f. set to -12 dBV and by using the procedure described in clause 9 of that Recommendation. The sound pressure is measured at the fundamental frequency of the stimulus. The results are expressed in dBPa/V.

The test is repeated with the input e.m.f. set to -32 dBV.

NOTE: Telephones using non-linear and time variant signal processing techniques will require a more complex test procedure.

A.2.6 Noise

A.2.6.1 Sending

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.6.1.

Test configuration:

A 600 Ω resistor shall be connected between terminals A and B shown in figure A.1.

An measuring set of high impedance, calibrated in dBV and using psophometric weighting according to table 1 of CCITT Recommendation O.41 [11], shall be connected between terminals A and B shown in figure A.1.

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω and 500 Ω .

The noise level shall be measured by averaging over a minimum period of 1 s. The measurement is made three times and the lowest value of the three measurements shall be selected as a determination of the noise level.

NOTE: This test does not test for noise correlated with the signal which may be caused by non-linear and time variant signal processing techniques.

A.2.6.2 Receiving

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.6.2.

Test configuration:

A 600 Ω resistor shall be connected between terminals A and B shown in figure A.1.

A measuring set calibrated in dBPa and using A weighting shall be connected to the artificial ear shown in figure A.1.

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω and 500 Ω .

The noise level shall be measured by averaging over a minimum period of 1 s. The measurement is made three times and the lowest value of the three measurements shall be selected as a determination of the noise level.

NOTE: This test does not test for noise correlated with the signal which may be caused by non-linear and time variant signal processing techniques.

A.2.7 Instability

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.7.

Test configuration:

Measurements shall be made under the following conditions:

- with R_f set to 2 800 Ω , with the impedance shown in figure A.8 connected between terminals A and B shown in figure A.1;
- with R_f set to 500 Ω , with a resistance of 600 Ω connected between terminals A and B shown in figure A.1.

The handset shall be positioned on one inside surface that is of three perpendicular plane, smooth, hard surfaces forming a corner. Each surface shall extend 0,5 m from the apex of the corner. One surface shall be marked with a diagonal line extending from the corner formed by the three surfaces, as shown in figure A.9.

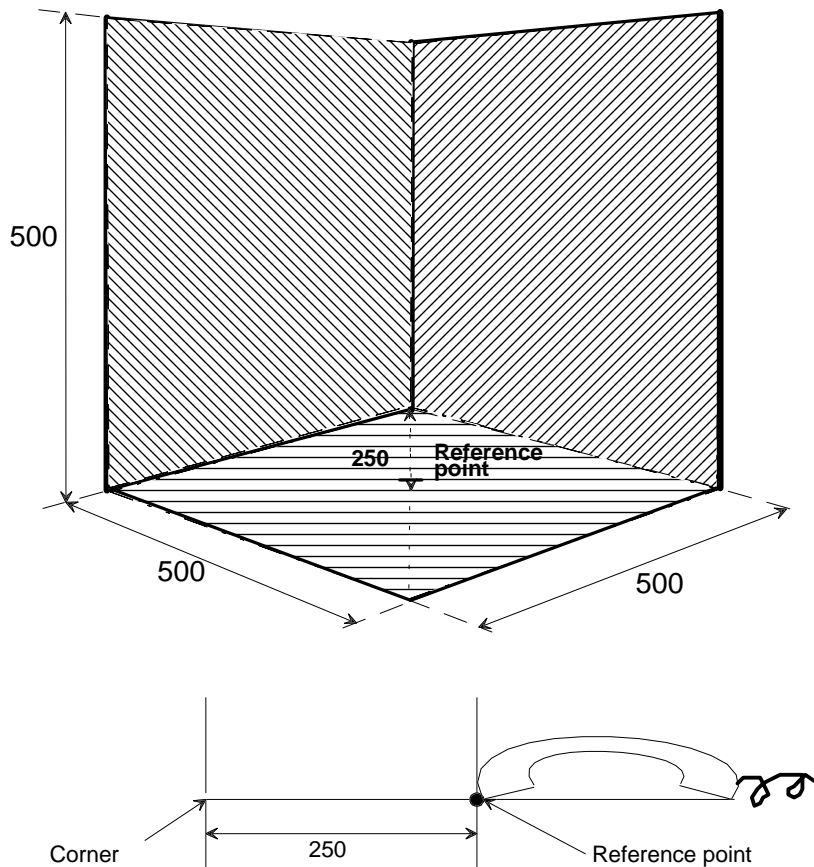
The handset, with the transmission circuit fully active and with the volume control set to give maximum receiving gain, shall be positioned on the defined surface as follows:

- the mouthpiece and earcap shall face towards the surface;
- the handset shall be placed centrally along the diagonal line with the earcap nearer to the apex of the corner;
- the extremity of the handset shall coincide with the normal to the reference point, as shown in figure A.9.

If necessary, e.g. in the case of a one piece telephone, the handset should be raised just sufficiently to achieve the "off-hook" position.

Measurement execution:

Checks shall be made to establish that the signal level resulting from any sustained audio frequency oscillation (up to 10 kHz) measured between terminals A and B shown in figure A.1 is less than -40 dBV.



All dimensions are in millimeters

Figure A.9: Handset position for instability test

A.2.8 Echo Return Loss (ERL)

Purpose:

To demonstrate compliance with the requirements of subclause 4.2.8.

Test configuration:

A suitable measuring set for measuring impedance shall be connected between terminals A and B shown in figure A.1.

The earcap shall be applied to the artificial ear.

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω and 500 Ω .

The test level across terminals A and B shown in figure A.1 shall be -18 dBV.

The input impedance of the apparatus shall be measured at frequencies spaced not greater than one-twelfth of an octave apart, within the range 300 Hz to 3 400 Hz inclusive.

NOTE 1: The frequencies do not need to be harmonically related.

For each value of impedance measured, the Return Loss (RL) (in dB) shall be calculated from the formula:

$$RL = 20 \log_{10} \left| \frac{Z_b + Z_t}{Z_b - Z_t} \right| \text{ dB}$$

where:

Z_t is the apparatus impedance, measured;

Z_b is the reference impedance shown in figure A.7.

For each value of R_f specified, the Echo Return Loss (ERL) shall be calculated (in dB), in accordance with ITU-T Recommendation G.122 [2], using the formula:

$$ERL = 3,24 - 10 \log_{10} \sum_{i=1}^n (A_i + A_{i-1}) \times (\log_{10} f_i - \log_{10} f_{i-1}) \text{ dB}$$

where:

A_i is the return loss power ratio at frequency f_i expressed as

$$A_i = 10^{-(\text{decibel return loss at } f_i)/10};$$

A_0 is the ratio at $f_0 = 300$ Hz;

A_n is the ratio at $f_n = 3\,400$ Hz.

NOTE 2: The test method specified does not include all of the mechanical and acoustic feedback effects which may occur in normal use. However these effects usually can be ignored.

Annex B (normative): TBR Requirements Table (TBR-RT)

Notwithstanding the provisions of the copyright clause related to the text in this TBR, ETSI grants that users of this TBR may freely reproduce the TBR-RT proforma in this annex so that it can be used for its intended purposes and may further publish the completed TBR-RT.

B.1 TBR Requirements Table

Table B.1: TBR Requirements Table (TBR-RT)

| Item | Reference | TBR Requirement | Status | Support (Y/N) | Comments |
|------|-----------|---|--------|---------------|----------|
| R.1 | 4.1.1 | Polarity Independence | M | | |
| R.2 | 4.1.2 | Feed conditions | M | | |
| R.3 | 4.1.3 | Power supply | O | | |
| R.4 | 4.1.4 | Volume control | O | | |
| R.5 | 4.2.1.1 | Sending sensitivity | M | | |
| R.6 | 4.2.1.2 | Receiving sensitivity | M | | |
| R.7 | 4.2.2.1 | Sending loudness rating | M | | |
| R.8 | 4.2.2.2 | Receiving loudness rating - no volume control | M | | |
| R.9 | 4.2.2.3 | Receiving loudness rating - volume control fitted | M | | |
| R.10 | 4.2.3 | Sidetone performance | M | | |
| R.11 | 4.2.4.1 | Sending distortion | M | | |
| R.12 | 4.2.4.2 | Receiving distortion | M | | |
| R.13 | 4.2.5.1 | Sending linearity | M | | |
| R.14 | 4.2.5.2 | Receiving linearity | M | | |
| R.15 | 4.2. 6.1 | Sending noise | M | | |
| R.16 | 4.2.6.2 | Receiving noise | M | | |
| R.17 | 4.2.7 | Instability | M | | |
| R.18 | 4.2.8 | Echo return loss | M | | |

NOTE: In this table, the Item column provides a unique identifier to each requirement.
 The Reference column lists the subclause reference in the TBR where the requirement may be found.
 The Requirement column gives the clause title of the relevant clause, supplemented by any additional information necessary to identify the requirement.
 The Status column contains one of the following items, possibly followed by a numerical suffix referring to a note at the base of the table.
 M Mandatory, shall be implemented in all circumstances
 O Optional, may not be provided, but if provided shall be implemented in accordance with the requirements.
 The blank column headed "Support (Y/N)" allows the supplier to indicate whether the requirement is supported.
 The column headed "Comments" permits the addition of comments or references to other documents (e.g. the appropriate section of the user manual).

Annex C (informative): Information for test purposes

Notwithstanding the provisions of the copyright clause related to the text in this TBR, ETSI grants that users of this TBR may freely reproduce the tables C.1 and C.2 in this annex so that they can be used for their intended purposes.

C.1 Introduction

In order to test an item of terminal equipment, extra information relating to the implementation is necessary. This annex indicates what information is necessary for test purposes, and provides a standard layout for the provision of such information by suppliers to test laboratories.

C.2 Guidance for the completion of the information required for test purposes

C.2.1 Options list

This list permits the identification of those options implemented in the equipment and provides a numeric identification of the options permitted.

The column headed "Comments" permits the addition of comments or references to other documents (e.g. the appropriate section of the user manual).

The list includes a blank column allowing the supplier to indicate whether the option is supported.

C.2.2 General information

"TE name" means the name or model number given by the supplier to the equipment.

"TE version" means any version numbers, software release codes etc. necessary to identify the correct version of the equipment.

Table C.1: Options table

| Item | Reference | Information | Yes/No | Comments |
|------|-----------|--|--------|----------|
| C.1 | 4.1.3 | Does the apparatus require an external power source? | | |
| C.2 | 4.1.4 | Is the apparatus provided with a user-controlled receiving volume control? | | |

Table C.2: General information

| | |
|--|-------|
| Terminal Equipment (TE) identification: | |
| TE name: | _____ |
| TE version: | _____ |
| Product supplier: | |
| Name: | _____ |
| Address: | _____ |
| | _____ |
| | _____ |
| Telephone number: | _____ |
| Facsimile number: | _____ |
| Additional information: | _____ |
| | _____ |
| | _____ |
| | _____ |
| Contact person: | |
| Name: | _____ |
| Address: | _____ |
| | _____ |
| | _____ |
| Telephone number: | _____ |
| Facsimile number: | _____ |
| Additional information: | _____ |
| | _____ |
| | _____ |
| | _____ |

Annex D (informative): Bibliography

For the purposes of this TBR, the following references have been provided within the text for information:

- CCITT Recommendation P.35 (1988, Blue Book): "Handset telephones".
- ITU-T Recommendation P.65 (03/93): "Objective instrumentation for the determination of loudness ratings".

History

| Document history | |
|------------------|--|
| June 1997 | Public Enquiry PE 9746: 1997-06-20 to 1997-11-14 |
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